

**CONTRACT DOCUMENTS**  
**FOR THE CONSTRUCTION OF**

**5200 WEST 6200 SOUTH FINISHED  
WATER RESERVOIR PROJECT**

**Volume 1 of 3  
Specifications**

**DISTRICT PROJECT NO. 4231**



**JORDAN VALLEY WATER**  
CONSERVANCY DISTRICT

For Information Regarding this Project Contact:

Josh Curtis, P.E.  
154 East 14075 South  
Draper, Utah 84020  
(801) 495-2224



**BOWEN COLLINS**  
& ASSOCIATES

May 2023



**CONTRACT DOCUMENTS FOR**

**5200 WEST 6200 SOUTH**  
**FINISHED WATER RESERVOIR PROJECT**

**PROJECT #: 4231**

**May 2023**

**OWNER**

Jordan Valley Water Conservancy District  
8215 South 1300 West  
West Jordan, Utah  
(801) 565-4300  
Project Manager: Travis Christensen, P.E.

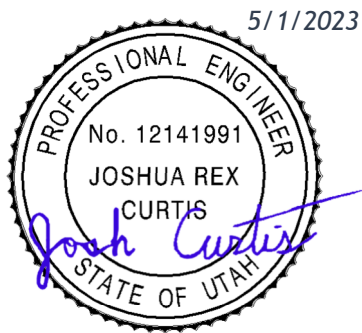
**ENGINEER**

Bowen, Collins and Associates  
154 East 14075 South  
Draper, Utah 84020  
Telephone: (801) 495-2224  
Project Engineer: Josh Curtis, P.E.

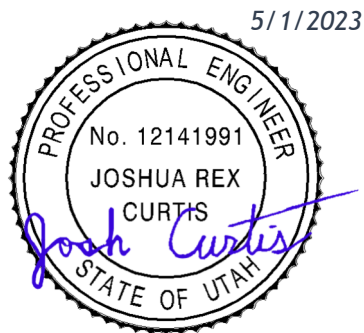




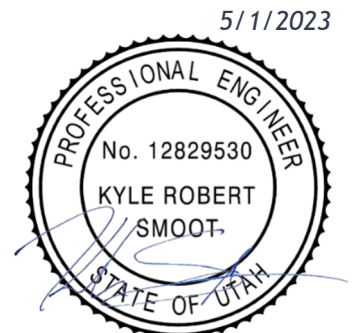
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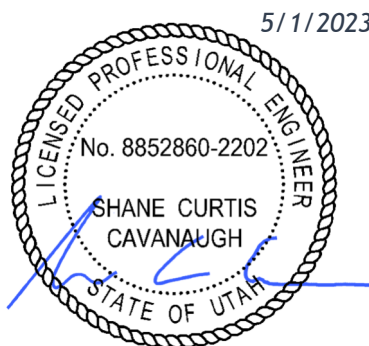
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[ ELECTRICAL/INSTR. AND CONTROLS ]



[ LANDSCAPE ]



## **TABLE OF CONTENTS**

### **VOLUME 1 OF 3**

## **BIDDING DOCUMENTS**

<b><u>Bidding Documents</u></b>	<b><u>Page</u></b>
Notice Inviting Bids.....	A-1
Instructions to Bidders.....	B-1
Bid .....	C-1
Bid Bond.....	D-1
Information Required of Bidder .....	E-1
 <b><u>Contract Documents</u></b>	 <b><u>Page</u></b>
Agreement.....	F-1
Performance Bond .....	G-1
Payment Bond.....	H-1
Notice of Award .....	I-1
Notice to Proceed.....	J-1
Payment Application and Certificate.....	K-1
Change Order .....	L-1
Contractor's Certificate of Substantial Completion .....	M-1
Contractor's Certificate of Final Completion .....	N-1
Consent of Surety for Final Payment.....	O-1
Affidavit of Payment .....	P-1

## **GENERAL CONDITIONS OF THE CONTRACT**

<b><u>Article</u></b>	<b><u>Page</u></b>
1 - Definitions .....	1-1
2 - Preliminary Matters .....	2-1
3 - Contract Documents: Intent, Amending, Reuse .....	3-1
4 - Availability of Land; Physical Conditions: Reference Points.....	4-1
5 - Bonds and Insurance .....	5-1
6 - Contractor's Responsibilities .....	6-1
7 - Other Work.....	7-1
8 - Owner's Responsibilities .....	8-1
9 - Engineer's Status During Construction.....	9-1
10 - Changes in the Work.....	10-1
11 - Change of Contract Price .....	11-1
12 - Change of Contract Time .....	12-1

**TABLE OF CONTENTS**  
**(continued)**

**GENERAL CONDITIONS OF THE CONTRACT**

<b><u>Article</u></b>	<b><u>Page</u></b>
13 - Warranty and Guarantee; Tests and Inspections; Correction, Removal, Or Acceptance of Defective Work .....	13-1
14 - Payments to Contractor, Liquidated Damages and Completion.....	14-1
15 - Suspension of Work and Termination .....	15-1
16 - Miscellaneous .....	16-1

**SUPPLEMENTAL GENERAL CONDITIONS**

<b><u>Article</u></b>	<b><u>Page</u></b>
17 - General .....	17-1
18 - Amounts of Liquidated Damages, Bonds, and Insurance .....	18-1
19 - Physical Conditions and Weather Delays .....	19-1
20 - Subcontract Limitations.....	20-1
21 - Miscellaneous .....	21-1
22 - Warranty Period .....	22-1

**TECHNICAL SPECIFICATIONS**

<b><u>Section</u></b>	<b><u>Page</u></b>
<b>DIVISION 01 - GENERAL REQUIREMENTS</b>	
01 11 00 Summary of Work .....	1 to 6
01 14 33 Rights-of-Way .....	1 to 2
01 14 40 Construction and Schedule Constraints .....	1 to 4
01 20 00 Measurement and Payment .....	1 to 6
01 25 10 Products, Materials, Equipment, and Substitutions .....	1 to 6
01 29 73 Schedule of Values .....	1 to 4
01 31 30 Safety .....	1 to 4
01 32 00 Electronic Project Management System .....	1 to 6
01 32 16 Construction Progress Schedule .....	1 to 8
01 33 20 Submittal Procedures .....	1 to 14
01 35 53 Security .....	1 to 2
01 41 26 Permits .....	1 to 4
01 42 13 Abbreviations of Institutions.....	1 to 4
01 42 19 Reference Standards .....	1 to 2

**TABLE OF CONTENTS**  
**(continued)**

**TECHNICAL SPECIFICATIONS**

<b><u>Section</u></b>	<b><u>Page</u></b>
01 45 00 Quality Control.....	1 to 10
01 50 10 Site Access and Storage .....	1 to 4
01 51 00 Temporary Utilities .....	1 to 4
01 52 13 Field Office, Equipment and Services .....	1 to 2
01 55 26 Traffic Control.....	1 to 10
01 57 19 Temporary Environmental Controls.....	1 to 4
01 58 13 Temporary Project Signage.....	1 to 2
01 71 00 Mobilization .....	1 to 2
01 71 30 Site Conditions Surveys .....	1 to 2
01 71 50 Protection and Restoration of Existing Facilities.....	1 to 6
01 74 19 Disposal of Water .....	1 to 2
01 77 00 Closeout Procedures.....	1 to 6
01 78 39 Project Record Documents.....	1 to 4
01 81 10 Seismic Design Criteria .....	1 to 2
01 81 11 Wind Design Criteria .....	1 to 2
01 91 14 Equipment Testing and Startup.....	1 to 6

**DIVISION 03 – CONCRETE**

03 11 00 Concrete Forming.....	1 to 8
03 20 00 Concrete Reinforcing.....	1 to 8
03 30 00 Cast-in-Place Concrete .....	1 to 30
03 30 60 Cast-in-Place Concrete Reservoirs .....	1 to 12
03 60 00 Grouting .....	1 to 10

**DIVISION 05 – METALS**

05 50 00 Metal Fabrications.....	1 to 14
05 52 13 Pipe and Tube Railings .....	1 to 8

**DIVISION 07 – THERMAL AND MOISTURE PROTECTION**

07 14 00 Fluid-Applied Waterproofing.....	1 to 6
07 22 16 Rigid Polystyrene Board Insulation.....	1 to 4
07 72 00 Roof Accessories .....	1 to 4
07 92 00 Joint Sealants.....	1 to 8

**DIVISION 09 – FINISHES**

09 90 00 Coatings and Painting .....	1 to 26
--------------------------------------	---------

**TABLE OF CONTENTS**  
**(continued)**

**TECHNICAL SPECIFICATIONS**

<b><u>Section</u></b>	<b><u>Page</u></b>
09 97 01 Pipeline Coatings and Linings .....	1 to 30
<b>DIVISION 23 – HVAC</b>	
23 00 00 Heating, Ventilating, and Air Conditioning .....	1 to 6
<b>DIVISION 26 – ELECTRICAL</b>	
26 05 00 Electrical General Provisions.....	1 to 28
26 05 83 Wiring Connections .....	1 to 6
26 20 00 Low-Voltage AC Induction Motors .....	1 to 12
26 28 16 Low-Voltage Circuit Breakers .....	1 to 8
26 42 14 Corrosion Monitoring System .....	1 to 20
26 50 00 Lighting.....	1 to 6
<b>DIVISION 31 – EARTHWORK</b>	
31 10 00 Site Preparation.....	1 to 4
31 23 00 Earthwork .....	1 to 16
31 23 26 Controlled Low Strength Material .....	1 to 6
31 32 19 Geotextiles .....	1 to 6
31 37 00 Riprap.....	1 to 6
31 50 00 Excavation Support and Protection .....	1 to 4
<b>DIVISION 32 – EXTERIOR IMPROVEMENTS</b>	
32 12 16 A.C. Pavement and Base .....	1 to 10
32 90 00 Landscape Restoration .....	1 to 14
<b>DIVISION 33 – UTILITIES</b>	
33 05 16 Precast Concrete Manholes and Vaults .....	1 to 6
33 08 00 Gravity Piping Testing and Inspection .....	1 to 8
33 11 11 Steel Pipe .....	1 to 22
33 11 12 Steel Pipe Fabricated Specials.....	1 to 6
33 13 00 Water Pipeline Testing and Disinfection .....	1 to 6
33 13 01 Hydraulic Structures Testing and Disinfection .....	1 to 4
33 41 01 Drainage Pipeline System Testing .....	1 to 2
33 41 02 Reinforced Concrete Pipe .....	1 to 4
33 41 03 PVC Non-Pressure Pipe, Rubber Joints.....	1 to 6
33 41 05 Ductile Iron Pipe .....	1 to 10
33 46 00 Reservoir Underdrains and Roof Drains.....	1 to 4

**TABLE OF CONTENTS**  
**(continued)**

**TECHNICAL SPECIFICATIONS**

<b><u>Section</u></b>	<b><u>Page</u></b>
<b>DIVISION 40 – PROCESS INTEGRATION</b>	
40 05 00 Piping, General.....	1 to 8
40 05 01 Piping Identification Systems.....	1 to 4
40 05 07 Pipe Supports.....	1 to 10
40 05 10 Mill Piping .....	1 to 6
40 05 50 Miscellaneous Valves .....	1 to 2
40 05 51 Valves, General.....	1 to 6
40 05 57 Valve and Gate Actuators .....	1 to 8
40 05 61 Gate Valves.....	1 to 2
40 05 63 Ball Valves.....	1 to 2
40 05 64 Butterfly Valves .....	1 to 8
40 05 65 Valves for Pump Control and Check Service.....	1 to 2
40 72 13 Level-Ultrasonic.....	1 to 6
40 72 76 Level-Switches .....	1 to 4
40 73 13 Pressure Gauges .....	1 to 6
40 73 26 Pressure-Transmitters .....	1 to 6
40 73 37 Pressure Switches.....	1 to 6
40 75 01 Instrument List.....	1 to 2
40 75 01a Instrument List Table .....	1 to 2
<b>DIVISION 43 – GAS, LIQUID AND STORAGE</b>	
43 20 10 Pumps, General .....	1 to 6
43 23 09 ANSI Horizontal End Section Pumps .....	1 to 6
43 25 15 Submersible Pumps .....	1 to 6

**DRAWINGS**

**VOLUME 2 OF 3 – DRAWINGS**

**APPENDIX**

**VOLUME 3 OF 3 – APPENDIX**

Appendix A – Selected Design Drawings (5262 Reservoir, KID & TBID Pump Stations)  
Appendix B – Geotechnical Report

**END OF SECTION**

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## **NOTICE INVITING BIDS**

### **PROJECT NAME: 5200 West 6200 South Finished Water Reservoir**

**DESCRIPTION OF WORK:** The Work of this Contract comprises the construction of the 5200 West 6200 South Finished Water Reservoir Project and generally includes construction of a new 6.8 MG Finished Water Reservoir. The Owner intends to award a single contract for construction of the Project. The Work generally includes the following:

1. A new 6.8 MG buried, reinforced concrete Finished Water Reservoir
2. Inlet/Outlet Valve Vault, Drain and Underdrain Vaults
3. Reservoir inlet, outlet, underdrain, drain, overflow, and washdown piping
4. Connection to the existing 2 MG reservoir piping/vault
5. Site work, access roads, grading, and landscape restoration
6. Electrical, instrumentation, and controls
7. Testing, disinfection, commissioning and startup
8. Work includes drain and overflow modifications to the existing 2 MG reservoir

### **DISTRICT WEB SITE AND PLANHOLDERS LIST**

Prospective bidders must register at the District's web site ([www.jvwcd.org](http://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 web site will be used to publish updated information relative to the project, including a planholders list.

**RECEIPT OF BIDS:** Sealed bids will be received at the administration office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, until **3:00 pm, on Friday, May 19, 2023**, for construction of the "5200 West 6200 South Finished Water Reservoir Project".

**OBTAINING CONTRACT DOCUMENTS:** The Contract Documents are entitled, "5200 West 6200 South Finished Water Reservoir". All Contract Documents may be obtained, online at [www.jvwcd.org](http://www.jvwcd.org) under "Engineering Projects".

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

**SITES OF WORK:** The work is located at 5211 West 6200 South, West Jordan, Utah.

## **NOTICE INVITING BIDS**

**PRE-BID MEETING:** A mandatory pre-bid meeting will be held at **9:00 am on Thursday, May 11, 2023** at the office of the Owner. Prequalified General Contractors must notify the Owner if they are unable to attend the pre-bid meeting, so that alternative pre-bid meeting arrangements can be made.

**PREQUALIFIED CONTRACTORS:** The Owner authorized use of a prequalification procedure to determine and select General Contractors eligible to bid and construct the Project. Based upon the qualification submittals received in response to the District's Invitation for Contractor Prequalification Submittals, only the following General Contractors are prequalified to bid and construct the Project. Only Prequalified General Contractors shall be allowed to submit Bids on this Contract.

**Dry Creek Structures**

**Gerber Construction**

**MGC Contractors**

**ProBuild Construction**

**Ralph L. Wadsworth Construction**

**COMPLETION OF WORK:** All work shall be Substantially Complete by May 1, 2025.

**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.

**PROJECT ADMINISTRATION:** All questions relative to this project prior to the opening

## **NOTICE INVITING BIDS**

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**

Bowen, Collins & Associates  
154 East 14000 South  
Draper, Utah 84020  
Telephone: (801) 495-2224  
Contact: Josh Curtis, P.E.  
Email: [jcurtis@bowencollins.com](mailto:jcurtis@bowencollins.com)

**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.

### **OWNER**

Jordan Valley Water Conservancy District  
8215 South 1300 West  
West Jordan, Utah 84088  
(801) 565-4300  
Project Manager: Travis Christensen, P.E.  
Email: [travisc@jvwcd.org](mailto:travisc@jvwcd.org)

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 in 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.

**QUALIFICATIONS OF BIDDERS:** To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

1. Evidence of Bidder's authority to do business in the state of Utah
2. Bidder's Utah or other contractor license number, if applicable.
3. Section E – Information Required of Bidder.

A Bidder's failure to submit the required information, and/or failure to meet the specific qualification and experience requirements of the Project, will render a Bid non-responsive and disqualify Bidder from receiving an award of the Contract.

General contractors have been prequalified to bid this project. Prequalified General Contractors are not required to submit written evidence establishing qualifications; however, all bidders must submit the additional information listed in Items 1, 2 and 3 above.

## **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.

## **INSTRUCTIONS TO BIDDERS**

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.

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

## **INSTRUCTIONS TO BIDDERS**

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 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



## **INSTRUCTIONS TO BIDDERS**

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 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

## **INSTRUCTIONS TO BIDDERS**

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.

**STATE REGISTRY:** The Contractor shall register the project, if awarded, on the State of Utah Construction Registry prior to the commencement of the work.

**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 "5200 West 6200 South Finished Water Reservoir Project" drawings and all addenda issued by said Owner prior to opening of the bids.

**Addenda, if issued, are only delivered by e-mail to those on Owner's website (jvwcd.org) Plan Holders List.**

The undersigned bidder acknowledges receipt of the following addenda:

No.	Date Received	No.	Date Received

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.

Bidder hereby certifies he has registered and participates in the Status Verification System (E-Verify).

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 SCHEDULE**

#### **PART 1 – GENERAL**

##### **1.01 CONSTRUCTION CONTRACT**

- A. Name of Project: 5200 West 6200 South Finished Water Reservoir Project
- B. Owner's Project Number: 4231

##### **1.02 SCHEDULES TO BE ADDED TO THE AGREEMENT**

- A. Bid Schedule contains the schedules of prices which will be incorporated into the Agreement (Document 00500) by reference.

##### **1.03 SCHEDULES OF PRICES**

- A. The Contract has been divided into separate Bid Schedules. The Owner intends to award a single contract for construction of the Project. Individual schedules will not be awarded separately.

Schedule A: Generally includes all Work associated with construction of the new 6.8 MG Finished Water Reservoir as indicated on the Contract Documents. The Work associated with Schedule A includes earthwork, yard piping, construction of large concrete vaults, site work and miscellaneous piping and facilities associated with the project.

- C. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the bidding documents without consideration of possible substitution of "or equal" items.
- D. Identify Steel Pipe and Coating Supplier:

1. \_\_\_\_\_ (Name Supplier)

# BID

Bid Schedule – Lump Sum

## E. BASE BID SCHEDULE A – 5262 FINISHED WATER RESERVOIR PROJECT:

Item No.	Description			Amount
1.	Mobilization, Demobilization, Temporary Facilities, and Administrative Items (not to exceed 6% of total lump sum Base Bid)			\$
2.	Lump Sum Price for construction of 6.8 MG 5200 West 6200 South Reservoir, complete.			\$
3.	Lump Sum Price for construction of Inlet/Outlet Valve Vault, Drain Vault, Underdrain Vault, Overflow/Drain Box, and Yard Piping, complete.			\$
4.	Lump Sum Price for construction of Electrical Work and Instrumentation, complete.			\$
5.	Lump Sum Price for PLC Programming and SCADA Integration.			\$
6.	Construction of Access Road	<u>Quantity</u> 16,800 SF	<u>Unit Price</u> \$	\$
7.	Building Permit Allowance			\$95,000.00
8.	Lump Sum Price for balance of the Work for the 5200 West 6200 South Finished Water Reservoir Project, not included in Bid items 1 through 7 above.			\$
9.	Lump Sum Add or Deduct (indicate which)			\$
Total Lump Sum Base Bid Price (Sum of Items 1 through 9)				
\$				
(Price in Words)				

## BID

### Bid Adjustment (Item 9 Lump Sum Add or Deduct)

The bid adjustment allows the Bidder to adjust their base bid just prior to bid opening without the need to adjust individual bid item amounts. The sum of the extended total shall be increased or (decreased) by this Bid Adjustment amount. Indicate decrease in parenthesis (\_\_\_\_\_). For payment purposes, this correction amount will be applied to Bid Items No. 1 through 8 proportionally to the amount bid for those items.

### BASE BID SCHEDULE A –Total of Items 1 through 9 Including Bid Adjustment

1. Bidder agrees to accept as full payment for Work proposed with the Bidding Documents, based upon the undersigned's own estimate of quantities and costs and including sales, consumer, use, other taxes, and overhead and profit, the following amount for Schedule A:

\_\_\_\_\_ Dollar  
s

And \_\_\_\_\_ Cents \$ \_\_\_\_\_

2. Based upon Bidder's own estimate of quantities and costs, the Bidder, if awarded the contract, shall provide costs for the items as outlined in Section 10 20 00 – MEASUREMENT AND PAYMENT.
3. Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

**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 "5200 West 6200 South  
Finished Water Reservoir Project", (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: \_\_\_\_\_  
— :

President  
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: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Contractor's telephone number: \_\_\_\_\_  
FAX number: \_\_\_\_\_
4. Contractor's Utah License Number: \_\_\_\_\_  
Primary Classification: \_\_\_\_\_  
Supplemental Classification held, if any: \_\_\_\_\_
6. Name and title of officers of Contractor's firm:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Number of persons employed full-time by the firm: \_\_\_\_\_
8. Name of person who inspected site of proposed work for your firm:  
Name: \_\_\_\_\_  
Date of Inspection: \_\_\_\_\_
9. Surety company and agent who will provide the required bonds on this contract:  
Name: \_\_\_\_\_  
Telephone: \_\_\_\_\_
10. Workers Compensation Insurance Policy #: - \_\_\_\_\_



### **INFORMATION REQUIRED OF BIDDER**

11. Name of Project Manager: As per Pre-qualification Documents previously submitted. Any substitutions will be considered only after project award.
12. Name Project Superintendent: As per Pre-qualification Documents previously submitted. Any substitutions will be considered only after project award.
13. Name of Pipeline Superintendent: As per Pre-qualification Documents previously submitted. Any substitutions will be considered only after project award.

## AGREEMENT

An Agreement made as of the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by and between the Jordan Valley Water Conservancy District, a water conservancy district organized under the laws of the State of Utah ("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 21.

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: \_\_\_\_\_  
Barton A. Forsyth  
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 "5200 West 6200 South Finished Water Reservoir Project".

**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: \_\_\_\_\_

(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, "5200 West 6200 South Finished Water Reservoir Project".

**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:           5200 West 6200 South Finished Water Reservoir Project

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: Travis Christensen.

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

Dated this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
Shane K. Swensen, P.E.  
Engineering Department Manager & 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: 5200 West 6200 South Finished Water Reservoir Project

You are hereby notified to commence work in accordance with the Agreement dated \_\_\_\_\_, 2023, and you are to complete the work by \_\_\_\_\_, 2023.

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

Dated this \_\_\_\_\_ day of \_\_\_\_\_.

\_\_\_\_\_  
Shane K. Swensen, P.E.  
Engineering Department Manager & Chief Engineer

**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: 5200 West 6200 South Finished Water Reservoir Project

JVWCD PROJECT NO.: 4241

CONTRACTOR: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

ENGINEER:

JVWCD \_\_\_\_\_

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 \_\_\_\_

PROJECT NAME: 5200 West 6200 South Finished Water Reservoir Project

PROJECT NUMBER: 4231

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 – Bowen, Collins & Associates	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 84088-0070

PROJECT: 5200 West 6200 South Finished Water Reservoir 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 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:

JORDAN VALLEY WATER CONSERVANCY DISTRICT

DATE:

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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 84088-0070

PROJECT: 5200 West 6200 South Finished Water Reservoir Project

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: 5200 West 6200 South Finished Water Reservoir Project

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 "5200 West 6200 South Finished Water Reservoir Project", 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 Contract 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

## GENERAL CONDITIONS

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

## **GENERAL CONDITIONS**

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**

## **GENERAL CONDITIONS**

- 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

## **GENERAL CONDITIONS**

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.

## **GENERAL CONDITIONS**

### **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

## **GENERAL CONDITIONS**

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.



## **GENERAL CONDITIONS**

### **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,

## **GENERAL CONDITIONS**

- 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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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

## **GENERAL CONDITIONS**

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

## **GENERAL CONDITIONS**

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.



## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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).

## GENERAL CONDITIONS

### 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.

## **GENERAL CONDITIONS**

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.

## GENERAL CONDITIONS

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.

## **GENERAL CONDITIONS**

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.

## **GENERAL CONDITIONS**

- 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

## **GENERAL CONDITIONS**

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.

## **GENERAL CONDITIONS**

### **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



## **GENERAL CONDITIONS**

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

## **GENERAL CONDITIONS**

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.

## **GENERAL CONDITIONS**

### **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,

## **GENERAL CONDITIONS**

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

## **GENERAL CONDITIONS**

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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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.

## **GENERAL CONDITIONS**

### **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.



## **GENERAL CONDITIONS**

### **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**





## **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

Bowen Collins & Associates  
154 East 14000 South  
Draper, Utah 84020  
801-495-2224

#### **17.03 SUPPLEMENTAL DOCUMENTATION**

##### **1. GEOTECHNICAL REPORT**

A geotechnical investigation was conducted for the 5200 West 6200 South Finished Water Reservoir Project. Results of this investigation are provided for the CONTRACTOR's reference in a Geotechnical Memorandum titled:

Geotechnical Design Recommendations – Jordan Valley Water Conservancy District (JVWD CD) 5200 West 6200 South Finished Water Reservoir  
Prepared by: Gerhart Cole, Inc.  
Date: March 18, 2022

This report is available in electronic (PDF) format from the ENGINEER upon request.

##### **2. REFERENCE PLANS**

The following plans were referenced by the Engineer during design of the

## SUPPLEMENTAL GENERAL CONDITIONS

Project. These plans represent previous projects that are relevant to construction of the 5200 West 6200 South Finished Water Reservoir Project:

No.	Reference Plan Description
1	JVWCD 5262 2 MG Reservoir (1962)
2	JVWCD 5262 Flow Control Vault (1986)
3	Kearns Improvement District Pump Station (1979)
4	Kearns Improvement District 30-inch Waterline (2002)
5	Kearns Improvement District Zone C Pump Station (2021)
6	Taylorsville Bennion Pump Station Schematic

Reference plans available in electronic (PDF) format from the ENGINEER upon request. Elevations shown in 1962, 1979, 1986, and 2002 drawings use NGVD 29 vertical datum. Elevations in 2021 and current drawings (2023) use NAVD 88 vertical datum. To convert NGVD 29 elevations to current (NAVD 88) elevations, add 3.5 feet.

### 17.04 AMEND PARAGRAPH 6.04 – SUBSTITUTE OR “OR EQUAL”

ITEMS Delete paragraph 6.04.A.1 in its entirety and replace with the following:

1. “Or Equal” Items: CONTRACTOR’s bid shall include equipment from the named supplier(s) in the technical specifications. No “Or-Equal” items will be considered during the bid period. The CONTRACTOR may submit “Or-Equal” proposals **only after award of the project**, which will be evaluated by the ENGINEER based on qualifications, performance history, service record, compatibility with the OWNER’s system, and price. If in the 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 the 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:

## **SUPPLEMENTAL GENERAL CONDITIONS**

- a. In the exercise of reasonable judgment the ENGINEER determines that: (i) it is at 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.

### **17.05 UTAH STATE CONSTRUCTION REGISTRY**

Add the following paragraph to Article 2:

#### **2.07 UTAH STATE CONSTRUCTION REGISTRY (SCR)**

1. CONTRACTOR shall register with the Utah State Construction Registry and comply with the requirements of Utah Administrative Rule R156-38b.

## **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 \$1,000 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 \$1,000 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: 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 ten (10) 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 60 percent of the WORK with its own forces (i.e., without subcontracting). The 60 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 60 percent of the Contract Price.

## **SUPPLEMENTAL GENERAL CONDITIONS**

### **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.



## **SUPPLEMENTAL GENERAL CONDITIONS**

### **ARTICLE 22 – WARRANTY PERIOD**

#### **22.01 WARRANTY, GUARANTEE AND MAINTENANCE PERIOD**

- A. The one (1) year warranty period required under General Conditions Article 13.01 shall be extended for specific items where required by individual technical specification sections. Contractor shall be aware that longer warranty periods may exist, and shall coordinate with subcontractors, equipment and material suppliers as necessary to accommodate these longer warranty periods where required.

**END SUPPLEMENTAL GENERAL CONDITIONS**



**DIVISION 01**  
**GENERAL REQUIREMENTS**

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**SECTION 01 11 00  
SUMMARY OF WORK**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Work to be performed under this Contract consists of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all Work, materials, and services not expressly indicated or called for in the Contract Documents, which may be necessary for the complete, safe and proper construction of the Work in good faith shall be provided by Contractor as though originally so indicated, at no increase in cost to Owner.

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of this Contract comprises construction of a new 6.8 MG buried, reinforced concrete Finished Water Reservoir; Inlet/Outlet Valve Vault; Drain and Underdrain Vaults; Overflow/Drain Box; reservoir inlet, outlet, underdrain, drain, overflow, and washdown piping; connections to existing yard piping; asphalt access road; landscape restoration; electrical, instrumentation and controls; testing, disinfection, commissioning and startup. Work includes excavation, excavation protection, preload, backfill and earthwork associated with construction of new facilities.
- B. The Work is located in West Jordan, Utah at the existing 5200 West 6200 South reservoir site, as indicated on the Drawings.

**1.3 CONTRACT METHOD**

- A. The Work hereunder will be constructed under a single lump-sum contract.

**1.4 STREAMLINED SPECIFICATIONS**

- A. These specifications are written in streamlined or declarative style, often using incomplete sentences. This imperative language is directed to Contractor unless specifically noted otherwise.
- B. Omissions of such words and phrases as "Contractor shall," "in conformity therewith," "shall be," "as shown on the Drawings," "a," "an," "the," and "all" are intentional in streamlined sections.
1. Omitted words shall be supplied by inference in the same manner as when a note appears on the Drawings.
  2. Omission of such words shall not relieve Contractor from providing the items and work described herein or indicated on the Drawings.
  3. Words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

## 1.5 WORK BY OTHERS

- A. Owner reserves the right to perform or award other work concurrent with the Work included in this Contract
  - 1. Work may be conducted at or adjacent to the Site by other contractors during the performance of the Work under this Contract. Conduct operations so as to cause a minimum of interference with the Work of such other contractors and cooperate fully with such contractors to provide continued safe access to their respective portions of the Site, as required to perform Work under their respective contracts.
- B. Interference With Work On Utilities:
  - 1. Cooperate and coordinate fully with all utility forces of Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work.
  - 2. Schedule the Work to minimize interference with said relocation, altering, or other rearranging of facilities.

## 1.6 WORK SEQUENCE AND SCHEDULING CONSTRAINTS

- A. Schedule and perform the Work in such a manner as to result in the least possible disruption to the public's use of roadways, driveways, and utilities. Utilities shall include but not be limited to water, sewerage, drainage structures, ditches and canals, gas, electric, cable television, and telephone. Refer to Utility Adjustment and other plan and profile sheets for approximate location of utilities. However, there is no guarantee as to accuracy or completeness. Contractor shall incorporate as-built locations on the reproducible record plans, in red ink, showing proper location on each sheet where these utilities are located.
- B. Except as specified in Section 01 14 40 – Construction and Schedule Constraints, no interruption in the water storage and supply process can be accommodated. Schedule construction operations so that no interference with the operation of the existing 2 MG reservoir and associated supply piping will occur outside of allowed shutdown periods.
- C. Access to the site is limited to the hours of 7:00 a.m. to 5:00 p.m. Monday through Friday.

## 1.7 CONTRACTOR USE OF PROJECT SITE

- A. Use of the Project Site shall be limited to construction operations, including on-Site storage of materials, on-site fabrication facilities, and field offices.
- B. Do not use the indicated portion of the site until Notice to Proceed has been provided to Contractor for any of its construction operations.

## 1.8 OWNER AND KEARNS IMPROVEMENT DISTRICT USE OF THE PROJECT SITE

- A. Owner and Kearns Improvement District (KID) may utilize all or part of the existing facilities during the entire construction period for the conduct of the Owner's and KID's normal operations. Cooperate and coordinate with the Owner and KID to facilitate Owner's operations and projects and to minimize interference with Contractor's operations at the same time. In any event, Owner and KID shall be allowed safe access to the Project Site during the period of construction.

#### 1.9 PARTIAL UTILIZATION OF THE WORK BY OWNER

- A. Owner will take partial utilization of the Work upon substantial completion of the new reservoir and associated yard piping. Partial utilization will involve the placing into service of facilities that are substantially complete and ready for use for water transmission and storage.

#### 1.10 CONTRACTOR'S WORKING HOURS

- A. Perform work within Owner's regular working hours from 7:00 a.m. to 5:00 p.m., Monday through Friday. If Contractor desires to work overtime or work on a Saturday, Sunday, or any legal holiday, obtain prior approval from Owner and Engineer.

#### 1.11 STORAGE

- A. Storage conditions shall be acceptable to Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for Owner's review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible to Engineer. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to Engineer with the request for payment by Contractor. All arrangements and costs for storage facilities shall be paid by Contractor, unless specifically designated in the Contract Documents to be furnished by Owner.

#### 1.12 NOTICES TO OWNERS OF ADJACENT PROPERTIES AND UTILITIES

- A. Notify Owners of adjacent property and utilities when prosecution of the Work may affect them.
- B. When it is necessary to temporarily deny access by owners or tenants to their property, or when any utility service connection must be interrupted, Give notices sufficiently in advance to enable the affected person(s) to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit any resulting inconvenience.
- C. Utilities and other concerned agencies shall be contacted at least seven days prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.
- D. Review with the various utility companies the construction methods, safety procedures, and Work to be done in the vicinity of utilities. When temporary relocation of utilities is necessary, provide sufficient advance notice to the utility involved.

#### 1.13 LINES AND GRADES

- A. Perform all Work to the lines, grades, and elevations shown on the Drawings.
- B. Basic horizontal and vertical control points will be established or designated as provided in General Conditions paragraphs. Use these points as datum for the Work. Perform any

additional survey, layout, or measurement work needed for proper construction of the Work as a part of the Work at no additional cost to Owner.

- C. Employ experienced instrument personnel, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, furnish, without additional charge, competent personnel and such tools, stakes, and other materials as Engineer may require in establishing or designating control points or in checking survey, layout, and measurement of Work performed.
- D. Keep Engineer informed, a reasonable time in advance, of the times and places at which Work is to be done, so that horizontal and vertical control points may be established and any checking deemed necessary by Engineer may be done with minimum delay to the Project.
- E. Remove and reconstruct Work, which is improperly located.

#### 1.14 PROJECT MEETINGS

##### A. Preconstruction Conference

- 1. 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, its Safety Representative, and its Subcontractors as Contractor deems appropriate. Other attendees will be:
  - a. Engineer
  - b. Representatives of Owner
  - c. Governmental representatives as appropriate
  - d. Others as requested by Contractor, Owner, or Engineer
  - e. Engineer's Representative
- 2. Bring to the conference, any submittals so indicated in Section 01 33 20 – Submittal Procedures.
- 3. The purpose of the conference is to designate responsible personnel, discuss contract requirements and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished by Engineer prior to the meeting date. However, be prepared to discuss all of the items listed below.
  - a. Contractor's assignments for safety and first aid, including Designated Competent person(s) and Contractor's safety Representative.
  - b. Status of Contractor's insurance and bonds.
  - c. Contractor's tentative schedules.
  - d. Transmittal, review, and distribution of Contractor's submittals.
  - e. Processing applications for payment.
  - f. Maintaining record documents.
  - g. Critical Work sequencing.
  - h. Field decisions and Change Orders.
  - i. Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
  - j. Major equipment deliveries and priorities.
  - k. Permits required for construction.
  - l. Utilities required for construction.
  - m. Contract Owner and channels of communication.



- n. Coordination with others.
  - 4. Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
- B. Progress Meetings
- 1. Engineer will schedule and hold regular on-Site progress meetings at least weekly and at other times as deemed necessary by Engineer or as required by progress of the Work. Contractor, Engineer and all Subcontractors active on the Site must attend each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
  - 2. Engineer will preside at the meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings will be to review the progress of the Work, discuss safety, maintain coordination of efforts, discuss commercial issues, discuss changes in scheduling, and resolve other problems, which may develop. During each meeting, all parties are required to present any issues, which may impact its Work, with a view toward resolving these issues expeditiously.

#### 1.15 AVAILABLE SUPPLEMENTAL REPORTS

- A. Geotechnical Report: Geotechnical data referenced in these Contract Documents are based upon the report titled "Geotechnical Design Recommendations – Jordan Valley Water Conservancy District 5200 West 6200 South Finished Water Reservoir", prepared by Gerhart Cole, Inc., dated March 18, 2022. Report is available from Owner upon request.

#### 1.16 UTILITY SERVICE

- A. Water: Temporary connections required for construction water will be installed by the Contractor at the Contractor's expense. Water used by the Contractor for construction will be provided by the Contractor at the Contractor's expense. Water for testing of tank and pipelines will be provided by the Owner as described in the specifications.
- B. Power: The Owner has existing power service available at the site. Temporary power required for construction shall be provided by the Owner at no charge to the Contractor provided that construction power requirements do not interfere with operation of existing facilities; however, the Contractor shall install any necessary transformers, conduits and conductor needed for temporary power service. Any additional temporary power required for construction shall be provided by the Contractor at the Contractor's expense, including any necessary generators, fuel, conduit, conductors and appurtenances.
- C. Temporary utilities needed for construction are subject to the requirements of Section 01 51 00 - Temporary Utilities.

#### 1.17 PLC PROGRAMMING AND SCADA INTEGRATION

- A. The Owner will perform programming and integration of instrumentation associated with the new reservoir and appurtenances. The Contractor is required to furnish and install all instruments, enclosures, and equipment, including terminating all wiring, loop testing, startup and troubleshooting of instruments. The Contractor will be responsible to ensure that all instrumentation is complete and operable as part of the construction contract.

- B. The Owner, herein called Integrator, will provide modification to the following services associated with the new reservoir and appurtenances:
1. Modifications in the existing PLC cabinet including addition of I/O cards, fuse and terminal blocks, and internal wiring (see drawings for more information.)
  2. PLC programming
  3. SCADA integration
  4. Assistance with point-to-point I/O checks
  5. Assistance with control loop tests
  6. Communication testing
  7. System operation testing.
- C. Contractor shall be responsible for the following:
1. Labeling and termination of all conductors and cabling on both ends. (Owner shall terminate conductors and cabling on PLC end.)
  2. Assistance to Integrator to perform point to point checkout of system.
  3. Providing PDF file to Owner documenting loop testing.
  4. All instrumentation and associated setup and calibration.
- D. The Owner will also contract directly with Utah Yamas Controls to provide security control systems as defined in the Contract Documents. Contractor shall install conduit, wiring, poles, boxes and rough in of security control systems, in coordination with Utah Yamas Controls.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 14 33  
RIGHTS-OF-WAY**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. This Section covers the designation and conditions related to Work area obtained by Owner.

1.2 RELATED SECTIONS

- A. Section 01 11 00 – Summary of Work  
B. Section 31 10 00 – Site Preparation

1.3 WORK AREA, EASEMENTS, AND RIGHTS-OF-WAY

A. Work Area:

1. Work Area Lands: Work areas are shown on the Drawings and are made up of land owned by Jordan Valley Water Conservancy District. Strictly adhere to all requirements related to use of lands, site preparation, site restoration, and related conditions of these Contract Documents. Limits of disturbance are shown on Drawings C-02, C-03, and C-06. Not all the land bounded by the properties shown is available for use. The existing 2 MG tank and Kearns pump stations must be avoided and protected. In general, work areas are limited to the new access road and tank construction areas shown on Drawings C-02, C-03, and C-06.

B. Use of Work Area:

1. Refer to the General Conditions and Supplementary Conditions of the Contract, along with Section 01 11 00 – Summary of Work, and Section 31 10 00 – Site Preparation for specific limitations to the use of project lands and designated work areas. In addition to the referenced Sections, all other conditions of the Contract Documents shall apply. Use the work area only for activities directly related to the performance of the Work. All items moved, relocated, or otherwise disturbed within the work area shall be returned, repaired, reinstalled, or otherwise replaced to a condition equal to, or better than, its original condition, unless otherwise indicated. All Work associated with returning the site to its original condition shall be subject to the final approval of Engineer.
2. The provisions regarding the use of the work area shall be applicable to all types of temporary use permits, agreements, and other arrangements intended to provide temporary or permanent use of lands to construct, operate, and maintain the facilities included in the Work. These shall include easements, encroachment permits, license agreements, bilateral agreements, permissions to construct, rights-of-entry, and all other similar agreements.
3. Permission is granted to use specific work areas as specified. Minimize the use of the available work area as much as possible.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 14 40**  
**CONSTRUCTION AND SCHEDULE CONSTRAINTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Schedule, sequence, and perform the Work in a manner, which minimizes disruption to the public and to the operation and maintenance of existing facilities.
- B. Allow for construction and schedule constraints in preparing the construction schedules required under Section 01 32 16 – Construction Progress Schedule. The schedule shall include the activities necessary to satisfy all constraints included and referenced in the Contract Documents.

**1.2 PERMITS**

- A. Abide by the conditions of all permits, easements, and private agreements made and obtain written acceptance of the constructed conditions from each issuer of the permit, easement, or private agreement prior to acceptance of Work by Owner, at no additional expense to Owner.

**1.3 COORDINATION WITH OTHER CONSTRUCTION**

- A. Be responsible for coordinating the Work depicted in the Contract Documents with Owner, Engineer, and all other contractors or suppliers working at, or near the Project Site in accordance with the General Conditions and Supplementary General Conditions.
- B. When two or more contracts are being executed at one time on the same, or adjacent land, and in such a manner that work on one contract may interfere with work on another, Owner will determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege shall be shared unless granted specifically by Owner to one contractor. No such decision as to the method or time of conducting the Work or the use of territory shall be made the basis of any claim for delay or damage, except as provided for in the General Conditions and Supplementary General Conditions.

**1.4 SCHEDULING AND COORDINATION OF SHUTDOWNS**

- A. Continuous operation of the Owner's facilities is of critical importance. Construction of the Work will require disruptions of service to make critical connections, replace existing pipelines and equipment, or modify existing facilities. Contractor shall schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified. Contractor shall provide temporary facilities, bypass systems, or other approved means to ensure continuous supply of water and water storage availability to meet system operational and emergency demands.
- B. Contractor shall notify Engineer and Owner in writing at least 14 days in advance of any operation that will disrupt Owner's facilities or operations or any required shutdown. Prior

to removing any portion of the existing facilities, submit and obtain Engineer and Owner approval for all submittals required to construct the proposed improvements.

- C. Clearly demonstrate in the CPM Schedule and other submittals, to the satisfaction of the Owner and the Engineer, the Contractor's ability to complete the Work requiring an interruption of service (shutdown work) within the allowable duration.
- D. If the Contractor does not clearly demonstrate the ability to complete the shutdown work in the CPM Schedule proposed during a shutdown period, the Owner reserves the right to limit the scope of the shutdown work which the Contractor may undertake.
- E. **Opportunities for shutdown of existing pipelines and other facilities will be limited to periods of low demand (typically winter) and limited in duration.**

#### 1.5 SCHEDULE CONSTRAINTS

- A. Be responsible to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall Work.
- B. Portions of the Work will be required to be constructed in sequence or limited in timing and duration in order to ensure uninterrupted water supply and water storage availability during the construction period. Critical Work activities and construction constraints are presented and discussed below. The construction constraints described do not include all activities necessary to complete the Work or the activity described. The construction constraints are intended to show the order and/or nature of critical activities necessary to minimize disruption to water supply and storage.
- C. Construction Schedule Milestones: The Contractor shall meet the following construction completion and milestone dates. These milestones shall be included in the CPM Construction Schedule:
  - 1. May 1, 2025: Substantial completion of new 5200 West 6200 South Finished Water Reservoir construction.
  - 2. June 15, 2025: Final completion of all Work.
- D. Shutdown Time and Duration: Constraints on the timing and duration of required shutdowns needed to complete critical work activities are shown in the tables below and described in the paragraphs that follow. These constraints shall be included in the CPM Construction Schedule. Allowable shutdown durations include dewatering of pipe or reservoirs.
- E. The listing of schedule constraints below does not mean that all constraints or special conditions have been identified. The list is not a substitute for the duty to coordinate and plan for completion, all Work by the Substantial/Contract Completion Dates specified in the Contract Documents.
- F. Special Listing: The following constraints affect the construction schedule.

# **1. 5200 West 6200 Sout FW Tank Construction**

<b>No.</b>	<b>Construction Activity</b>	<b>Shutdown Required?</b>	<b>Facility Impacted (Allowable Duration)</b>
1	Pothole existing connection locations and pipe crossing locations	No	--
2	Install construction access and SWPPP measures	No	--
3	Excavation and subgrade preparation for new reservoir. Preload east half of reservoir footprint.	No	--
4	Construct new 6.8 MG reservoir and yard piping.	No	--
5	Excavation for new Inlet/Outlet Valve Vault	No	--
6	Construct new Inlet/Outlet Valve Vault. Also construct 30" inlet/outlet pipe up to connection in existing JVWCD Control Vault and 30" inlet and outlet pipes to new reservoir.	No	
7	Connect to existing 30" tee in JVWCD Control Vault	Yes	New KID pump station and JVWCD 30" gravity transmission line (1 day)
8	Construct new Drain Vault, Underdrain Vault, and Overflow Box. Includes drain, underdrain, and overflow pipes for new reservoir; connections to existing 2 MG reservoir drain and overflow pipes; and manhole tie-in to existing downstream drain pipe.	No	Existing drain and overflow pipes
9	Disinfect and test new tank and yard piping	No	--
10	Install new electrical, instrumentation, and PLC panel for new 6.8 MG tank, and place in service. Commission new instrumentation	No	--
11	Backfill and Landscape Restoration	No	--
12	Final access road improvements and paving	No	--

- a. Water will continue to be supplied to downstream customers via the existing 2 MG reservoir during the entire construction phase.
- b. Activity 1: Pothole all proposed connections to existing pipe, utilities and facilities. Also pothole pipe crossing locations with unknown elevations.
- c. Activity 2: Install construction access and SWPPP measures.

- d. Activity 3: Excavation and subgrade preparation for new reservoir. Preload east half of reservoir footprint.
  - e. Activity 4: Construct new 6.8 MG reservoir and yard piping.
  - f. Activity 5: Excavation for new Inlet/Outlet Valve Vault.
  - g. Activity 6: Construct new Inlet/Outlet Valve Vault. Also construct 30" inlet/outlet pipe up to connection in existing JVWCD Control Vault and 30" inlet and outlet pipes to new reservoir.
  - h. Activity 7: Remove existing blind flange and connect new 30" pipe in existing JVWCD Control Vault.
  - i. Activity 8: Construct new Drain Vault, Underdrain Vault, and Overflow Box. Includes drain, underdrain, and overflow pipes for new reservoir; connections to existing 2 MG reservoir drain and overflow pipes; and manhole tie-in to existing downstream drain pipe.
  - j. Activity 9: Disinfect and test new tank and yard piping.
  - k. Activity 10: Install new electrical, instrumentation, and PLC panel for new 6.8 MG tank, and place in service. Commission new instrumentation.
  - l. Activity 11: Backfill and Landscape Restoration.
  - m. Activity 12: Final access road improvements and paving.
- G. Essential Service and Capacity Constraints
- 1. Water Supply: All water mains must remain in service throughout the project, with only the specified brief interruptions to make connections.

END OF SECTION



**SECTION 01 20 00  
MEASUREMENT AND PAYMENT**

**1.1 DESCRIPTION**

- A. This Section defines the manner in which the Lump Sum Prices, Unit Prices, and the Allowances listed in the Bid Schedule will be used to determine measurement and payment for all Work and describes the required procedures for monthly progress payments to the Contractor.
- B. Bid amounts will include all plant, equipment, tools materials, labor, service, and all other items required to complete the Work included in the Agreement unless specifically excluded by this section. Work required for which no separate Bid item is identified will be considered as a subsidiary obligation of the Contractor, and the cost therefore shall be included in the most applicable Bid item. Refer to 01 32 16 – Construction Progress Schedule for resource loading and progress payments. Compensation for partial completion of the Work will be determined by use of the Construction Schedule. Bid amounts for each item will be the basis for development of budget values for activities included in the Construction Schedule and in the Schedule of Values. Adjustments to Allowance Bid Item amounts will be applied to the Contract Price when Work is completed, and actual Allowance item amounts are known.
- C. Payment for all items in the Bid Schedule will include full compensation for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including but not limited to all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Division of Industrial Safety and the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA).
- D. All costs shall be included in the prices named in the Bid Schedule for the various items of Work. Except as otherwise provided herein, no separate payment will be made for any item that is not specifically set forth in the Bid Schedule.
- E. When included, all estimated quantities stipulated in the Bid or other Contract Documents are approximate and are to be used only as a basis for estimating the probable cost of the Work and for the purpose of comparing the Bids submitted for the Work. The actual amounts of Work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts thereof.
- F. The unit or lump sum item of work, which involves excavation or trenching shall include all costs for such work. No direct payment will be made for excavation or trenching. All excavation and trenching will be unclassified as to materials which may be encountered; in addition, trenches will be unclassified as to depth. No additional payment will be made for rock or caliche excavation, nor for blasting which the Contractor determines is required for rock or caliche excavations.

- G. Monthly pay requests are due on the 30th of each month, and while pay requests will be accepted prior to this date, pay request processing will not begin until this date for purposes of meeting the Owner's pay request processing obligations. Failure to submit a pay request by this day may be cause for the rejection of the pay request. If rejected, Contractor may have to resubmit the pay request the next month. Should the submittal date fall on a holiday or weekend day during the month, then consider the next working day as the due date.
- H. Note that the information provided in this Section is intended for use as a general description of the breakdown of work to be included in the Bid Schedule. The following descriptions are NOT intended to represent a complete listing of all Work required by the Contract Documents. It is the Bidder's responsibility to make sure that costs for all Work required in the plans and specifications is accounted for in the appropriate Bid Items, whether or not specifically described in this Measurement and Payment section. The Owner is not responsible for Contractor's failure to properly coordinate with Subcontractors and Suppliers regarding the breakdown of Work in these Contract Documents.

## 1.2 MEASUREMENT AND PAYMENT

### A. Lump Sum Bid Items

1. All Work Required by the Contract Documents
  - a. The sum allowed for Bid Items 1, 2, 3, 4, 5, 8, and 9 as set forth in the Bid Form includes all Work for and in connection with construction of the Contract in its entirety, including but not limited to all costs associated with dust control mitigation measures, permit fees and other related costs to ensure compliance with the Board of Health Air Pollution Control Regulations.
  - b. Payment for Work under this Bid item will be based on the breakdown of costs for each scheduled activity in the Construction Schedule and the percentage of completion for each activity in accordance with the Contract Documents.
  - c. Preparing the Construction Progress Schedule shall be a separate activity on the Construction Schedule and shall also be a separate activity on the Schedule of Values. Payment for the Construction Progress Schedule is not in addition to, but is incidental to the other lump-sum items included in the Work.
    - 1) The Contractor may submit application for the full amount of this item if the CPM Schedule is accepted by the Engineer within 45 days after issuance of Notice to Proceed.
    - 2) Because the CPM Construction Schedule has less value to Owner and Contractor as time passes, an amount of \$ 500 per day will be deducted from the Contract Price for each day after 45 days following Notice to Proceed that the CPM Construction Schedule has not been accepted by the Engineer.
    - 3) Deductions for overdue schedule submittal will cease to accumulate when the earliest of either of the following items occurs.
      - a) The Engineer accepts the CPM Construction Schedule.
      - b) The amount of accumulated deductions equals two percent (2%) of the applicable item in the Schedule of Values.
      - c) The Work is accepted as Substantially Complete.

- 4) Both the Owner and the Contractor agree that deductions for delayed submittal of an acceptable CPM Construction Schedule are not penalties but reflect the diminishing value of the delayed submittal.
- d. Payment for mobilization, as defined in Section 01 71 00 – Mobilization, as part of the lump sum price named in the Bid Schedule shall equal six percent (6.0%) of the total lump sum price bid for the Work. The payment for mobilization is not in addition to, but is part of the lump sum price for the Work. A separate activity for mobilization shall be included in the Construction Schedule and in the Schedule of Values. This activity shall include all principal items and all submittals specified in Section 01 71 00 – Mobilization, as applicable. The remaining lump sum, except as otherwise required by this Agreement, shall be appropriately distributed among the remaining work activities that make up the total lump sum price. Payment for mobilization will be approved in accordance with the status of completion of each mobilization component as defined in the approved mobilization plan required in Section 01 71 00; except that no payment for mobilization will be approved until Items 1, 2, 8, 9, 10, and 11 of paragraph 3.1.A of Section 01 71 00 are complete. No more than one-half of the payment for mobilization will be paid until all submittals required by paragraph 3.2 of Section 01 71 00 have been approved by the Engineer.
- e. Payment for each approved Operations & Maintenance (O & M) Manual, as defined in Section 01 33 20 – Submittal Procedures, as part of the total lump sum price named in the Bid Schedule shall equal 10% of the value of the piece of equipment or group of like-kind pieces of equipment that it represents. The payment for each O & M Manual is not in addition to but is part of the lump sum price for the Work. A separate activity for each O & M Manual shall be included in the Construction Schedule and in the Schedule of Values. The remaining lump sum price, except as otherwise required by this Contract, shall be appropriately distributed among the remaining work activities that make up the total lump sum price.

B. Unit Price Bid Items

- 1. Measurement and calculation of quantities for payment to be as indicated in this section.
- 2. Unit prices or lump sum amounts to include full compensation for furnishing all labor, materials, products, tools, equipment, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit, and doing all work shown on the Drawings, defined in the Specifications, and/or stipulated herein.
- 3. Payment covers the cost of incidental work which includes: quality control and testing; temporary facilities; construction surveying; as-built surveying; removal and disposal of waste materials; miscellaneous dewatering; managing storm water, and ground water during construction; constructing needed temporary access to construction areas; monument restoration; removal and replacement of landscape materials equal to or better than existing if damaged by the Contractor's operations; coordinating utility relocations to be performed by others; removing and replacing street signs impacted by construction activities; temporary watering of landscape restoration areas; dust control; site cleanup; and all other necessary work, to install the Work complete.

4. Unit Price Work required by the Contract Documents.
  - a. Bid Item No. 6 – Access Road (4-inch PG 64-28 DM ½).
    - 1) Measurement: Measured and paid for on a square foot basis as measured in the field by the Engineer. Maximum pay width for access road is the width shown in the drawings.
    - 2) Payment Covers: All labor, materials, tools and equipment required to complete improvements to existing access road including but not limited to: clearing and grubbing; removal of native materials and subgrade preparation; furnishing, placing and compacting untreated base coarse; final grading; furnishing, placing and compacting new asphalt material.

C. Allowance Bid Items

1. None of the amounts of the Allowance Bid items contained in the Bid form may be increased without a Change Order to increase. Adjustments to Allowance Bid Item amounts will be applied to the Contract Price when Work is completed, and actual Allowance item amounts are known. Allowances for Bid Item 7 are intended to reimburse the Contractor for fees associated with permits. Costs associated with preparing permit applications and obtaining permits (including preparation of a Stormwater Pollution Prevention Plan) should be included in Bid Item 1.
2. Specific Allowance 1 – West Jordan City Building Permit Allowance Item (Bid Item No. 7)
  - a. The Building Permit Allowance set forth in the Bid Form shall be included in the Bid to cover the cost of the West Jordan City Building Permit including but not limited to Excavation Permit, Traffic Control Permit, Building Permit, Building Department Inspection Fees, Electrical Permit, and Storm Water Pollution Prevention Permit. The Contractor shall pay the fees associated with obtaining these permits. The Owner will reimburse the Contractor for the costs of these permits, using the lump sum allowance for this bid item.
  - b. Measurement: The amount shown in Bid Item 7 has been included in the Bid Schedule to compensate the Contractor for this Specific Allowance which includes specified items of Work generally known to be required for the Project but whose quantities and/or pricing is unknown until after the items of Work have been identified.
  - c. Payment Covers: Permit fees for West Jordan City Building Permit.
  - d. Specific Allowance funds that have not been disbursed at the completion of the project will be credited to the Owner by the final reconciliation Change Order.

1.3 GENERAL PROGRESS PAYMENT REQUIREMENTS

- A. Payment for Work performed shall be in accordance with installed quantities as assessed in comparison to the Schedule of Values and the Construction Schedule. The Engineer will verify measurements and quantities. Each activity necessary to manage and complete the Work is identified on the Contract schedules. Each activity will be assigned its respective value, a portion of the Contract Price, as shown on the Schedule of Values (Roll-up), and detailed cost loaded activity schedule.

- B. Payment for all lump sum costs and services incurred on this Agreement shall be based on the earned value of Work accomplished during the reporting period. Earned value is determined by the completion percentage of each activity as determined by the Schedule of Values and the Construction Schedule applied to the total value of the activity. No construction activity shall be deemed 100 percent complete until the Contractor has completed the physical check out and inspection of the completed Work and has submitted the signed inspection form to the Engineer.
- C. Earned value is derived from the current status of the Contractor Construction Schedule as determined by the monthly schedule status submittals. Each schedule status submittal is reviewed and approved by the Engineer prior to the Contractor obtaining approval for the Summary of Earned Values or quantities installed and the Application for Payment.

#### 1.4 APPLICATION FOR PAYMENT

- A. Submit application for payment on the Owner's form and be certified by signature of an Authorized Officer of the Contractor.
- B. The Application for Payment shall contain all necessary references and attachments that substantiate the invoice for progress payment (e.g., certified payrolls, labor reports, progress schedule data, and Summary of Earned Values). It shall substantiate the invoice for progress payment and shall be preceded or accompanied by the schedule and status data as a condition of payment, in accordance with the Construction Schedule and the Schedule of Values.

#### 1.5 REVIEWS/APPLICATION FOR PAYMENT

- A. Review meetings between the Contractor and the Engineer will be held weekly and within 7 Days prior to the payment application date designated by the Engineer. Three Days prior to the last review meeting of the month, submit an updated schedule and a signed application for payment showing a Summary of Earned Values for the reporting and payment period so that the Engineer can compare earned values to available status data. Make any adjustments to the Master Record Documents, updated schedule, and payment applications required by the Engineer. Upon completion of the adjustments, the Engineer will sign the payment request and forward it to the Owner. The Engineer will determine payment amounts if agreement with the Contractor is not reached.

#### 1.6 PAYMENT FOR SUPPLIES AND MATERIALS

- A. Payment based on the actual cost of supplies, materials and equipment on hand shall be made by the Owner with or without a paid invoice. "Actual cost" of materials shall be the invoice amount, whether paid or not, and shall not include any costs associated with installation, testing, etc. The Contractor shall be entitled to payment of the actual cost of supplies, materials and equipment only if it (1) presents an invoice to the Owner with the application for payment and (2) states in the application for payment that the materials have been delivered and stored in the time and manner specified in the contract between the Contractor and his Supplier or Subcontractor. If Contractor fails to comply with those conditions, the Owner may withhold payment in accordance with the provisions. The Owner expressly reserves the right to withhold retention until Contractor presents to the Owner a paid invoice, or some other proof of payment satisfactory to the Owner, for the Owner's use in verifying

the accuracy of the actual cost of the supplies, materials or equipment. If the amount paid does not match the actual cost, the Owner will adjust the amount of retention accordingly. Payment for supplies, materials or equipment on hand does not alter the responsibility of the Contractor for all supplies, materials and equipment until Final Acceptance of the Work.

END OF SECTION

**SECTION 01 25 10**  
**PRODUCTS, MATERIALS, EQUIPMENT, AND SUBSTITUTIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for delivery and storage of products and materials specified for use in the Project. It also includes requirements for handling requests for equals and substitutions made after award of the Contract.

**1.2 RELATED SECTIONS**

- A. Section 01 32 00 – Electronic Project Management System

**1.3 DEFINITIONS**

- A. Definitions in this Article are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. The word "Products," as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for the Project or taken from stock of previously purchased products.
- C. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work.
- D. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items).
- E. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: To the greatest extent possible for each unit of work, provide products, materials, and equipment of a singular generic kind from a single source.
- B. Compatibility of Options: Where more than one choice is available as options for selection of a product, material, or equipment, select an option, which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### A. Delivery and Acceptance

1. Deliver and store products, materials, and equipment in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft.
2. Manage delivery schedules to minimize long-term storage of products at Site and overcrowding of construction spaces. Ensure coordination to minimize holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

### B. Transportation and Handling

1. Transport products by methods to avoid damage. Deliver in undamaged condition in manufacturer's unopened containers and packaging.
2. Furnish equipment and personnel to handle products, materials, and equipment, including those provided by Owner, by methods to prevent soiling and damage.
3. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

### C. Storage and Protection

1. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
2. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
3. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
4. Storage shall be arranged to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.
5. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

### D. Maintenance of Storage

1. Periodically inspect stored products on a scheduled basis. Maintain a log of inspections and make the log available on request.
2. Comply with manufacturer's product storage requirements and recommendations.
3. Maintain manufacturer-required environmental conditions continually.
4. Ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
5. For mechanical and electrical equipment, provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
6. Service products on a regularly scheduled basis. Maintain a log of services and submit as a record document prior to acceptance by Owner in accordance with the Contract Documents.



1.6 PROPOSED SUBSTITUTIONS AND "OR EQUAL" ITEMS

- A. Substitution and "or equal" determination shall be submitted and evaluated per the General Conditions included in the Contract Documents.
- B. When proposing a substitution, make written application to Engineer on the "Substitution Request Form."
- C. Unless otherwise provided by law or authorized in writing by Engineer, submit the "Substitution Request Form(s)" within 35 days after award of the Contract.
- D. Whenever products, materials, or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the manufacturer is intended to establish the type, function, and quality required. The Contract Price is understood to be based upon furnishing the item specified.
- E. If a named item is not available or a supplier is no longer doing business, the following shall apply:
  - 1. In the event that a named supplier is no longer doing business under the name indicated, furnish the specified product from the legal successors to the named supplier.
  - 2. In the event that a named product is no longer available from the named supplier due to acquisition or sale of the given product line, but the product is available from another supplier, provide the named product. In such cases, submit a substitution request form and include certification from the supplier that the product being supplied is materially and functionally identical to the product named in the Contract Documents.
  - 3. In the event that the named product is no longer available from the named supplier or any other supplier, notify Owner in writing and Owner will direct Engineer to identify suitable substitute products. Provide one of the suitable substitute products.
- F. The procedure for review by the Engineer will include the following:
  - 1. Wherever a proposed substitution has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by Engineer, provide the product, material, or equipment indicated in the Contract Documents.
  - 2. Certify that the proposed substitution will adequately perform the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated and be suited to the same use as that indicated.
  - 3. Engineer will evaluate each proposed substitution within a reasonable period.
  - 4. As applicable, do not make shop drawing submittals for a substitution without Engineer's prior written acceptance of the request for substitution. Do not order, install, or utilize any substitution item prior to written acceptance of the request for substitution.
  - 5. Engineer will record the time required by Engineer in evaluating substitutions and in making changes by Contractor in the Contract Documents occasioned thereby.

- G. Application using the "Substitution Request Forms" shall contain the following statements and information, which shall be considered by Engineer in evaluating the proposed substitution:
1. The evaluation and acceptance of the proposed substitution shall not prejudice the achievement of substantial completion on time.
  2. Whether or not acceptance of the substitution for use in the Work will require a change in any of the Contract Documents to adapt the design to the proposed substitution.
  3. Whether or not incorporation or use of the substitution in connection with the Work is subject to payment of any license fee or royalty.
  4. All variations of the proposed substitution from the items originally specified shall be identified.
  5. Available maintenance, repair, and replacement service shall be indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
  6. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.
- H. Without any increase in cost to Owner, be responsible for, and pay all costs in connection with proposed substitutions and costs of inspections and testing of equipment or materials submitted for review prior to purchase thereof for incorporation in the Work, whether or not Engineer accepts the proposed product, equipment, or material. Reimburse Owner for the charges of Engineer and other authorized representatives for evaluating each proposed substitution.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION



## SUBSTITUTION REQUEST FORM

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project: \_\_\_\_\_  
Date: \_\_\_\_\_  
Owner: \_\_\_\_\_

Specified Item:

Section	Page	Paragraph	Description
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The undersigned requests consideration of the following:

**Proposed Substitution:** \_\_\_\_\_

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. Applicable portions of the data are clearly identified.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings and will not require a change in any of the Contract Documents.
2. The undersigned will pay for changes to the design, including engineering design, detailing, and construction costs caused by the request substitution which is estimated to be \$.
3. The proposed substitution will have no adverse effect on other contractors, the construction schedule (specifically the date of substantial completion), or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The incorporation or use of the substitute in connection with the work is not subject to payment of any license fee or royalty.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by **Contractor:**

Firm: \_\_\_\_\_  
By: \_\_\_\_\_  
Signature: \_\_\_\_\_  
Telephone: \_\_\_\_\_  
Attachments: \_\_\_\_\_  
Comments: \_\_\_\_\_

Reviewed by **Engineer:**

☐ Accepted as Submitted    ☐ Accepted as Noted  
☐ Not Accepted    ☐ Received too Late  
By: \_\_\_\_\_  
Title: \_\_\_\_\_  
Date: \_\_\_\_\_  
Comments: \_\_\_\_\_



**SECTION 01 29 73  
SCHEDULE OF VALUES**

**PART 1 - GENERAL**

**1.1 GENERAL**

- A. This Section defines the process whereby the Schedule of Values shall be developed and incorporated into the cost loading function of the Construction Progress Schedule as specified in Section 01 32 16 - Construction Progress Schedule. Monthly progress payment amounts shall be determined from the weekly progress updates of the scheduled activities. The schedule of values shall, as a minimum, list the value of every activity on the schedule, and shall include such additional breakdowns as required herein. The values in the Schedule of Values do not establish a commitment by either Contractor or Owner when negotiating changes to the Contract Documents.

**1.2 DETAILED SCHEDULE OF VALUES**

- A. Prepare and submit a detailed Schedule of Values to Engineer as part of the Construction Progress Schedule submittal. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through resource loading of the schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The Schedule of Values shall have a one-to-one relationship to the work activities of the Construction Schedule even though additional detailed breakdowns for the Schedule of Values may be required. Engineer will be the sole judge of acceptable breakdowns, details, and descriptions of the values established. If, in the opinion of Engineer, a greater number of Schedule of Values items than proposed is necessary, add the additional items so identified.
- B. The minimum details of a breakdown of the major Work components are indicated below. Provide greater detail when directed by Engineer.
1. Mobilization: Six percent of Contract Price.
  2. Construction Progress Schedule shall be broken down by initial submittal and monthly updates.
  3. Break down Civil site Work into roadways, individual drainage systems, individual flood control structures, site concrete, soil cement, paving, excavation cut and fill, clearing and grubbing and any other items determined to be necessary for the establishment of pay and activity items.
  4. Break down concrete structures into excavation, subgrade preparation, and appurtenant pre-foundation Work, concrete foundation construction, slabs on grade, walls, columns, suspended slabs, etc. (provide sufficient breakdown to accommodate necessary schedule detail.
  5. Break down mechanical Work within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.
  6. Break down electrical and Instrumentation Work within each structure to identify individual systems, equipment installation by equipment name and number, and equipment testing and checkout.

- a. Break down fiber optic conduit Work into conduit installation and pullboxes.
    - b. Break down cathodic protection Work by ribbon anode and appurtenances, test station types, rectifiers, and insulating flanges.
  - 7. Break down protective coating Work by system. Where specific coating Work may be critical to performing the Work to meet milestone and schedule dates, such Work shall be included as individual pay and activity items.
  - 8. Break down utility relocation Work into individual pipelines running from and to termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the Engineer.
  - 9. Break down pipeline Work into individual items including pipe, specials, and other pipe materials, excavation, pipe installation, joint welding (including testing), joint protection, CLSM, pipe zone, backfill, surface restoration, and hydrostatic testing; aqueduct crossings; aqueduct interconnections; and any other items determined necessary for the establishment and pay and schedule activities.
  - 10. Break down in-field pipeline lining by stations between access manholes.
  - 11. Provide breakdown for disinfection, testing, and commissioning of pipelines and reservoirs.
  - 12. Operations and Maintenance (O & M) Manuals shall be broken down into one O & M Manual per piece of equipment or one O & M Manual per group of like-kind pieces of equipment for establishment of pay and schedule activity items.
  - 13. Break down all other Work not specifically included in the above items as necessary for establishment of pay and schedule activity items.
- C. After submittal of the Schedule of Values, as part of the Construction Progress Schedule submittal, meet with Engineer and jointly review the schedules. Review the value allocations and extent of detail to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed. Make adjustments deemed necessary to the value allocation or level of detail and submit a revised detailed Schedule of Values within 5 work days from receipt of comments from Engineer.

### 1.3 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the Construction Progress Schedule, provide a cross referenced listing in two parts as follows:
  - 1. In the first part, list each scheduled activity with the breakdown of the respective valued items making up the total cost of the activity.
  - 2. In the second part, list the valued items with the respective scheduled activity or activities that make up the total cost indicates.
  - 3. Where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values), the total cost for each scheduled item shall be indicated.
- B. Update and submit the listings in conjunction with the monthly Construction Progress Schedule updates.
- C. Incorporate approved Change Orders reflected in the Construction Progress Schedule into the Schedule of Values as a single unit identified by the Change Order number.

#### 1.4 CHANGES TO SCHEDULE OF VALUES

- A. Assign values, approved by Engineer, for changes to the Construction Schedule which add activities not included in the original Construction Schedule but are included in the original Work (schedule omissions). Reduce other activity values to provide equal value adjustment increases for added activities as approved by Engineer.
- B. In the event that Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made. Engineer may direct changes to the schedule when inequities are discovered and agreement on the reallocation cannot be achieved.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

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**SECTION 01 31 30**  
**SAFETY**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Contractor's safety program shall conform to the requirements specified in the General Conditions and Supplementary Conditions.

1.2 DEFINITIONS

- A. For the purposes of this Section, an "active construction area" is any area where construction activities are occurring or construction activities could be considered a potential hazard to people.
- B. A "Designated Safety Officer" or "Safety Representative" for the purposes of this Contract, means anyone who is capable of identifying the existing and predictable hazards in the areas surrounding a construction project or those working conditions at a construction project that are unsanitary or dangerous to employees. A "Designated Safety Officer" has the authority to make prompt corrective measures to eliminate those hazards.

1.3 SUBMITTALS

- A. Demonstrate compliance action with the stipulations of Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and other applicable local, state, and federal safety requirements by submitting to Engineer a copy of all safety plans, programs, and permits. Such plans and programs shall include, but are not limited to:
1. Hazard Analysis Prior to Major Activities (job safety analysis, JSA).
  2. Emergency Plan.
  3. Rigging and Hoisting Plans.
  4. Excavation and Trenching Plans.
  5. Respiratory Protection Program.
  6. Fire Protection Plan.
  7. Confined Space Entry Program.
  8. Explosives Handling and Storage.
  9. Confined Space Entry Program.
  10. Electrical Safety (drop cords, temporary power, GFCI's, etc.)
  11. Lock Out/Tag Out.
  12. Fall Protection.
  13. Heavy Equipment Operations.
  14. Burning and Welding Operations.
  15. Training Plan.
  16. Tunneling/Underground/Jacking/Boring Operations.
  17. Project Site Rules and Regulations (hazard protection plan).
  18. Material Handling (storage-disposal).
  19. Fuel Storage and Refueling.
  20. Hazard Communication/Right to Know.
  21. Subcontractor Requirements.

22. Ventilation.
  23. Personal Protective Equipment (hearing, eye, face).
  24. Power Transmission/Distribution (temporary and/or permanent).
  25. Traffic Control.
  26. Environmental Controls.
  27. Safety Meetings.
  28. Spill Control Plan.
  29. First Aid Facilities.
- B. Engineer's receipt of safety plans or programs will not relieve Contractor in any way from the full and complete responsibility for safety and training of its personnel, and the onsite personnel of Owner, Engineer, and other visitors to areas of active construction areas. On a daily basis, inform Engineer of changes to the boundaries of the active construction areas.
- C. Be responsible for safety training all personnel who will have access to the active construction areas to meet state, federal, local and Contractor requirements. Maintain reasonable, regularly scheduled training sessions in mutually accessible facilities through entire Contract. Training costs for all personnel and visitors, except those costs associated with training personnel of Contractor, subcontractors, suppliers, and visitors will be considered incidental to other lump-sum portions of the Work and no additional compensation for such training will be provided.
- D. Safety Program Requirements:
1. Safety Representative Requirements:
    - a. Assign a full-time Safety Representative as defined in the General Conditions of the Contract.
    - b. The Safety Representative's duties and responsibilities will be hazard recognition, accidents prevention, new employee orientation (including subcontractors), and the maintaining and supervising of safety precautions and program. This person shall have no other duties. The Safety Representative or a qualified and approved deputy shall be onsite at all times while Work is ongoing.
    - c. Qualifications of the Safety Representative and assigned deputies shall be submitted to Engineer for review. Acceptance of their qualifications by Engineer is required prior to the start of any activity on the Project. The Safety Representative will, as a minimum, meet the requirements of regulations for the Occupational Safety & Health Enforcement Program.
  2. Hazardous Substances:
    - a. Provide Engineer with a list of all hazardous substances anticipated to be brought on-site.
    - b. Maintain on site Material Safety Data Sheets (MSDS) prior to arrival of any hazardous substances on the Project.
    - c. Use storage area(s) as outlined in the spill control plan.
  3. Job Safety Analysis (JSA):
    - a. Outline the sequence of the Work, equipment to be used, identify hazards that may exist or may be created and what procedures and/or safety equipment will be used to eliminate or reduce these hazards. A Scope of Work JSA shall be prepared and provided to the Engineer prior to the start of unusual,

- hazardous, or have risk potential activities on the Project. The name of the competent person assigned to this activity will be included on the JSA.
- b. Complete a JSA for any activity, which may be of an unusual nature or involves unique hazards.
4. Reports
- a. Provide to Engineer copies of Contractor's and subcontractor's:
    - 1) First aid, recordable, lost time and near miss, monthly logs.
    - 2) OSHA 200 injury log (annually).
    - 3) Safety meeting reports and topics (weekly).
    - 4) List of competent persons as required by OSHA and the Project Health and Safety Manual for each required task and their qualification as such.
    - 5) Injury and accident reports will be submitted to Engineer within 24 hours of any incident. **Immediate** notification to Engineer of an accident is **required**. Full cooperation with Engineer in accident investigation is required.
  - b. Conduct weekly safety inspections. Corrective actions shall be taken within 24 hours to address all deficiencies identified during inspections. Deficiency reports shall be prepared and submitted to Engineer within 48 hours indicating corrective actions taken. Failure to comply with required corrective measures identified in the safety inspection will result in the delayed signing of the monthly application for progress payment by Engineer.
  - c. Provide Engineer with a report of any periodic audit of Contractor's safety performance and/or records.

END OF SECTION

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**SECTION 01 32 00**  
**ELECTRONIC PROJECT MANAGEMENT SYSTEM**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes requirements to use Engineer's web-based Electronic Project Management system (EPM).

1.2 RELATED SECTIONS

- A. Section 01 33 20 – Submittal Procedures.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Contractor is required to use Engineer's (EPM) system, VPO, by The Simplex Group, Inc. for electronic construction management document control and communications between the Owner, Engineer, other project-related consultants, and Contractor. Having the system capability in place onsite is a condition precedent to processing the first payment request.

B. User Access Limitations:

1. Engineer will control access to the EPM system by allowing access and assigning user profiles to accepted personnel.
2. User profiles will define levels of access into the system, determine assigned function-based authorizations, and user privileges.
3. Subcontractors and suppliers will be given access to the EPM system by and through Engineer. Entry of information exchanged and transferred between Contractor and subcontractors and suppliers will be the responsibility of Contractor.

C. Ownership and Management of Data:

1. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the EPM system) by all parties will be owned by Engineer, but maintained and operated collaboratively by members of the Project Team.

D. Automated System Notification and Audit Log Tracking:

1. Review comments made (or lack thereof) by Engineer or Owner on Contractor submitted documentation does not relieve Contractor from compliance with requirements of the Contract Documents.
2. Contractor is responsible for managing, tracking, and documenting Work to comply with the requirements of the Contract Documents.
3. Engineer's or Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of Contractor's submitted information.

E. Computer Requirements:

1. Use computer hardware and software that meets the requirements of the EPM system. As recommendations are modified by the EPM system's authors, upgrade hardware and software system(s) to meet or exceed the recommendations.

- Upgrading Contractor's computer systems will not be justification for a cost or time modification to the Contract.
2. Ensure that connectivity to the EPM system is accomplished through DSL, cable, T-1, fiber optic, or wireless communications systems. Minimum bandwidth requirements for using the system are 128 kb/s. It is recommended that a faster connection be used when uploading pictures, videos, and data files into the system.
  3. Before upgrading any computer software or hardware, verify that such upgrades are compatible with the latest version of the EPM system at no additional cost to the Engineer or Owner.
  4. Utilize the full version of Adobe Acrobat (or equal) so that Portable Document Format (PDF) submittals can be assembled into single files and organized appropriately. Obtaining and utilizing this software will be at no additional cost to Engineer or Owner.
- F. User Connectivity:
1. Provide a list of Contractor's key EPM personnel for the Engineer's acceptance.
  2. Contractor is responsible for identifying personnel to be added or removed from the system.
  3. Engineer reserves the right to perform a security check on all potential users.
  4. Contractor will be allowed to add additional personnel and subcontractors to the EPM system.
- G. Training:
1. Engineer will provide a single training session to assist Contractor in the use of the EPM system. Time cost of the training session will be borne by the attendees.
  2. Make applicable staff available for an initial 2-hour training session to be scheduled at a mutually agreeable time and place within 14 days of Notice to Proceed.
  3. Training may consist of web-based seminar(s) in conjunction with a conference call.
  4. Contractor may request Engineer to provide additional training and technical support for use of the EPM system. Time cost of the training session will again be borne by the attendees.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Web Based EPM User's List:
1. At the preconstruction meeting, provide a list of key EPM personnel, utilizing form at the end of this Section. Engineer will use this information for no other purpose than to establish the necessary accounts for use by each individual.
  2. Specifically identify Contractor's administrator on the list.
  3. Personnel shall have sufficient computer skills required to access the Internet, log on to the EPM system, and utilize the system.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 SYSTEM UTILIZATION**

- A. Utilize the EPM system to transmit all documents and for all information management required by the Contract Documents.
- B. When transmitting electronic documents, use PDF format unless specifically instructed to upload native format document files. When creating PDF files, utilize the native software to produce the most efficient files directly and avoid optically scanning hard copies.
- C. Unacceptable documents include faxed and/or hand-written documentation of RFI, sketches, and inspection requests/reports.
  - 1. Contractor is responsible for data entry via the EPM system in the generation of Project related documentation.
  - 2. Contractor is responsible for preparing electronic sketches and drawings necessary for the electronic submittal of necessary information related to general questions and formal RFI.
  - 3. Provide field personnel with the necessary computer equipment to allow entering documentation electronically.

### **3.2 SYSTEM CONTENTS**

- A. The EPM system will contain the following information available to Contractor and the Project team in general.
- B. Administrative Documents
  - 1. Submit all general correspondence and pre-construction submittals using the EPM system. Examples include:
    - a. Permits
    - b. Requests for Substitution per Section 01 25 10 – Products, Materials, Equipment, and Substitutions.
    - c. Transmit Construction Schedules in both the native software format and as a PDF file in the format specified herein.
    - d. General information requests.
    - e. Contractor's Quality Control Plan and associated reports.
    - f. Meeting minutes from Project meetings.
- C. Requests for Interpretation (RFI): Submit RFI and maintain logs through the EPM system and in accordance with Section 01 26 13 – Requests for Interpretation (RFI).
- D. Compliance Submittals
  - 1. Submit material test reports, inspection requests and reports, certificates, and manufacturer field reports through the EPM system as PDF files.
- E. Project Photographs and Videos.
  - 1. Include dates on photographs and videos.
  - 2. Use JPEG or JPEG2000 format for photos

- 3. Use WMV file format for videos.
  - F. Inspection requests and reports.
  - G. Record and Closeout Submittals
    - 1. Submit operation and maintenance data and closeout submittals through the EPM system as PDF documents during the approval and review of such, as specified in Section 01 33 20 – Submittal Procedures. Hard copy submittal is required only for final approved documents.
  - H. Financial Submittals
    - 1. Submit required Schedule of Values, Pay Estimates, and Change Request Proposals through the EPM system.
- 3.3 OFFICIAL RECORD
- A. The documentation and records maintained in the EPM system will be the “Official Records” for the Project. This documentation shall be the records for adjudication of all Project disputes.

END OF SECTION



**EPM System User List**

Name	Project Role	E-mail Address	Company	Primary Phone	Address	City	State	Zip Code

Attach additional pages as needed



**SECTION 01 32 16**  
**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The project management scheduling tool, "Critical Path Method", commonly called CPM, shall be employed for the planning and scheduling of all Work required under the Contract Documents. Because preparation, submittal, acceptance and updating of a CPM Construction Schedule is considered of vital importance to the success of the Project for both Owner and Contractor, Owner agrees to pay for a completed Construction Progress Schedule and for acceptable updates thereto, as described in Section 01 20 00 - Measurement and Payment.
- B. In addition to the scheduling aspect under the CPM method, the Construction Progress Schedule shall show an "S" curve for scheduled dollar expenditures versus time and a progress curve showing physical progress expected over time. Resource curves for manpower and equipment shall also be provided with the Construction Progress Schedule and monthly updates.
- C. In preparing the baseline schedule and monthly updates, consult with all key subcontractors and suppliers to assure concurrence with the feasibility and achievability of planned start dates, sequencing, durations, and completion dates.

**1.2 RELATED SECTIONS**

- A. Section 01 20 00 – Measurement and Payment.

**1.3 QUALIFICATIONS**

- A. Demonstrate competence in the use of CPM scheduling through the submission of a fully compliant CPM Construction Schedule with the initial CPM submission. Upon failure to so demonstrate competence in the CPM scheduling, Engineer may direct Contractor to employ the services of a scheduler that can demonstrate competence. Comply with such directive.
- B. The Contractor shall use the services of a scheduler who has verifiable training and credentials in preparing and maintaining a computerized CPM Construction Schedule using Primavera software as specified herein. The scheduler must qualify within the planning period.
  - 1. Required Experience: Performed CPM scheduling on at least 2 completed construction projects of value at least 75 percent as large as this one and having at least 75 percent as many schedule items as this one. Scheduling of both projects shall have been done using Primavera software (P3 for Windows) or equal.
  - 2. Submit the following:
    - a. Descriptions of at least 2 projects of the value and complexity above.
    - b. Copy of a CPM schedule from one of the previous projects.
    - c. Names and telephone numbers of facility owner representative, design engineer, and Engineer for each project.
  - 3. Evidence supporting the above qualifications shall be submitted to the Engineer.

#### 1.4 CPM CONSTRUCTION SCHEDULE SUBMITTAL PROCEDURES

A. The Contractor shall submit the following:

1. A CPM time-scaled logic network, computer generated using Primavera P3 scheduling software.
2. Computerized Tabular Reports.
  - a. Activity sort by activity ID, organized by facility or area.
  - b. Activity sort by early start, organized by facility or area.
  - c. Activity sort by float, organized by facility or area.
  - d. Predecessor/successor listing.
  - e. Activity code dictionary.
  - f. Resource code dictionary.
3. Basis of schedule narrative describing the logic and reasoning of the schedule.
4. Resource value allocation by activity.
5. Breakdown of specific cost amount for each component of multi-component activities in the CPM Schedule in spreadsheet format (using Microsoft Excel) showing component unit quantities as well as costs. Such breakdown, when accepted by Engineer shall constitute the Schedule of Values for the Project.
6. Compact Disk (CD-ROM) copy of entire schedule, resources, and spreadsheet.
7. A look-ahead schedule for the weekly progress meetings in a format approved by Engineer.

B. CPM Standards

1. Definition: CPM, as required by this Section, shall comply with the standards outlined in the Associated General Contractors' publication, "Construction Planning and Scheduling" unless specifically changed by this Section.
2. CPM Construction Schedule: The Contractor's CPM Construction Progress Schedule shall include a graphic time scaled logic network, computerized tabular reports and resource loading as described below. To be acceptable, the schedule must demonstrate the following:
  - a. A logical succession of Work from start to finish. This logical succession, when accepted, is the Contractor's work plan.
  - b. Clear definition of each activity including cost, manpower, equipment and material quantities as resources. The assigned dollar value (cost loading) of each activity shall cumulatively equal the Contract Price.
  - c. Proper interfacing of related activities including submittals, major material and equipment deliveries, procurement, required permits and other constraints such as equipment or manpower/crew availability. Submittal dates must include review periods and permit schedules must include agency review and issue dates. The narrative shall explain the rationale for all constraints, lags and unusual relationships.
  - d. Agreement with the interim milestones, schedule coordination requirements, and completion dates indicated in the Contract Documents.
3. CPM Graphic Logic Network
  - a. The CPM graphic logic network or diagram shall be in the form of a time-scaled diagram of the customary precedence diagram and may be divided into a number of separate pages with suitable notation relating the interface points among the pages. Individual pages shall not exceed 24-inch by 36-inch.

Notation on each activity line shall include activity descriptions, total float, and durations as a minimum.

- b. All construction activities and procurement shall be indicated in a time-scaled format, and a calendar shall be shown on all sheets along the entire sheet length. Each activity shall be plotted so the beginning and completion dates of said activity can be determined graphically by comparison with the calendar scale. A legend shall be included clearly distinguishing between critical and non-critical path activities and progress to date.
  4. Duration: The duration indicated for each activity shall be in units of whole working days and shall represent the single best time considering the scope of the Work and resources planned for the activity including time for holidays and inclement weather. The calendar for the network shall be in calendar days. Except for certain non-labor activities, such as curing concrete or delivering materials, activity durations shall not exceed 14 Days, be less than one Day, nor exceed \$50,000 in value unless otherwise accepted by Engineer.
  5. Computerized Tabular Reports: Reports shall include the following for each activity depicted in the schedule.
    - a. Activity ID
    - b. Activity Description
    - c. Duration (original and remaining)
    - d. Early Start Date
    - e. Early Finish Date
    - f. Total Float
    - g. Percent Complete
    - h. Activity Cost and Resources
    - i. Actual Start Date
    - j. Actual Finish Date
  6. Project Information: Each report shall be prefaced with the following summary data.
    - a. Project Name
    - b. Contractor
    - c. Type of Tabulation (Initial or Updated)
    - d. Project Duration
    - e. Project Scheduled Completion Date
    - f. Projected Completion Date
- C. Time of Submittals
  1. Submit the items listed in paragraph 1.3.A above, within 45 days of the Notice to Proceed for Engineer to review. Engineer will review the schedule submittals within 15 Days and state acceptance or rejection of the proposed CPM Construction Progress Schedule.
  2. Within 15 Days after receipt of Engineer's review comments, revise and resubmit the CPM Construction Progress Schedule as required. The revised CPM Construction Progress Schedule will be reviewed and accepted or rejected by Engineer within 10 Days after receipt.
  3. Submit a CPM Construction Progress Schedule update, as provided in Paragraph 1.5 of this Section along with each Application for Payment, or monthly, whichever is shorter.
- D. Acceptance

1. The finalized CPM Construction Schedule will be acceptable to Engineer when it provides an orderly progression of the Work from Notice to Proceed to Final Completion in accordance with the Contract requirements, adequately defines the Contractor's Work plan, provides a workable arrangement for processing submittals in accordance with the requirements, and properly allocates resource values for manpower, major materials, equipment and costs to each activity (free of unbalances in resources) as determined by Engineer. Manpower may be represented as composite crews in the CPM Construction Progress Schedule. The network diagram and tabular reports when accepted by Engineer shall constitute the CPM Construction Progress Schedule until revised or updated as provided herein. When the CPM Construction Schedule has been accepted, submit to Engineer three (3) copies of the CPM graphic logic network, three (3) copies of a computerized, tabular report in which the activities have been sequenced by activity numbers, three (3) copies of a computerized, tabular report in which activities have been sequenced by early starting date, and three (3) copies of a computerized, tabular report in which activities have been sequenced by total float.
2. Owner's review and acceptance of the CPM Construction Progress Schedule is for conformance to the requirements of the Contract Documents only. Review and acceptance by Owner does not relieve Contractor of any of its responsibility whatsoever for the accuracy or feasibility of the CPM Construction Progress Schedule, or of Contractor's ability to meet interim milestone dates and the Contract completion date, nor does such review and acceptance expressly or impliedly warrant, acknowledge, or admit the reasonableness of the logic, durations, and resource value loading of the CPM Construction Progress Schedule.

#### 1.5 CHANGE OF CONTRACT TIMES

- A. If a change of Contract Times is made pursuant to Article 12 of the General Conditions, the approved change shall be reflected in the next schedule update as an integrated fragment for the changed work item(s).

#### 1.6 SCHEDULE UPDATES

- A. The CPM Construction Schedule shall be updated to reflect the as-built conditions of the Work and to accurately forecast the status of incomplete activities. Progress reports shall be given at each weekly progress meeting, stating actual percent earned versus percent planned. CPM Construction Progress Schedule updates shall be submitted to Engineer with each payment request. Updates shall include approved changes in the Work and shall accurately depict the current status and sequence of all activities.
- B. The updated CPM Construction Schedule shall be submitted in the form, sequence, and number of copies requested for the initial schedule.
- C. The Engineer will review each CPM Construction Progress Schedule update and comments within seven (7) days of the submittal. Revise and resubmit the schedule within five (5) days of receipt of comments from Engineer. Engineer will review the re-submittal within five (5) days and provide comments if the schedule update is still unacceptable. Revise and resubmit the schedule within five (5) days of receipt of comments from Engineer.

## 1.7 PROGRESS MEETINGS AND LOOK-AHEAD SCHEDULES

- A. For the weekly progress meetings, submit a look-ahead schedule. This schedule will cover four weeks: the immediate past week, the current week, and the forthcoming two weeks. This schedule will include all activities, which are complete, started, are incomplete or underway, or scheduled to be worked during this four-week time frame. This schedule shall list all activities from the accepted CPM Construction Progress Schedule, which are complete, are scheduled for Work during the period, are currently planned to be worked, even if out of sequence, and Work which is unfinished but scheduled to be finished. Actual start and completion dates shall be provided for the Work that has been completed the prior week; forecast early start and early finish dates shall be provided for the Work that is in-process or upcoming.
- B. Each activity noted above shall be identified by activity number corresponding to the accepted CPM Construction Progress Schedule and detailed description of the activity.
- C. Deliver the look-ahead schedule to Engineer 24 hours prior to the weekly progress meeting in a format approved by Engineer.
- D. Provide tabular reports for manpower and equipment resources with each look-ahead schedule.

## 1.8 CPM CONSTRUCTION SCHEDULE REVISIONS

- A. If Engineer directs, propose revisions to the CPM Construction Progress Schedule upon occurrence of any of the following instances:
  - 1. The actual physical progress of the Work falls more than five percent (5%) behind the accepted CPM Construction Progress Schedule, as demonstrated by comparison to the accepted CPM Construction Progress Schedule updates or as determined by Engineer if a current accepted CPM Construction Progress Schedule does not exist.
  - 2. Engineer considers milestone or completion dates to be in jeopardy because of "activities behind schedule". "Activities behind schedule" are all activities that have not or cannot be started or completed by the dates shown in the CPM Construction Progress Schedule, regardless of the existence of positive float on the activity.
  - 3. A Change Order has been issued that changes, adds, or deletes scheduled activities or affects the time for completion of scheduled activities.
- B. When the instances requiring revision to the CPM Construction Progress Schedule occur, submit the proposed revised CPM Construction Progress Schedule within ten (10) working days after receiving direction from Engineer to provide such Schedule. No additional payment will be made to Contractor for preparation and submittal of proposed revised CPM Construction Progress Schedules. However, if Engineer accepts the proposed revised CPM Construction Progress Schedule, it shall replace and supersede all previous CPM Construction Progress Schedules and substitute for the next CPM Construction Progress Schedule update that would otherwise be required and shall qualify for payment of the CPM Construction Schedule update. Failure to submit required CPM Construction Progress Schedule revision proposals in a form acceptable to Engineer shall result in forfeiture and deduction of payments for CPM Construction Schedule updates.

- C. Revisions to the CPM Construction Progress Schedule shall comply with all of the same requirements applicable to the original schedule.

#### 1.9 SCHEDULE RECOVERY

- A. If a revised CPM Construction Progress Schedule accepted by Engineer requires additional manpower, equipment, hours of work or work shifts, or to accelerate procurement of materials or equipment, or any combination thereof, as schedule recovery measures to meet Contract milestones, implement such schedule recovery measures without additional charge to Owner.

#### 1.10 TIME IMPACT ANALYSIS REQUIREMENT

- A. When delays are experienced and a time extension is requested, submit to Engineer a written time impact analysis illustrating the influence of all changes or all delays on the current Project completion date. The time impact analysis shall be constructed on an as-built schedule analysis approach. The as-built schedule that is created will incorporate all actual start and finish dates, actual durations of activities, actual sequences of construction (referred to as the as-built logic) current as of the time the time impact analysis is performed. This time impact analysis shall incorporate all delays (including Owner, Contractor and third party delays without exception) in the time frame that they actually occurred with actual logic ties. The as-built schedule data shall be obtained from the most recent approved monthly schedule update. The as-built schedule shall be created as an early start schedule with the actual start and finish dates coinciding with the early start and finish dates from the most recent approved monthly schedule update. The as-built schedule shall show the original activity durations equal to the actual duration and the actual logic driving all activities. This as-built schedule will be validated by Engineer. All requests for time extension shall be based upon an analysis of this as-built schedule. The critical path will be established and all Owner-caused delays on the critical path will be identified. The time extension will be based solely upon the cumulative duration of all Owner and third party caused delays, which are on the critical path. Any time extensions to the Project's interim milestone dates, if any, shall be non-compensable time extensions only.
- B. Each time impact analysis shall demonstrate the estimated time impact based on the events of delay, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest approved update of the project schedule, in effect at the time the change or delay was encountered.

#### 1.11 EARLY COMPLETION SCHEDULES

- A. Early completion schedules are generally not acceptable to Owner but may be accepted as a convenience to Contractor and under the following conditions.
  - 1. Submit a specific written request outlining the specific reasons for using the early completion schedule.
  - 2. Acknowledge and agree in writing that the proposed reduction in time represents Project time already paid for by Owner as part of the Bid Price, and available to both Contractor and Owner for the mitigation of impacts to the Project from any source.



- Contractor is not entitled to any increase in Contract Price for failure to achieve the early completion and waives all claim to same.
3. Early completion schedules shall not be based upon or rely on expedited approvals by Owner or Engineer.
  4. Early completion schedules must meet all other requirements of the Contract.
- B. Revise early completion schedules, which have activities behind schedule, when and as requested by Engineer.
- C. When completion occurs early, any remaining future schedule updates shall be considered complete and earned and shall be paid as part of the final payment.

#### 1.12 BASIS OF SCHEDULE NARRATIVES

- A. Furnish a basis of schedule narrative to Engineer with each Application for Payment. If the Work falls behind schedule, submit additional narrative at such intervals as Engineer may request.
- B. In each narrative, include a summary of progress for the month, description of any current and anticipated delaying factors, a variance analysis for varying activities, impacts on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Engineer, must be substantiated with satisfactory evidence.
- C. In each narrative, include a list of the activities completed during the preceding month and a list of the activities started during the month but not yet completed.

#### 1.13 FLOAT

- A. Total Float is the number of days by which a part of the Work in the CPM Construction Progress Schedule may be delayed from its early start and finish dates without necessarily extending the Contract Times. The difference in time between the Project's scheduled early completion date, as submitted, and the required Contract completion date shall be considered as float, slack time, or contingency. Float, slack time, or contingency within the schedule, and total float within the overall schedule, is not for the exclusive use of either Owner or Contractor, but is jointly owned by both parties and is a resource available to and shared by both parties as needed to meet Contract milestones and the Contract completion date.
- B. Do not sequester shared float through such strategies as extending activity duration estimates to consume available float, using preferential logic, using extensive crew/resource sequencing, etc. Since float time within the schedule is jointly owned, no time extensions will be granted nor delay damages paid until a delay occurs which extends the work beyond the Contract completion date. Since float time within the Construction Progress Schedule is jointly owned, it is acknowledged that Owner-caused delays on the project may be offset by Owner-caused time savings (i.e. critical path submittals returned in less time than allowed by the Contract, approval of substitution requests which result in a savings of time to the Contractor, etc.). In such an event, no time extension or delay damages will be granted until all Owner-caused time savings are exceeded and the Contract completion date is also exceeded.

1.14 PAYMENTS

- A. Payment for CPM Construction Schedule shall be as described in Section 01 20 00 - Measurement and Payment.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 33 20**  
**SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. "Submittals" may be shop drawings, schedules, surveys, reports, samples, plans, lists, drawings, documents, findings, programs, manuals, data, or any other item or information required by the Contract Documents to be submitted in accomplishing the Work.
- B. Wherever submittals are required hereunder, all such documents shall be furnished to Engineer.
- C. Be responsible for the accuracy, completeness, and coordination of all submittals. Do not delegate this responsibility in whole or in part to any subcontractor. Submittals may be prepared by the Contractor, subcontractor, or supplier, but the Contractor shall ascertain that each submittal meets the requirements of the Contract and the Project. Ensure that there is no conflict with other submittals and notify Engineer in each case where a submittal may affect the work of another contractor or Owner. Ensure coordination of submittals of related crafts and subcontractors.
- D. Failure to make timely submittals in accordance with the requirements of the Specifications constitutes grounds for Owner to withhold 20 percent of compensation for the equipment to which the submittal is related, or, in the case of information lists, record drawings, investigation findings, safety plans, quality plans, and similar items, Owner may withhold 20 percent of the value of the information in the submittal.
- E. Submittal processing and review will be administered using an Electronic Project Management System as specified in Section 01 32 00.

**1.2 RELATED SECTIONS**

- A. Section 01 11 00 - Summary of Work
- B. Section 01 25 10 – Products, Materials, Equipment and Substitutions
- C. Section 01 29 73 – Schedule of Values
- D. Section 01 31 30 – Safety
- E. Section 01 32 16 – Construction Progress Schedule
- F. Section 01 45 00 – Quality Control
- G. Section 01 70 10 – Project Closeout
- H. Section 01 71 30 – Site Conditions Surveys

- I. Section 01 71 50 – Protection and Restoration of Existing Facilities
- J. Section 01 78 39 – Project Record Documents
- 1.3 PRECONSTRUCTION CONFERENCE SUBMITTALS
  - A. At the preconstruction conference referred to in Section 01 11 00 - Summary of Work, submit the following items for review:
    - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
    - 2. A list of all permits and licenses to be obtained, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
    - 3. A preliminary Schedule of Values in accordance with Section 01 29 73 – Schedule of Values.
    - 4. A preliminary Construction Project Schedule in accordance with requirements of Section 01 32 16 – Construction Progress Schedule.
    - 5. The names and qualifications of the Designated Safety Representative and Designated Competent Persons.
- 1.4 SITE CONDITIONS SURVEYS
  - A. Submit the site conditions survey data as required in Section 01 71 30 – Site Conditions Surveys.
- 1.5 PROGRESS REPORTS
  - A. Furnish a progress report to Engineer with each Application for Payment. If the Work falls behind schedule, submit additional progress reports at such intervals as Engineer may request.
  - B. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Engineer, must be substantiated with satisfactory evidence.
  - C. In each progress report, include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.
- 1.6 SHOP DRAWINGS
  - A. Wherever called for in the Contract Documents, or where required by Engineer, furnish to Engineer for review, 5 copies of each Shop Drawing Submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever required to submit design calculations as part of a Submittal, such calculations shall bear the signature and seal of a professional engineer registered in the appropriate discipline in the state of Utah unless otherwise directed.

- B. Submit all Shop Drawings accompanied by the submittal transmittal form included at the end of this Section. Submittals not accompanied by this form, or where all applicable items on the form are not completed, will be returned for resubmittal. Electronic version of the form is available from Engineer.
- C. Organization
1. A single shop drawing transmittal form shall be used for each item or class of material or equipment for which a submittal is required. At a minimum, separate submittals are required for different Specification Sections except as follows. A single submittal covering multiple sections will not be accepted, unless the primary specification references other sections for components. Example: If a pump section references other sections for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted; a single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
  2. On the transmittal form, index the components of the submittal and insert tabs in the Submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, drawing number, detail number, schedule title, or room number or building name, as applicable.
  3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match the Contract Documents.
  4. Engineer will assign a single review action to each submittal, which action shall pertain to every part of the submittal as a whole.
- D. Format
1. Minimum sheet size shall be 8.5 inches by 11 inches.
  2. Maximum sheet size shall be 24 inches by 36 inches.
  3. Number every page in a submittal in sequence.
  4. Each copy of a printed submittal shall be collated and stapled or bound, as appropriate. Engineer will not collate copies.
  5. Electronic copies of submittals shall be assembled into a single PDF file for each submittal.
  6. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
  7. Each Submittal shall be assigned a unique number, including the Specification Section under which it is submitted. Multiple submittals in the same specification section shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number, e.g. 03 20 00-1. Resubmittals shall bear an alpha-numeric system which consists of the number assigned to the original submittal for that item followed by a letter of the alphabet to represent that it is a subsequent Submittal of the original. For example, if Submittal 03 20 00-25 requires a resubmittal, the first resubmittal will bear the designation "03 20 00-25.1" and the second resubmittal will bear the designation "03 20 00-25.2" and so on.
- E. Disorganized submittals, which do not meet the requirements above will be returned without review.

- F. Except as may otherwise be indicated herein, Engineer will return each submittal, with its comments noted thereon, within 21 calendar days following their receipt by Engineer. For resubmittal of submittals, Engineer will be allowed the same review period as for the original submittal. It is considered reasonable that Contractor will make a complete and acceptable submittal to Engineer by the second submission of an item. Owner reserves the right to withhold monies due to the Contractor to cover additional costs of any review beyond the second submittal.
- G. If three copies of a Submittal are returned to the Contractor marked "NO EXCEPTIONS TAKEN", formal revision and resubmission of said Submittal will not be required.
- H. If three copies of a submittal are returned to the Contractor marked "MAKE CORRECTIONS NOTED", formal revision and resubmission of said submittal will not be required.
- I. If a submittal is returned marked "REVISE AND RESUBMIT", revise said submittal and resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing Submittal that consists of ten drawings contains only one drawing that needs to be amended and resubmitted, the submittal as a whole is deemed as "REVISE AND RESUBMIT", and all ten drawings included in the submittal are required to be resubmitted.
- J. If a submittal is returned marked "REJECTED-RESUBMIT", revise said submittal and resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a shop drawing submittal that consists of ten drawings contains only one drawing that is rejected and needs to be resubmitted, the submittal as a whole is deemed as "REJECTED-RESUBMIT", and all ten drawings included in the submittal are required to be resubmitted.
- K. Any changes made on a resubmittal, other than those made or requested by Owner or Engineer, shall be identified and flagged on the resubmittal.
- L. Fabrication of an item shall commence only after Engineer has reviewed the pertinent submittals and Engineer has returned copies marked either "NO EXCEPTIONS TAKEN" or "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 for changes to the Contract requirements.
- M. All shop drawing submittals shall be carefully reviewed by an authorized representative of Contractor prior to submission. Sign and date each submittal with a direct statement acknowledging that the equipment or material in the submittal meets all the requirements specified or shown in the Contract Documents without exception. No consideration for review of any submittals will be made for any items, which have not been so certified. All non-certified submittals will be returned without action taken, and any delays caused thereby shall be the total responsibility of Contractor. Submittals, which Contractor wishes to have reviewed that cannot bear this certification because they contain an exception or deviation to the Contract Documents shall be so noted on the transmittal form and shall be submitted in accordance with Section 01 25 10 – Products, Materials, Equipment and Substitutions.
- N. Owner's and/or Engineer's review of shop drawing submittals does not relieve Contractor of the entire responsibility for the correctness of details and dimensions and for compliance

with the Contract Documents. Assume all responsibility and risk for any misfits due to any errors in submittals. Be responsible for the dimensions and the design of adequate connections and details.

- O. No changes in the Contract times will be considered for schedule delays resulting from non-compliant submittals.
- P. Within 30 days of the Notice to Proceed, submit a complete list of anticipated submittals, which includes Specification and Drawing references. Update the list with "early start" submittal dates within 15 days of submittal of the Construction Progress Schedule. Submittal dates shall be updated whenever the schedule is updated. Any additional submittals identified after the initial submittal shall be included in the updates.
- Q. If an incomplete submittal is made, the submittal may be returned without review. A complete submittal shall contain sufficient data to demonstrate that the items contained therein comply with the Contract Documents, meet the minimum requirements for submittals as described in the Contract Documents, and include all corrections as required from previous submittals.

#### 1.7 SCHEDULE

- A. The Construction Progress Schedule and reports shall be prepared and submitted to Engineer in accordance with the Construction Progress Schedule requirements per Section 01 32 16 – Baseline and Progress Schedules.

#### 1.8 SAMPLES

- A. Whenever in the Specifications samples are required, submit not less than 3 samples 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 a minimum of 21 days 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 delays in the Work.
- C. Individually and indelibly label and tag all samples, indicating thereon all specified physical characteristics and Manufacturer's name for identification. Upon receiving acceptance of Engineer, one set of the samples will be stamped, dated, and returned. Another set of samples will be retained by Engineer, and set of samples will remain at the Project site until completion of the Work.
- D. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in Contract time or Price, clearly indicate same on the transmittal page of the submittal.

## 1.9 SURVEY DATA

- A. Make available for examination throughout the construction period, all field books, notes, and other data developed while performing the surveys required by the Work and submit all such data to Engineer with documentation required for final acceptance of the Work.

## 1.10 UTILITY INVESTIGATION

- A. Submit the findings of the utility investigation in accordance with Section 01 71 50 – Protection and Restoration of Existing Facilities.

## 1.11 QUALITY ASSURANCE/QUALITY CONTROL PLAN

- A. Prepare and submit a Quality Assurance/Quality Control Plan for the Work contained in the Contract in accordance with Section 01 45 00 – Quality Control.

## 1.12 DAILY REPORT

- A. Submit to the Engineer, or designee, a daily report. Deliver report not later than 9:00 A.M. of the work day following the report date and include the following:
  - 1. Day of week, date, Contractor name and Report number.
  - 2. Summary of work in process (segregated by Contractor and Subcontractor).
  - 3. Details of work accomplished including quantities of Work installed.
  - 4. Summary of equipment working and where working.
  - 5. Summary of manpower by work element and Subcontractor.
  - 6. Receipt of major equipment or materials.
  - 7. All required testing performed and, if available, documented results.

## 1.13 OPERATIONS AND MAINTENANCE MANUAL

- A. Submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the *Operations and Maintenance Manual*. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff.
- B. The initial submittal of the *Operations and Maintenance Manual* shall be furnished to Engineer upon delivery of the respective equipment.
- C. The *Operations and Maintenance Manual* shall be subdivided first by specification section number; second, by equipment item; and last, by "Part." "Parts" shall conform to the following (as applicable):
  - 1. Part 1 – Equipment Summary:
    - a. Summary: A summary table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
    - b. Form: The Contractor will supply an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the Work. Fill in the relevant information on the form and include it in Part 1.
  - 2. Part 2 – Operational Procedures:
    - a. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:



- 1) Installation
  - 2) Adjustment
  - 3) Startup
  - 4) Location of controls, special tools, equipment required, or related instrumentation needed for operation
  - 5) Operation procedures
  - 6) Load changes
  - 7) Calibration
  - 8) Shutdown
  - 9) Troubleshooting
  - 10) Disassembly
  - 11) Reassembly
  - 12) Realignment
  - 13) Testing to determine performance efficiency
  - 14) Tabulation of proper settings for all pressure relief valves, low and high- pressure switches, and other protection devices
  - 15) List of all electrical relay settings including alarm and contact settings
  - 16) Lubrication.
3. Part 3 – Preventive Maintenance Procedures:
    - a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.
    - b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.
  4. Part 4 – Parts List:
    - a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
    - b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.
  5. Part 5 – Wiring Diagrams:
    - a. Diagrams: Part 5 shall include complete internal and connection wiring diagrams for electrical equipment items.
  6. Part 6 – Shop Drawings:
    - a. Drawings: This part shall include approved shop or fabrication drawings, complete with dimensions.
  7. Part 7 – Safety:
    - a. Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.
  8. Part 8 – Documentation:
    - a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.
- D. Furnish to Engineer 4 identical *Operations and Maintenance Manuals*. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not

exceed 2.5 inches. Prepare a table of contents indicating all equipment in the manuals. Display the title of each volume on the cover and spine.

- E. *Operations and Maintenance Manuals* shall be submitted in final form not later than the 75 percent of construction completion date. All discrepancies found by Owner or Engineer in the *Operations and Maintenance Manual* shall be corrected within 30 days from the date of written notification.
- F. Incomplete or unacceptable *Operations and Maintenance Manuals* at the 75 percent construction completion point shall constitute sufficient justification to withhold the amount stipulated in paragraph " *Operations and Maintenance Manual Submittals*" of Section 01 70 10 – Project Closeout, from any monies due.

#### 1.14 SPARE PARTS LIST

- A. Furnish to Engineer 5 identical sets of spare parts information for all mechanical, electrical, and instrumentation equipment. Include the current list price of each spare part. Limit the spare parts list to those spare parts which each manufacturer recommends be maintained by Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate Owner in ordering. Cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. Bind the spare parts lists in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

#### 1.15 RECORD DOCUMENTS

- A. Prepare and maintain one set of record documents at the Project Site per the requirements of Section 01 78 39 – Project Record Documents.

#### 1.16 SAFETY PROGRAM

- A. Prepare and submit safety plans, programs, and permits to Engineer in accordance with the provisions of Section 01 31 30 – Safety.
- B. Engineer's receipt of any safety plans, programs or permits will not relieve Contractor in any way from the full and complete responsibility for safety.

#### 1.17 REQUESTS FOR INFORMATION

- A. In the event that Contractor, Subcontractor or supplier, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation by Owner, submit a Request for Information in writing to Engineer. Requests for Information shall only be submitted on the Request for Information form provided by Engineer. Clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from Owner. In the Request for Information, indicate the interpretation or understanding of the requirement along with reasons for such an understanding.

- B. Engineer will review all Requests for Information to determine whether they are Requests for Information within the meaning of this term. If Engineer determines that the document is not a Request for Information it will be returned, unreviewed as to content, for resubmittal on the proper form and in the proper manner.
- C. Responses from Engineer will not change any requirement of the Contract Documents unless so noted by Engineer in the response to the Request for Information. In the event that a response to a Request for Information is believed to cause a change to the requirements of the Contract Documents, immediately give written notice to Engineer stating why this is believed to be true. Failure to give such written notice immediately shall waive any right to seek additional time or compensation under the Contract.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

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## REQUEST FOR INFORMATION

**RFI No:** \_\_\_\_\_

**Project No:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Project:** \_\_\_\_\_

**Owner:** \_\_\_\_\_

**Engineer:** \_\_\_\_\_ **Construction Mgr:** \_\_\_\_\_

**Contractor:** \_\_\_\_\_ **Contractor PM:** \_\_\_\_\_

**Subject:** \_\_\_\_\_

**Drawing No:** \_\_\_\_\_ **Specification Sect:** \_\_\_\_\_

### Contractor's Request for Information (RFI)

Contractor's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

### Engineer's Response

Engineer's Signature: \_\_\_\_\_

Date: \_\_\_\_\_





# BOWEN COLLINS & ASSOCIATES

## CONTRACTOR SUBMITTAL

<b>Submittal Number</b>	
<b>Specification Section</b>	
<b>Area/Phase</b>	
<b>Requested Priority (1, 2, or 3)</b>	

Owner: \_\_\_\_\_  
Construction Mgr: \_\_\_\_\_

Project: \_\_\_\_\_  
Project Number: \_\_\_\_\_

CONTRACTOR	
Contractor: _____	
Address: _____	
Contact: _____	
Phone: _____	
Date Submitted: _____	
No. of Copies Submitted: _____	
Supplier: _____	
Specification Paragraph	Description
<input type="checkbox"/> Electronic Copy Enclosed	
<input type="checkbox"/> Contractor has verified that the materials or equipment contained in this submittal meet all requirements specified or shown (no exceptions).	
<input type="checkbox"/> Contractor has verified that the material or equipment contained in this submittal meets all the requirements specified or shown, except for the following deviations (list deviations below):	

DESIGN ENGINEER
Engineer: <u>Bowen, Collins and Associates</u>
Address: <u>154 East 14000 South</u>
<u>Draper, Utah 84020</u>
Contact: _____
Phone: <u>(801) 495-2224</u>
Date Returned: _____
No. of Copies Returned: _____
<input type="checkbox"/> See Attached Sheet(s) for Review Comments
<b>Action Taken</b>
<input type="checkbox"/> <b><u>NAT</u></b> No Action Taken – Record Submittal Only
<b><u>No Resubmittal Required</u></b>
<input type="checkbox"/> <b><u>NET</u></b> No Exceptions Taken
<input type="checkbox"/> <b><u>MCN</u></b> Make Corrections Noted
<b><u>Resubmittal Required</u></b>
<input type="checkbox"/> <b><u>RAR</u></b> Revise and Resubmit
<input type="checkbox"/> <b><u>RR</u></b> Rejected - Resubmit
Corrections or comments made on submittals during review do not relieve the Contractor from compliance with Contract Drawings and Specifications. Review is for conformance to the design concept and general compliance with the Contract Documents only. The Contractor is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating Work with the trades, and satisfactory and safe performance of the Work.

Contractor Authorized Representative Signature \_\_\_\_\_ Date \_\_\_\_\_

Reviewing Engineer Signature \_\_\_\_\_ Date \_\_\_\_\_

Requested Priority Legend (Engineer will attempt to meet these goals):

- 1: Highest priority -- as fast as possible.
- 2: Moderate priority -- 10 day target
- 3: Low priority -- 21 day turnaround per contract

Project Manager Signature \_\_\_\_\_ Date \_\_\_\_\_

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## **SECTION 01 35 53 SECURITY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Protect the active construction areas of the Work, including all material, equipment, field office trailers, and their contents from theft, vandalism, and unauthorized entry.
- B. This may include night guards, project area patrols, fencing and gates, alarm systems, intrusion detection systems, and any other methods and means to protect project facilities against damage or theft.

#### **1.2 DEFINITIONS**

- A. For the purposes of this Section, an “active construction area” is any area where construction activities are occurring or construction activities could be considered a potential hazard to people.

#### **1.3 RELATED SECTIONS**

- A. Section 01 57 19 – Temporary Environmental Controls

#### **1.4 SUBMITTALS**

- A. Prior to performance of any work at the Project Site, submit to Engineer for record only, two copies of the security plan commensurate with the needs of the Project, signed by officer of Contractor. Be solely responsible for adequacy of the security plan.
- B. Provide Engineer with drawing and data showing temporary fencing and gate locations, along with materials to be used.
- C. Provide Engineer with a list of 24-hour emergency phone numbers for Contractor personnel.
- D. Submit to Engineer an updated progressive inventory of materials and equipment received on-site.
- E. Submit log of workmen and visitors to Project Site.

#### **1.5 SECURITY PROGRAM**

- A. Protect Work and existing premises, including the field office trailers and their contents, from theft, vandalism, and unauthorized entry during working and non-working hours.
- B. Accept sole responsibility for Project Site security and protection of the Work.
- C. Initiate the security program at job mobilization and maintain the security program throughout construction period.

- D. Limit lighting to basic safety and security requirements, and shield when possible.
- E. Be responsible for the security of storage compound and lay down area, and for all plant material, equipment, and tools at all times.
- F. Prohibit firearms for the Project Site.
- G. Erect and maintain temporary security fencing as required to protect the Work, the Project Site, and existing facilities on the Project Site. The location of all temporary security fencing shall be approved in advance by Engineer.
  - 1. Fence Height: 6 feet
  - 2. Fence Material: Galvanized chain link, including barbed wire, equal in function to permanent site security fence.

#### 1.6 ENTRY CONTROL

- A. Entry control shall not unreasonably limit the personnel of Owner, Engineer, and their operations and maintenance groups from performing assigned duties. Temporary access limitations will be identified to Engineer and the operations and maintenance groups at least 24 hours prior to such limitation.
- B. Restrict entry of unauthorized persons and vehicles into Project Site.
- C. Allow entry only to authorized persons with proper identification.
- D. Maintain a log of workmen and visitors and make log available to Owner on request. This log shall be submitted to Engineer biweekly or as necessary.
- E. Require all visitors to sign the visitor log acknowledgment of the project rules included in this Section. A copy of the project rules shall be given to each visitor. Submit copies of these forms to Engineer biweekly.
- F. Contractor has the right to refuse access to the Project Site or require that a person or vehicle be removed from the Project Site if found violating any of the project rules.
- G. Give jobsite security orientation training to all affected employees, including subcontractor employees. Employee participation in the security orientation shall be acknowledged by their respective individual signatures affixed to an orientation roster.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 41 26**  
**PERMITS**

**PART 1 - GENERAL**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- A. Obtain permits required for the execution of Work in accordance with the Contract Documents. Provide copies of these permits to Owner.
- B. The intent of this Section is to furnish the known list of required permits for the Work under the Contract Documents. Owner does not guarantee that this list is complete. Be responsible for determining and verifying the extent of all permits required and for obtaining such permits.
- C. In the Bid Price, include costs for obtaining all necessary permits, including application fees and other costs, and the costs of complying with the conditions of all permits. Any fees listed in this section are estimates and are for information only. Verify and pay all actual fees.
- D. Within 30 Days of the Limited Notice to Proceed, submit a list of all permits and licenses to be obtained, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.

**1.2 SUMMARY OF PERMITS TO BE OBTAINED BY CONTRACTOR**

- A. Obtain the following permits. Submit copies of these permits to Engineer and maintain copies on-site. Comply with all conditions of the permits.
  - 1. Salt Lake Valley Health Department Bureau of Air Pollution Control Dust Control:
    - a. Dust Permit: The dust permit application requires a description of proposed dust control measures. The permit will include a number of conditions, including agreement to suspend all or part of the permitted activities if satisfactory control of airborne particulates cannot be obtained, attendance at a dust control class, and possibly posting of a bond to assure performance of permit conditions. Under all circumstances, comply with all mitigation requirements for dust control indemnify Owner against any and all liability arising out of this responsibility and for any and all Salt Lake Valley Health Department Bureau of Air Pollution imposed fines which may be assessed to the Project for violating the Dust Control Permit.
      - 1) Agency: Bureau of Air Pollution Control, Salt Lake Valley Health Department
      - 2) Contact Person: Joshua Greer - Environmental Health Specialist
      - 3) Telephone No.: (801) 313-6724
      - 4) Fax No.: (801) 313-6676
  - 2. Utah Occupational Safety and Health Administration:
    - a. Construction Permit: Covers worker safety and health for all project features.
  - 3. Utah Department of Environmental Quality, Division of Water Quality:
    - a. UPDES General Permit for Construction Dewatering/Hydrostatic Testing of Pipelines: Covers discharge waters associated with dewatering operations and hydrostatic testing of pipelines and tanks.

- 1) Agency: Utah Department of Environmental Quality, Division of Drinking Water
- 2) Contact Person: Harry Campbell
- 3) Telephone No.: (801) 538-6923
- 4) Email: [hcampbell@utah.gov](mailto:hcampbell@utah.gov)
- b. Notification of Chlorinated Water Discharge: This notification provides 30 days notice prior to disinfection of pipeline and discharge of pipeline and discharge of chlorinated water.
4. Utah Division of Environmental Protection, General Storm Water Permit for Construction Activities:
  - a. As a condition of contract award, sign a certification of agreement to comply with the terms and conditions of the permit. Permit not required if area of disturbance is less than one acre. Requires preparation of Storm Water Pollution Prevention Plan (SWPPP).
  - b. Construction work shall be conducted in accordance with SWPPP and/or NOI requirements. Inspections shall be completed per the requirements of the SWPPP and/or NOI. All inspections shall be documented and made available via the online SWPPP management system. Regular review of the online SWPPP management system and inspections will be completed by the Public Utilities Department to confirm that construction work is being performed in accordance with SWPPP, NOI, and UGCP requirements. Review and inspection reports completed by the Sandy City Public Utilities Department will be provided to the Contractor which are to be posted to the online SWPPP management system. All identified violations are to be addressed and documented on the online SWPPP management system.
  - c. Agency and Contact Person:
    - 1) Agency: Utah Department of Environmental Quality, Division of Drinking Water
    - 2) Contact Person: Tom Rushing
    - 3) Address: 288 North 1460 West (Cannon Building) 3rd Floor, PO Box 144870, Salt Lake City, Utah 84114-4870
    - 4) Telephone No.: (801) 538-6951
    - 5) Email: [trushing@utah.gov](mailto:trushing@utah.gov)
5. West Jordan City Development Services, Building and Safety Division
  - a. Building Permit: Permit is for construction in West Jordan City. A Traffic Control Plan will be required with this permit.
    - 1) Agency: West Jordan City Development Services, Building and Safety Division
    - 2) Contact: Doug Rolfe
    - 3) Address: 8000 South Redwood Road, West Jordan, Utah 84088
    - 4) Telephone No. (801) 569-5050
  - b. The Contractor will pay the fee to West Jordan City Development Services for the Building Permit. The Owner (Jordan Valley Water Conservancy District) will reimburse the Contractor for the permit fee using the allowance included in the bid. All other costs associated with obtaining this permit and the other permits listed in this section are the responsibility of the Contractor.
6. West Jordan City Engineering Department
  - a. Land Disturbance Permit: This permit covers clearing, grubbing and excavation within the City

- 1) Agency: West Jordan City Engineering Department
- 2) Contact: Nate Nelson
- 3) Address: 8000 South Redwood Road, West Jordan, Utah 84088
- 4) Telephone No. (801) 569-5127
- 5) Email: naten@wjordan.com

### 1.3 SUMMARY OF PERMITS OBTAINED BY OWNER

A. The following permits have been or will be obtained by Owner for this Project. Verify and comply with conditions of said permits.

1. Utah Department of Environmental Quality, Division of Drinking Water
  - a. Project Notification Form and Plan Review/Construction Approval
    - 1) Agency: Utah Department of Environmental Quality, Division of Drinking Water
    - 2) Contact Person: Nathan Lunstad
    - 3) Telephone No.: (801) 536-0039
    - 4) Email: nlunstad@utah.gov
2. West Jordan City Development Services, Planning and Zoning
  - a. Site Plan Approval for improvements to City property.
    - 1) Agency: West Jordan City Development Services, Planning and Zoning
    - 2) Contact Person: Megan Jensen
    - 3) Address: 8000 South Redwood Road, West Jordan, Utah 84088
    - 4) Telephone No.: (801) 569-5182

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

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**SECTION 01 42 13**  
**ABBREVIATIONS OF INSTITUTIONS**

**PART 1 - GENERAL**

**1.1 GENERAL**

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

**1.2 ABBREVIATIONS**

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National 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
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLSI	Clinical and Laboratory Standards Institute
CRSI	Concrete Reinforcing Steel Institute
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Power Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers



IES	Illuminating Engineering Society
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NLGI	National Lubricating Grease Institute
NSF	NSF International
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers

SAMA	Scientific Apparatus Makers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPR	Simplified Practice Recommendation
SSPC	Society for Protective Coatings
SSPWC	Standard Specifications for Public Works Construction
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories, Inc.
WEF	Water Environment Federation
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association
WWPA	Western Wood Products Association (WWPA)

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Titles of Sections and Paragraphs: Captions accompanying Specification Sections and Paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- 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, Specification text 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 with no choice or option. These requirements 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, accept the final responsibility for fulfillment of the entire set of contract requirements.

**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 applicable codes and the applicable requirements of the following documents.
- B. References herein to "Building Code", "Plumbing Code", "Mechanical Code", "Fuel Gas Code", or "Fire Code" shall mean the latest adopted version of the International Building Code (IBC), the International Plumbing Code (IPC), the International Mechanical Code (IMC), the International Fuel Gas Code (IFGC), and the International Fire Code (IFC) as published by the International Code Council (ICC). Similarly, references to the "Uniform Mechanical Code" or the "Uniform Plumbing Code" shall mean the Uniform Mechanical Code or the Uniform Plumbing Code as published by the International Association of Plumbing and Mechanical Officials (IAPMO). References to the "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of any "building" code as approved by the Municipal Code and adopted by the authority 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 Documents, the most stringent requirements shall govern. Bring all conflicts to the attention of Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. Bid the most stringent requirements.
  - D. Construct the Work indicated herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.
  - E. Applicable Standard Specifications: References in the Contract Documents to the "Standard Specifications" shall mean the *Manual of Standard Specifications* (APWA), latest version.
  - 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 all changes and amendments thereto.
  - H. References herein to "UDOT Standards" shall mean *Standard Specifications for Road and Bridge Construction*.
  - I. References herein to "MSHA Standards" shall mean *Mine Safety and Health Administration Standards*, latest version.
- 1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS
- A. Be responsible that all Work included in the Contract Documents, regardless if shown or not, complies with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.
  - B. Where no specific regulations exist, all chemical, hazardous, and petroleum product piping and storage in underground locations must be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by Owner.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 45 00**  
**QUALITY CONTROL**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The requirements of this Section apply to, and are a component part of, each Section of the Specifications.
- B. The Contractor is fully responsible for quality control.
- C. If any inspection demonstrates non-compliance with the Contract Documents, the Owner will provide for one re-inspection of this work at no cost to the Contractor. Subsequent re-inspections will be done at the Contractor's expense.
- D. The Owner, at the Owner's expense, shall provide for materials quality assurance testing for earthfill and concrete materials. Owner inspection and testing are for the sole benefit of the Owner and do not:
  - 1. Relieve the Contractor of responsibility for providing adequate quality control measures;
  - 2. Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;
  - 3. Constitute or imply acceptance; or
  - 4. Affect the continuing rights of the Owner after acceptance of the completed work.
- E. The Engineer retains right to direct more control testing, if in Engineer's opinion work is not being adequately controlled.
- F. The Engineer also retains right to accept or reject material or work based upon Contractor's control testing or the Owner's control testing.
- G. All material shall be new and of the specified quality and equal to the accepted samples, if samples have been submitted. All work shall be done and completed in a thorough, workmanlike manner, notwithstanding any omission from these Contract Documents; and it shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instructions before proceeding with the work. The Engineer may, by appropriate instructions, correct errors and supply omissions, which instructions shall be as binding upon the Contractor as though contained in the original Contract Documents.
- H. At the option of the Engineer, 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. Give the Engineer written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin. 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 re-inspection at the site of the work.
- I. Materials which will require testing and inspection at the place of origin shall not be shipped prior to such testing and inspection.

## 1.2 REFERENCES

### A. ASTM International (ASTM) standards, most recent editions:

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

## 1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Submit Quality Control Plan.
- C. Submit credentials for field Quality Control Representative showing experience acceptable to Engineer.
- D. Submit credentials for testing laboratory showing compliance with Specifications and acceptable to Engineer.
- E. Submit results of testing as specified below.

## 1.4 SITE INVESTIGATION AND CONTROL

- A. Check and verify all dimensions and conditions in the field continuously during construction. Be solely responsible for any inaccuracies built into the Work due to Contractor's (including Subcontractor's) failure to comply with this requirement.
- B. Inspect related and appurtenant Work and report in writing to Engineer, any conditions which will prevent proper completion of the Work. Failure to report any such conditions constitutes acceptance of all Site conditions. Required removal, repair, or replacement caused by unsuitable conditions shall be performed at no additional cost to Owner.
- C. Vibration Monitoring: The Owner may conduct seismic vibration monitoring adjacent to the work site during construction. The Contractor is responsible to request vibration monitoring from the Engineer. It shall be the Contractor's responsibility to manage or modify construction methods as necessary to prevent damage to adjacent structures and residences. In the event that vibration levels are observed to approach damaging threshold levels, the Contractor shall stop work immediately and implement controls to mitigate vibration from construction equipment. No additional time shall be provided for delays caused by excessive vibration problems.

## 1.5 INSPECTION OF THE WORK

- A. Inspect all Work performed by the both Contractor and Subcontractors. Nonconforming Work and any safety hazards in the work area shall be noted and promptly corrected. Be responsible for the Work to be performed safely and in conformance with the Contract Documents.
- B. The Work shall be conducted under the general observation of Engineer and is subject to inspection by representatives of Owner acting on behalf of Owner to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. Owner, Engineer, or any inspector(s) shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.
- C. The presence of Engineer, or any inspector(s), shall not relieve Contractor of responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of Contractor. No act or omission on the part of Engineer, or any inspector(s) shall be construed as relieving Contractor of this responsibility. Inspection of Work later determined to be nonconforming shall not be cause or excuse for acceptance of the nonconforming Work. Owner may accept nonconforming Work when adequate compensation is offered and it is in Owner's best interest as determined solely by Owner.
- D. All materials and articles furnished shall be subject to rigid documented inspection by qualified personnel. No materials or articles shall be used in the Work until they have been inspected and accepted by Contractor's Quality Control Representative and Engineer or other designated representative. No Work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected. Any Work covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection.
- E. All Owner furnished materials and articles shall be subject to rigid inspection by Contractor's Quality Control Representative before being used or placed in the Work. Inform Engineer, in writing, of the results of said inspections within one working day after completion of inspection. In the event that any material or articles provided by Owner are considered to be of insufficient quality for use in the Work, immediately notify Engineer.

## 1.6 TIME OF INSPECTION AND TESTS

- A. Furnish and prepare samples and test specimens required under these Specifications and for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Furnish and prepare all required test specimens without additional expense to Owner. As provided in the Contract Documents, performance of certain tests will be by Owner, and all costs therefore will be borne by Owner, except that the costs of any test, which shows unsatisfactory results shall be back charged to Contractor.
- B. Notify Engineer at least three Work Days before being ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract and request inspection before

beginning any such Work of covering. Failure to notify Engineer at least three Work Days in advance of any such inspections shall be reasonable cause for Engineer to order a sufficient delay in scheduled operations to allow time for such inspection. Be responsible for costs of any remedial or corrective work required, and all costs of such delays, including its impact on other portions of the Work.

#### 1.7 SAMPLING AND TESTING

- A. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, Engineer reserves the right to use any generally-accepted system of inspection which, in the opinion of Engineer, will ensure Engineer that the quality of the workmanship is in full accord with the Contract Documents.
- B. Owner reserves the right to waive tests or quality control measures. However, waiver of any specific testing or other quality control measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality control requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, Owner reserves the right to make independent investigations and tests as specified in the following paragraph and failure of any portion of the Work to meet qualitative requirements of the Contract Documents shall be reasonable cause for Owner to require the removal or correction and reconstruction of any such Work.
- D. In addition to any other inspection or quality control provisions that may be specified, Owner reserves the right to independently select, test, and analyze, at the expense of Owner, additional test specimens of any or all of the materials to be used. Results of such additional tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by Contractor.

#### 1.8 RIGHT OF REJECTION

- A. Engineer or designated representative, acting for Owner, reserves the right at all times and places to reject any articles or materials furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the Site. If Engineer or designated representative, through an oversight or otherwise, has accepted materials or Work which are defective or in any way contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected.



- B. Promptly remove or replace rejected articles or materials from the Site of the Work after notification of rejection.
- C. Bear all costs of removal and replacement of rejected articles or materials.
- D. Failure to promptly remove and replace rejected Work shall be considered a breach of this Contract and Owner may, after 7 days' notice, terminate Contractor's right to proceed with the affected Work and remove and replace the Work and issue a backcharge to cover the cost of the Work.

#### 1.9 QUALITY CONTROL REQUIREMENTS

- A. Establish and execute a Quality Control program for the services, which are being provided. The program shall provide adequate measures for verification and conformance to defined requirements of all personnel, including lower-tier subcontractors (including fabricators, suppliers, and sub-subcontractors). Prepare and submit a plan responsive to this Section for review by Engineer.
- B. Furnish Engineer with a project specific Quality Control Plan. The plan shall contain a comprehensive account of quality control procedures applicable to this Project. The detailed requirements for this Plan are delineated in the following paragraphs. No progress payments will be made until the Quality Control Plan is fully accepted by Engineer.
- C. Using the Quality Control Plan, describe and define the personnel requirements described herein. Provide personnel with assigned quality control functions reporting to a field Quality Control Representative. The field Quality Control Representative shall report to a senior manager of Contractor and shall not have supervisory or managerial responsibility over the work force. Persons performing quality control functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions. Contractor's Quality Control representative(s) shall be on-site as often as necessary (but not less than the daily hours specified in the Contract Documents) to remedy and demonstrate that Work is being performed properly and to make multiple observations of all Work in progress. The Quality Control Plan shall include a statement by the senior manager designating the Quality Control Representative and specifying authorities delegated to the Quality Control Representative to direct cessation or removal and replacement of defective Work.
- D. The Quality Control Plan shall ensure the achievement of adequate quality throughout all applicable areas of the contract. In the Quality Control Plan, describe the program and include procedures, work instructions and records. In addition, describe methods relating to areas that require special testing and procedures as noted in the Specifications.
- E. Identification and Control of Items and Materials: Describe procedures in the Quality Control Plan to ensure that items or materials that have been accepted at the site are properly used and installed. Provide procedures for proper identification and storage, and to prevent the use of incorrect or defective materials.
- F. Inspection and Tests: Provide written procedures defining a program for control of inspections performed. These procedures shall be described in the Quality Control Plan.

1. Inspections and tests shall be performed and documented by qualified individuals. At a minimum, "qualified" shall mean having performed similar quality control functions on similar type projects. Records of personnel experience, training and qualifications shall be maintained and made available for review by Engineer upon request.
2. Maintain and provide to Engineer, within two working days of completion of each inspection and test, adequate records of all such inspections and tests. Inspection and test results shall be documented and evaluated to ensure that requirements have been satisfied.
3. Procedures shall include:
  - a. Specific instructions defining procedures for observing all Work in process and comparing this Work with the Contract requirements (organized by specification section).
  - b. Maintaining and providing Daily Inspection Reports. Such reports shall, at a minimum, include the following:
    - 1) Item(s) inspected
    - 2) Quality characteristics in compliance
    - 3) Quality characteristics not in compliance
    - 4) Corrective/remedial actions taken
    - 5) Statement of certification
    - 6) QC Manager's signature
  - c. Specific instructions for recording all observations and requirements for demonstrating through the reports that the Work observed was in compliance or a deficiency was noted and action to be taken.
  - d. Procedures to preclude the covering of deficient or rejected Work.
  - e. Procedures for halting or rejecting Work.
  - f. Procedures for resolution of differences between the Quality Control Representative(s) and the production representative(s).
4. The Quality Control Plan shall identify all contractual hold/inspection points as well as any Contractor imposed hold/inspections points.
5. The Quality Control Plan shall include procedures to provide verification and control of all testing provided, including:
  - a. Maintaining and providing to Engineer Daily Testing Records. Such records shall, at a minimum, contain the following:
    - 1) Item(s) tested
    - 2) Quality characteristics in compliance
    - 3) Statement of correctness & certification
    - 4) Quality characteristics not in compliance
    - 5) Corrective/remedial actions taken
    - 6) QC Manager's signature
  - b. Individual test records will contain the following information:
    - 1) Item tested –item number and description
    - 2) Test results
    - 3) Test designation
    - 4) Test work sheet including location sample was obtained
    - 5) Acceptance or rejection
    - 6) Date sample was obtained
    - 7) Retest information, if applicable
    - 8) Control requirements
    - 9) Tester signature

- 10) Testing QC staff initials
  - c. Providing for location maps for all tests performed or location of Work covered by the tests.
  - d. Maintaining copies of all test results.
  - e. Ensuring Engineer receives independent copy of all tests.
  - f. Ensuring testing lab(s) are functioning independently and in accordance with the specifications.
  - g. Ensuring re-tests are properly taken and documented.
- G. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated, and adjusted to maintain accuracy within prescribed limits. Perform calibration at specified periods against valid standards traceable to nationally recognized standards and documented.
- H. Supplier Quality Assurance: The Quality Control Plan shall include procedures to ensure that procured products and services conform to the requirements of the Contract Documents. Requirements of these procedures shall be applied, as appropriate, to lower-tier suppliers and/or Subcontractors.
- I. Deficient and Nonconforming Work and Corrective Action: The Quality Control Plan shall include procedures for handling of deficiencies and non-conformances. Deficiencies and non-conformances are defined as documentation, drawings, material, equipment, and Work not conforming to the specified requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
  1. Personnel responsible for identifying deficient and non-complying items within the work.
  2. How and by whom deficient and non-compliant items are documented "in the field".
  3. The personnel and process utilized for logging deficient and non-compliant work at the end of each day onto a Deficiency Log.
  4. Tracking processes and tracking documentation for deficient and non-compliant items.
  5. Personnel responsible for achieving resolution of outstanding deficiencies.
  6. Once resolved, how are the resolutions documented and by whom.
- J. Special Processes and Personnel Qualifications
  1. The Quality Control Plan shall include detailed procedures for the performance and control of special process (e.g. welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
  2. Personnel performing special process tasks shall have the experience, training and certifications commensurate with the scope, complexity, or nature of the activity. They shall be approved by Engineer before the start of Work on the Project.
- K. Audits: The Quality Control Plan shall provide for documented audits to verify that quality control procedures are being fully implemented by Contractor as well as its subcontractors. Audit records shall be made available to Engineer upon request.

- L. Documented Control/Quality Records
  - 1. Establish methods for control of Contract Documents, which describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. The methods shall also describe how as-built data are documented and furnished to Engineer.
  - 2. Maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.
  - 3. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction.
  - 4. Provide a list with specific records as specified in the Contract Documents, which will be furnished to Engineer at the completion of activities.
- M. Acceptance of Quality Control Plan: Engineer's review and acceptance of the Quality Control Plan shall not relieve Contractor from any of its obligations for the performance of the Work. Contractor's quality control staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, without cause, may direct Contractor to remove and replace the Quality Control Representative. No Work covered by the Quality Control Plan shall start until Engineer's acceptance of the Quality Control Plan has been obtained.
- N. Engineer may perform independent quality assurance audits to verify that actions specified in the Quality Control Plan have been implemented. No Engineer audit finding or report shall in any way remove any requirements of this Contract.

#### 1.10 COLD WEATHER CONSTRUCTION PLAN AND SUBMITTAL

- A. As a key component of the Quality Control Plan, the Contractor shall prepare and submit a written Cold Weather Construction Plan, and obtain Engineer authorization for the same, for all Work required, or proposed, to be done when air, ground, or materials temperatures are below 35 degrees Fahrenheit.
- B. The Cold Weather Construction Plan shall detail the special materials, precautions, procedures and techniques, the Contractor will employ to assure cold weather construction will comply with the quality standards specified for the Work at higher temperatures. The Cold Weather Construction Plan shall integrate all relevant manufacturer recommendations as well as industry recommended practices, such as ACI guidelines for cold weather concreting.
- C. The Cold Weather Construction Plan must be authorized by the Engineer prior to performing construction, which in the opinion of the Engineer, could be adversely affected by cold temperatures.

#### 1.11 TESTING SERVICES

- A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians,

properly equipped and fully qualified to perform the tests in accordance with the specified standards.

- B. Independent testing laboratory shall be accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests they will perform and as appropriate for the Work being performed. The laboratory shall also be accredited under ASTM C1077, ASTM D3740, and ASTM D3666.
- C. Engineer shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the independent testing laboratory's internal quality assurance records (quality assurance manual, equipment calibrations, proficiency sample performance, etc.).
- D. Obtain Engineer's acceptance of the testing firm before having services performed. Pay all costs for these testing services.
- E. Testing services provided by Owner, if any, are for the sole benefit of Owner. However, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.
- F. Testing Services furnished by Contractor: Unless otherwise specified, and in addition to all other specified testing requirements, provide all testing services in connection with the following materials as required for Engineer's review:
  - 1. Concrete materials and mix designs. Qualification testing for mix designs, for cement, aggregates and concrete, including preliminary and trial batch concrete strength and shrinkage testing.
  - 2. Embankment, fill, and backfill materials qualification testing.
  - 3. Quality control testing of all precast concrete.
  - 4. All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work.
  - 5. In addition, the following quality control tests shall be performed by Contractor:
    - a. Holiday testing of pipeline coatings.
    - b. Air testing of field-welded joints for steel pipe or pipe cylinders and fabricated specials.
    - c. All testing and inspection of welding work including, but not limited to, welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate nondestructive testing of welds and all repair and retest of weld defects.
- G. Testing Services furnished by Owner: Unless otherwise specified, Owner will provide quality control testing services in connection with the following materials and equipment incorporated in the Work;
  - 1. Concrete strength tests.
  - 2. Moisture-density and relative density tests on embankment, fill, and backfill materials.
  - 3. In-place field density test on embankments, fills, and backfill.
  - 4. Other materials and equipment as specified herein.

5. Testing, including sampling, shall be performed by Engineer or testing firm's laboratory personnel, in general manner and frequency indicated in the Specifications.
  6. Furnish all sample materials and cooperate in the testing activities, including sampling. Interrupt the Work when necessary to allow testing, including sampling to be performed. There shall be no claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by the testing firm's laboratory personnel, furnish personnel and facilities to assist in the activities.
  7. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test. Distribution of the reports shall be as directed by Engineer.
- H. Transmittal of Test Reports: Written reports of tests and engineering data furnished for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted per Section 01 33 20 Contractor Submittals.
- I. The testing firm retained for material field testing shall furnish a minimum of five copies of written report of each test. Three copies of each test report will be transmitted to Engineer within three Work Days after each test is completed. Consecutively number each report for each type of test.
- J. Testing firm shall furnish one copy of each field and laboratory quality control test to Contractor.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 50 10  
SITE ACCESS AND STORAGE**

**PART 1 - GENERAL**

**1.1 REFERENCES**

- A. U.S. Dept. of Transportation, Federal Highway Administration (FHWA) standards.  
MUTCD                                      Manual of Uniform Traffic Control Devices
- B. U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA) standards.  
Subpart G, Part 1926                      Safety and Health Standards for Construction

**1.2 SUBMITTALS**

- A. Provide design and engineering calculations for custom temporary bridges or steel plates to be employed.
- B. Submit hazardous materials storage plan.
- C. Submit the EPA issued number for wastes generated at the site.

**1.3 CONSTRUCTION SITE ACCESS**

- A. All construction access to the site shall be via the proposed access point shown on Drawing C-01. This is the only permitted access to the site. Due to high traffic volume on 6200 South, truck access to the site is generally restricted to right turn in, right turn out movements.
- B. The Contractor is responsible for maintaining the access road to the site throughout the construction period. The Contractor shall prepare the subgrade and install road base in order to stabilize the road for use during construction. Access road maintenance includes snow removal during the winter.

**1.4 ROADWAY AND TRAFFIC LIMITATIONS**

- A. Investigate the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. Comply with the provisions specified in the Traffic Management Plan. Accept responsibility to construct and maintain any haul roads required for construction operations.
- B. Maintain a maximum speed limit of 15 mph while on the Project Site.
- C. Confine all vehicles to the designated construction area. Cross-country travel is prohibited.

## 1.5 TEMPORARY CROSSINGS

- A. General: Provide continuous, unobstructed, safe, and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Provide safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300 feet. Cooperate with parties involved in the delivery of mail and removal of trash and garbage to maintain existing schedules for such services. Maintain vehicular access to residential driveways to the property line except when necessary construction precludes such access for reasonable periods of time.
- B. Temporary Bridges: Wherever necessary, provide suitable temporary bridges or steel plates over unfilled excavations, except where written consent of the individuals or authorities concerned to omit such temporary bridges or steel plates has been secured. Any such obtained written consent shall be delivered to Engineer prior to excavation. Maintain all such bridges or steel plates in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case. Adopt designs furnished by said authority for such bridges or steel plates, or submit designs to said authority for approval, as may be required. New designs shall be stamped and signed by a professional engineer, licensed to practice in the State which the work is taking place.
- C. Street Use: Nothing herein shall be construed to entitle Contractor to the exclusive use of any public street, alleyway, or parking area during the performance of the Work hereunder. Conduct operations so as not to interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of Engineer and proper governmental authority. Where excavation is being performed in primary streets or highways, maintain one lane in each direction open to traffic at all times unless otherwise indicated. Provide toe boards to retain excavated material if required by Engineer or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.
- D. Traffic Control: For the protection of traffic in public or private streets and ways, provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the MUTCD, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations."
- E. 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. Station such guards or flaggers and 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 OSHA Safety and Health Standards for Construction.



- F. Temporary Street Closure: If closure of any street is required during construction, apply in writing to the authority having jurisdiction at least 30 days in advance of the required closure for signage and detour requirements.
- G. Temporary Driveway Closure: Notify property owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than one eight-hour work day at least three working days prior to the closure. Minimize the inconvenience and minimize the time period that the driveways will be closed. Fully explain to the owner/occupant how long the work will take and when closure is to start.

#### 1.6 WORK AND STORAGE AREA

- A. Owner will designate as indicated in the Contract Documents, and arrange for the Contractor's use, a portion of the property within the easements and property boundaries shown on Drawing C-01 for use during the term of the Contract as a storage and shop area for construction operations on the Work. In general, construction activities are limited to the Owner's property boundaries shown on Drawing C-01. Provide a plan of intended storage/work area use to Engineer.
- B. Make independent arrangements for any necessary off-site storage or shop areas necessary for the proper execution of the Work.
- C. Lands to be furnished by Owner for construction operation and other purposes are indicated. Should it be necessary to use any additional land for staging or for other purposes during the construction of the Work, independently arrange for the use of such lands and pay any required rental or use fees. Unless otherwise shown, specified, or agreed, all sites shall be returned to their original condition or better upon completion of the Work.
- D. Nothing herein shall imply granting an exclusive use of roadways or public and/or private land employed to perform the Work.
- E. Temporary Storage Buildings and Enclosures
  - 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials to be stored therein.
  - 2. Arrange and partition to provide security of contents and ready access for inspection and inventory.
- F. Construct and use a separate storage area with adequate spill containment for hazardous materials used in constructing the Work.
  - 1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
  - 2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.

3. Develop and submit to Engineer a plan for storing and disposing of the materials above.
  4. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.
  5. Hazardous materials which are delivered in containers, shall be stored in the original containers until use. Hazardous materials which are delivered in bulk, shall be stored in containers which meet the requirements of authorities having jurisdiction.
  6. Obtain and submit to Engineer a single EPA number for wastes generated at the site.
  7. The separate storage area shall be inspected by the proper authorities prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.
- G. In the event machinery and equipment need servicing on site, be responsible to clean environmentally hazardous materials from the site immediately.

#### 1.7 PARKING

- A. Provide a level pad sufficient for parking of minimum 7 vehicles. This work will be done within seven days of mobilization at the jobsite.
- B. Parking of construction vehicles is limited to the Owner's property shown on Drawing C-01.
- C. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. Repair breaks, potholes, low areas, which collect standing water, and other deficiencies.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 51 00  
TEMPORARY UTILITIES**

**PART 1 - GENERAL**

1.1 THE REQUIREMENT

- A. The Contractor shall provide temporary utilities as required to provide the Work and perform the services, complete, in accordance with the Contract Documents.
- B. The types of utility services required for general temporary use at the project site include the following:

Water service (potable for certain uses)

Sanitary sewer

Electric power service

Telephone service

Gas service.

1.2 JOB CONDITIONS

- A. Scheduled Uses: In conjunction with establishment of the job progress schedule, establish a schedule for implementation and termination of service for each temporary utility or facility; at earliest feasible time, and when acceptable to Owner, change over from use of temporary utility service to permanent service.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. The Contractor shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of temporary utility is provided for Contractor by Owner or another utility company, provide the remainder with matching and compatible materials and equipment that comply with applicable standards and codes and requirements of Owner and that company.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF TEMPORARY UTILITY SERVICES**

- A. Availability of Utilities: In general, there are no available utilities (i.e. power, telephone, gas, sewer, pressurized water) at the site.
- B. General: Wherever feasible, the Contractor shall engage the utility company to install temporary service to project, or as a minimum, to make connection to existing utility service; locate services where they will not interfere with total project construction Work, including installation of permanent utility services; and maintain temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction Work.
- C. Electrical Connections: All temporary connections for electricity shall be subject to approval of the Engineer and approval of a power company representative, and shall be removed in like manner at the Contractor's expense prior to final acceptance of the Work.
- D. Separation of Circuits: Unless otherwise permitted by the Engineer, circuits separate from lighting circuits shall be used for all power purposes.
- E. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

### **3.2 INSTALLATION OF POWER DISTRIBUTION SYSTEM**

- A. Power: The Contractor shall provide all necessary power required for its operations under the Contract, and provide and maintain all temporary power lines and equipment required to perform the Work in a safe and satisfactory manner. This includes portable generators and fuel if needed for temporary construction power.
- B. Temporary Power Distribution: The Contractor shall provide a weatherproof, grounded, temporary power distribution system sufficient to accommodate performance of entire Work of project, including construction operations, temporary electrical heating as needed, operation of test equipment, temporary operation of other temporary facilities, and power for temporary operation of existing facilities (if any) at the site. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations, and result in least interference with performance of the Work; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other recognized exposures to damage or abuse. All temporary construction power wiring shall be on a Ground Fault Installation System.

### **3.3 INSTALLATION OF LIGHTING**

- A. Construction Lighting: All Work conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper Work and to afford adequate facilities for inspection

and safe working conditions. All construction lighting shall be hooded and directed downward.

- B. Temporary Lighting: The Contractor shall provide a weatherproof, grounded temporary lighting system in every area of construction work, as soon as overhead floor/roof deck structure has been installed; and provide sufficient illumination for safe work and traffic conditions; and run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, floors, decks, or other recognized areas of possible damage or abuse.

#### 3.4 WATER SUPPLY

- A. Water Supply: Temporary connections required for construction water will be installed by the Contractor at the Contractor's expense. Water used by the Contractor for construction will be provided by the Contractor at the Contractor's expense. Water for testing of tank and pipelines will be provided by the Owner as described in the specifications.
- B. Water Connections: The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the Contractor shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency. The Contractor shall pay all permit and water charges.

#### 3.5 INSTALLATION OF GAS SERVICE

- A. Gas Service: There is no gas service at the site. The Contractor may install propane service and distribution piping, in lieu of electricity, of size adequate for temporary heating of enclosed construction Work, construction offices, toilets, fabrication shops and similar temporary facilities requiring heat.

#### 3.6 COMMUNICATIONS

- A. Telephone Services: The Contractor shall provide and maintain at all times during the progress of the Work a cellular telephone system which will allow the Owner or Engineer telephone access to the Contractor and staff.

#### 3.7 INSTALLATION OF SANITARY FACILITIES

- A. Toilet Facilities: Fixed or portable chemical toilets shall be provided whenever needed for the use of Contractor's employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 2926.51 of the OSHA Standards for Construction. Provide separate field office facilities in conformance with Section 01 52 13.
- B. Sanitary and Other Organic Wastes; The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.

- C. Sewer Connection: There is no sewer service at the site.

### 3.8 OPERATIONS AND TERMINATIONS

- A. Inspections: Prior to placing temporary utility services into use, the Contractor shall inspect and test each service and arrange for governing authorities' required inspection and tests, and obtain required certifications and permits for use thereof.
- B. Protection: The Contractor shall maintain distinct markers for underground lines, and protect from damage during excavating operations.
- C. Termination and Removal: When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the Contractor shall promptly remove installation unless requested by Engineer to retain it for a longer period. The Contractor shall complete and restore Work which may have been delayed or affected by installation and use of temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces.
- D. Removal of Water Connections: Before final acceptance of the Work on the project, all temporary connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to original condition or better, to the satisfaction of the Engineer and to the agency owning the affected utility.

END OF SECTION

**SECTION 01 52 13**  
**FIELD OFFICE, EQUIPMENT, AND SERVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Provide a field office, equipment, and services in a trailer as specified herein for Contractor, Engineer and Owner at the Project Site during the entire time of construction beginning at the commencement date stated in the Notice to Proceed until Notice of Completion of the project and the acceptance of the Work by Owner.

**1.2 FIELD OFFICE REQUIREMENTS**

- A. The required field office, equipped as specified herein, shall be provided at the site indicated, ready for use by Contractor, Engineer and Owner within 14 days after the commencement date stated in the Notice to Proceed. No initial payments for mobilization will be approved for payment for any such work done under the Contract until the field office facilities specified herein, have been provided.
- B. Unless released earlier by Engineer in writing, said field office shall be maintained in full operation at the site with all utilities connected and operable until the Notice of Completion has been executed or recorded. Upon execution or recordation of the Notice of Completion, or upon early release of the field office by Engineer, remove the field office within 14 days from said date, and restore the site occupied by said field office to the condition indicated.
- C. Ownership of all equipment specified herein, unless otherwise specified, will remain that of the Contractor.

**1.3 FIELD TELEPHONE AND INTERNET SERVICE**

- A. Cellular telephone service will be provided by the Contractor, Engineer and Owner, for their respective staff.
- B. High speed internet service for the conference room area will be provided by the Contractor.

**1.4 OFFICE FACILITIES**

- A. General: Provide all necessary electrical wiring, air conditioning and heating equipment, shelving, and furnish all necessary light, heat, and water at the field office specified herein, for the duration of the Work. Remove the office and appurtenant facilities within 14 days after the execution of the Notice of Completion.
- B. Field Office for Engineer or Owner: Provide and maintain for the exclusive use of Engineer and Owner's representative and personnel, one separate, well lighted, air conditioned, electrically heated, 240 sq. ft. office space located in the Contractor's site trailer. Provide all furnishings, services and equipment specified herein.
- C. The trailer shall have an outside door lock.

## 1.5 FIELD OFFICE FURNISHINGS

A. Provide the following listed items in new condition for both the Engineer's/Owner's representative's field office, and the Contractor's field office:

- 1 Each Plan table, 36 inches by 72 inches top, 36 inches tall.
- 1 Each Standard desk, 30 inches by 60 inches top, with not less than 3 lockable drawers.
- 1 Each File cabinet, legal size, 4 or 5 drawers with lock and 3 keys, double suspension, complete with suspension racks for each drawer.
- 1 Each Bookshelves, five shelves each.
- 1 Each Office chair, standard armrest type, adjustable, swivel, tilt-back with casters.
- 2 Each 6-foot long folding table.
- 1 Each Dry erase board, 48 inches by 36 inches, magnetic with set of four color compatible markers and eraser.
- 4 Each Waste basket.
- 1 Each Bottled water dispenser unit, supplying both hot and cold water, complete with bottled water service and continuous supply of paper cups.
- 1 Each Small refrigerator.
- 8 Each Field office side chairs.

## 1.6 FIELD OFFICE SERVICES

- A. The field office required shall be provided with sufficient lighting at each desk location. Exterior lighting shall be provided over the entrance door.
- B. A minimum of four 110-Volt AC duplex electric convenience outlets shall be provided in each office and in the conference room and common area. At least one such outlet shall be located on each wall. The electric distribution panel shall service not less than 2 110-Volt, 60-Hz circuits.
- C. Regular weekly janitorial services shall be furnished during working hours each week. Offices shall be swept, dusted, and waste receptacles emptied.

## 1.7 COMPUTER

- A. Computer equipment will be provided by the Contractor, Engineer and Owner for their respective staff.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

END OF SECTION



**SECTION 01 55 26  
TRAFFIC CONTROL**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Traffic Control Plan requirements and materials and labor necessary for implementation.
- B. Traffic Control Maintainer and Flagging.
- C. Work zone traffic control devices, arrow boards, and pilot cars.

1.2 RELATED SECTIONS

- A. Section 01 11 00 – Summary of Work

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO) standards, latest edition:

Roadside Design Guide

- B. American Traffic Safety Services Association (ATSSA) standards, latest edition:

Quality Guidelines for Temporary Traffic Control Devices &  
Features

- C. National Cooperative Highway Research Program (NCHRP) standards, latest edition:

Report 350                      Recommended Procedures for the Safety Performance  
Evaluation of Highway Features

- D. U.S. Dept. of Transportation, Federal Highway Administration (FHWA) standards:

MUTCD                      Manual of Uniform Traffic Control Devices  
  
Standard Highway Signs

- E. Utah Department of Transportation (UDOT) standards and specifications, latest edition:

Flagger Training Handbook

Guidelines for Crash Cushions and Barrier End Treatments

Standard Section 2891                      Traffic Signs

Operations Policy 06C-23                      Use of Variable Message Signs (VMS)

#### 1.4 SUBMITTALS

- A. Administrative Submittals: Copies of permits, licenses, and approvals for construction as required by Laws and Regulations and governing agencies.
- B. Shop Drawings:
  - 1. Approved Traffic Control and Routing Plans: As specified herein.
  - 2. Message Boards: Proposed locations for placement at each detour or road closure.
- C. Traffic Control Supervisor(s) qualifications: Qualifications of proposed traffic control supervisor(s) and traffic control plan signatory.

#### 1.5 TRAFFIC CONTROL SUPERVISOR

- A. The traffic control supervisor shall be responsible for initiating, installing, and maintaining all traffic control devices as shown on the Traffic Control and Routing Plans, and as specified in the MUTCD and these specifications, or as directed. The traffic control supervisor shall be an employee of the Contractor and shall be assigned full time to the Project while work is underway on public roadways. The traffic control supervisor shall work exclusively with traffic control services. The designated traffic control supervisor shall also be available to be contact by the Engineer 24 hours a day for the life of this contract. The persons so designated shall have at least one year of experience directly related to work site traffic control in a supervisory capacity and shall be certified as a work sit traffic control supervisor by ATSSA. Submit the name and qualifications of this person for review 7 days in advance of the date set for the preconstruction conference.
- B. The traffic control supervisor shall be capable of being onsite within 45 minutes of notification. The traffic control supervisor shall make at least four inspections of all traffic controls devices each day as follows:
  - 1. Before beginning work.
  - 2. At mid-shift.
  - 3. Half an hour after the end of the shift.
  - 4. Once during the period of nonworking hours.
- C. The traffic control supervisor shall make a daily record of traffic control activities using a form provided to and approved by the Engineer. Submit completed forms within 24 hours.
- D. The traffic control supervisor shall oversee the security of the message boards to be implemented by the Contractor's field staff. Security measures shall be implemented daily and shall include locking the tires to the message boards, chaining the message boards to a fixed item, and other measures to prevent theft.
- E. Each day the traffic control supervisor shall develop the messages for the message boards, determine the locations of the message boards, coordinate with field labor to locate the message boards, and program the message boards.
- F. The traffic control supervisor shall oversee the flagging operations. For road closures, the traffic control supervisor shall prepare information handouts showing schedules and maps of the crew locations. The traffic control supervisor shall keep the handouts updated and furnish copies of the flaggers for distribution to drivers approaching closure barricades and

drivers waiting to drive through single-lane zones. The traffic control supervisor shall manage the distribution of radios to flaggers, and oversee the proper functioning of radios.

- G. Each evening and morning, signs shall be covered and uncovered as needed to inform the public of roadway closures, detours, work zones, and other traffic information. Each evening just before crews leave, all signs not required shall be covered and all signs required shall be uncovered. Each morning before start of construction, all signs not required shall be covered and all signs required shall be uncovered. The traffic control supervisor shall oversee the covering and uncovering of signs each evening and morning.
- H. Traffic control supervisor shall oversee storage of materials and construction equipment along right-of-way, as needed to ensure compliance with the Contract Documents.
- I. Traffic control supervisor shall be responsible for verifying that property owner notifications are made in accordance with Contract requirements.

#### 1.6 FLAGGER

- A. Flaggers must have a current Utah flagging certificate and must present proof of certification upon request by the Engineer.
  - 1. Acceptable Certifications
    - a. Refer to <http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:1385> for a list of certified instructors.

#### 1.7 TRAFFIC CONTROL AND ROUTING PLANS

- A. The Traffic Control and Routing Plans shall be prepared and/or certified as to conformance with these Specifications by a Professional Traffic Operation Engineer (PTOE) or an ATSSA certified Work Site Traffic Control Supervisor and shall include the PTOE registration number or ATSSA certification number of the certifying person.
- B. Submit the initial phase Traffic Control and Routing Plans at the preconstruction conference. Submit plans for future phases of construction a minimum of 28 days before start of that construction phase to allow review and resubmittal, if necessary, and public notification. Meet with the Engineer and affected agency having jurisdiction to review each of the Traffic Control and Routing Plans for each phase of construction. Do not begin construction on any given phase before receiving written acceptance by [South Jordan City, Riverton City, and/or Herriman City] Traffic Division of the Traffic Control and Routing Plans for that phase.
- C. Failure to submit the Traffic Control and Routing Plans within the specified time frames will not be justification for additional working days. Failure to adequately address comments in any required resubmittal also will not justify additional working days.
- D. Changes to this plan shall be made only by written approval of Engineer. Secure approvals for necessary changes so as not to delay progress of the Work.
- E. If multiple road closures are desired simultaneously, detours must be coordinated and approved in advance by the Engineer and the agency or agencies having jurisdiction. Allow a minimum of 14 working days for the Engineer and the agency or agencies having jurisdiction review followed by 14 working days of prior notification of residents. Multiple simultaneous

road closures will require additional message boards (at each end of the closure) which shall be provided by Contractor at no additional cost for the duration of simultaneous closures.

- F. Traffic Routing Plan: Show sequences of construction affecting the use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians, bicycles, and vehicles. Include schedule for covering traffic control signs (including detour signs) when not in use and uncovering just prior to use.
- G. The Traffic Control Plans in the Contract Documents are guidelines only, and shall not be used in lieu of detailed Contractor-prepared plans. Detailed Traffic Control Plans shall show the location of traffic cones, barrier rail, construction zones, flaggers, stored pipe and materials, construction truck access, barricades, detours, signs, message boards, and other traffic control facilities.
- H. On a time and day agreed upon between the Contractor and Engineer to describe the following week's construction operations and the traffic control provisions. At each meeting, submit a detailed update of traffic control provisions and construction crew locations. This shall be submitted in hardcopy and electronic form using a Word file. The update shall contain a list of signs and the time and location for covering and uncovering signs. The update shall include the location and wording of message control boards.
- I. Any days lost due to improper traffic control will be charged against the allowable working days.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE CRITERIA**

- A. Use devices and systems, which meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration. Some exceptions will be acceptable as stated below.
  - 1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.
  - 2. Category 2: Portable sign stands with signs, Type I, II and II barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause signification vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350. Report test requirements.
  - 3. Category 3: Portable/Temporary pre-cast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements.
    - a. Manufactured date to be stamped into top of each barrier section using a numeric format (ex: 10/2006) with 2 inch x 2 inch numerals, ¼ inch deep. See Standard Drawing BA 1A and BA 2.
    - b. Portable/Temporary pre-cast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP 230 may be used until they are no longer serviceable.
  - 4. Category 3: Crash cushions and truck mounted attenuators must be certified by FHWA as meeting NCHRP-350 test requirements.

5. Category 4: Advanced warning arrow boards and portable variable message signs do not have to meet NCHRP-350 test requirements.

## 2.2 PILOT CAR

- A. Equip with a reflectorized sign:
  1. Comply with UDOT Standard Specifications, Section 02891 – Traffic Signs.
  2. MUTCD Sign G20-4.

## 2.3 FLAGGER EQUIPMENT AND CLOTHING

- A. Comply with UDOT's "Flagger Training Handbook."
- B. Comply with Contract Drawings traffic control sheets.
- C. Paddle:
  1. Use a combination "STOP" and "SLOW" sign paddle. The paddles shall be a minimum of 18 inches wide with 6-inch series "C" letters and have a rigid fixed handle approximately 5 feet in length, from the bottom of the paddle to ground level.
  2. Fabricate the combination sign paddle from sheet metal or other light semi-rigid material.
  3. The background of the "STOP" face shall be red with white letters and border. The background of the "SLOW" shall be orange with black letters and border.
  4. Use Type II reflective sheeting for the background, letters, and border on the faces of the STOP/SLOW paddles.
- D. Clothing:
  1. Flagger vest and hard hat:
    - a. Color: Orange, red-orange, or fluorescent version of these colors.
    - b. Safety vest with a minimum of 775 inches of background material. Night work requires a minimum of 20 inches of reflective material (100 inches on the front and 100 inches on the back). Reflective material will be white and/or strong yellow-green.
    - c. Hard hat with 10 inches of white or strong yellow-green reflective tape places around the base of the hard hat and visible to traffic from all directions.

## 2.4 TRAFFIC CONTROL SIGNING AND DEVICES

- A. Signs:
  1. Comply with this section, Article 2.1.
  2. Comply with UDOT Standard Specifications, Section 02891 – Traffic Signs.
  3. Comply with Contract Drawings traffic control sheets.
- B. Channelizing Devices:
  1. Comply with Article 2.1.
  2. Comply with Contract Drawings traffic control sheets.
  3. Comply with UDOT Standard Specifications, Section 02891 – Traffic Signs, for reflective sheeting.
  4. Use construction orange tubular markers and cones during daylight hours only.

- C. Barricades:
  - 1. Comply with Article 2.1.
  - 2. Comply with Contract Drawings traffic control and routing sheets.
  - 3. Do not use rocks, asphalt, or concrete pieces, construction materials, and other debris as weighting devices for barricades. Sand bags will be permitted as long as a low center of gravity is maintained as approved.
- D. Precast Concrete Barrier:
  - 1. Comply with Article 2.1.
  - 2. Comply with Contract Drawings traffic control and routing sheets.
  - 3. Use an approved construction zone attenuator or permanent style end sections, as listed in UDOT Guidelines for Crash Cushions and Barrier End Treatments.
    - a. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
      - 1) Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements.
      - 2) Install crash cushions as per contract traffic control sheets and manufacturer's recommendations.
  - 4. Do not use a truck mounted attenuator (TMA) to protect temporary precast barrier end for more than 24 hours. Use properly rated TMA as directed in this Section, Article 2.4, Paragraph E.
- E. Impact Attenuator: Use properly rated truck mounted attenuator for the posted speed limit prior to construction.
  - 1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
  - 2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.

## 2.5 ADVANCE WARNING ARROW BOARD

- A. Meet all standards as specified in the MUTCD, Section 6F.61 Arrow Boards.
- B. Perform all functions as specified in Contract Drawings traffic control sheets and the MUTCD.

## 2.6 VARIABLE MESSAGE SIGNS (VMS)

- A. Design, placement, operation, maintenance, and message content of portable variable message signs will conform to the current edition of the MUTCD and UDOT Operations Policy 06C-23 were applicable.
- B. Portable variable message boards shall be a transportable truck or trailer mounted programmable message sign. The message sign board shall be capable of displaying three lines of message text with characters of twelve-inch minimum height formed by a bulb type, LCD, LED or electromagnetic disk matrix, and shall have a display area of 96-inches x 48-inches. At nighttime the sign display shall be self-illuminated.
- C. Portable variable message boards shall be placed at least 14 calendar days before construction begins on the affected roadways and maintained by the Contractor at locations designated and provided by the Owner.

- D. Provide at least two portable variable message boards throughout construction at each location impacting City streets. Additional signs may be required by Cities based upon review of Contractor's Traffic Control Plans.

### **PART 3 - EXECUTION**

#### **3.1 LIMITATIONS OF OPERATIONS**

- A. See Section 01 11 00 – Summary of Work for Contract information to coordinate construction and traffic control involving signalized intersections. Give maintaining agency a minimum of 72-hours' notice for the adjustment of signal phasing to accommodate the approved Traffic Control Plan.
- B. During nonworking hours, Saturdays, Sundays, and holidays, the full width of the traveled way in both directions shall be open for use by the public.
- C. Allow emergency vehicles immediate passage.
- D. When construction operations are not actively in progress, one through lane of traffic in each direction shall be open to public traffic. A maximum of 15 percent vertical profile grade shall be constructed and maintained at all times in order to accommodate public traffic.
- E. Minimum lane width shall be 10 feet, unless noted otherwise. Where cones are used to separate traffic lane from construction zone, do not use traffic lane for accessing construction zone, and do not store materials or equipment on or near shoulder of traffic lane side of roadway.
- F. Whenever it is necessary to cross, close, or obstruct driveways and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.
- G. Driveway and Private Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along the route of the Work. When access to private driveways must be temporarily denied due to construction operations, notify the property owner or responsible part of such closure not less than 24 hours in advance of closure. Give notification in writing and include the estimated duration of the closure.
- H. In making street crossings, do not block more than one-half the street at a time. Maintain one lane of traffic at all times. Ensure access for traffic both directions.
- I. Notify the fire department, police/sheriff department, highway patrol, ambulance service, local school district, and transit 14 days before closing roadway or portion thereof. Notify said departments or agencies when streets are again passable for vehicles. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to the police or sheriff's department.
- J. If Work will interfere with mail delivery, move mailboxes to temporary locations accessible to postal service, and on completion of Work in each area, replace them in their original

location and in a condition equal to or better than original. When access to private driveways must be temporarily denied due to construction operations, notify the property owner or responsible part of such closure not less than 24 hours in advance of closure. Give notification in writing and include the estimated duration of the closure.

- K. If Work will interfere with garbage pickup, move property owner's (resident's) garbage cans to areas accessible for garbage pickup. Garbage cans shall be returned to owner's driveway after pickup.
- L. Pedestrian and cycle access along sidewalks and streets will be kept open and safe from construction activities.
- M. Coordinate traffic routing with that of others working in the same or adjacent areas. Coordinate access for garbage pickup, mail delivery, and school buses.
- N. Each evening prior to crew departure, sweep all Work areas to ensure all construction debris (including, but not limited to, AC waste, gravel, and dirt) has been removed from the surface of the road. Dispose of debris offsite and do not sweep into ditches or otherwise outside of Work area.
- O. Barricades and Lights:
  - 1. Provide as shown on the Traffic Control Details and in sufficient quantity to safeguard public and Work.
  - 2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
  - 3. Provide to protect existing facilities and adjacent properties from potential damage.
  - 4. Locate to enable access by facility operators and property owners.
  - 5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
  - 6. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section.
- P. Signs and Equipment:
  - 1. Traffic control signs and equipment shall be as described herein, the MUTCD, and the Standard Highway Signs, shown on Traffic Control Details, and as directed by Engineer.
  - 2. Maintain existing traffic control signs during construction.
  - 3. Variable Message Signs: Provide two variable message signs conforming to the provisions of Section 2.6 of these Specifications for use as directed by Engineer. Be responsible for moving and programming message boards as required throughout the Project.
  - 4. Portable TOW-AWAY-NO STOPPING Signs; Place where approved by police department of the agency having jurisdiction and Owner.
  - 5. Business Access Signs: Place at accesses to businesses in the vicinity of construction activities.



6. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements. Provide at obstructions such as material piles and equipment, as directed by Engineer.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise, or as directed by Engineer.
8. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.
9. Post-mount informational signs both sides of detour a minimum of 14 days before detouring any traffic as to the date, time, and duration of the detour. Sign shall be stenciled with 6-inch black letters on an orange background. Signs shall meet these specifications.
10. Place solar powered barricade-type lights on Road Work Ahead signs and construction speed limit signs.
11. All portable and night use signs shall use high intensity reflective sheeting.
12. Cover Detour signs when not in use and uncover just prior to use. Detour signs shall be covered with wood or metal. The use of easily displaced material such as plastic bags, burlap sacks, duct tape, etc. is not acceptable.
- 13.** Each sign or piece of equipment shall be certified by the manufacturer to meet the requirements of these Specifications. Any sign or equipment, which is damaged, or appears to be in poor condition, must be recertified by the manufacturer. Engineer shall be the sole judge as to whether used signs or equipment supplied under this contract need recertification.

END OF SECTION

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**SECTION 01 57 19**  
**TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 - GENERAL**

**1.1 EXPLOSIVES AND BLASTING**

- A. The use of explosives on the Work will not be permitted.

**1.2 DUST ABATEMENT**

- A. Furnish all labor, equipment, and methods required to prevent, control, and mitigate fugitive dust from the construction activities. In complying with this requirement, conform to all local requirements in all circumstances. Be responsible for damage resulting from dust generated by its activities. Dust abatement measures shall be continued until Engineer directs otherwise.
1. Unpaved Roads: Apply liquid dust palliative as appropriate for traffic areas as approved by Engineer.
  2. All other Non-Paved Work Areas: Apply a liquid dust palliative (soil stabilizer type) derived from natural organic plant sources and containing no growth – or germination – inhibiting materials as approved by Engineer. Application shall be effective for dust suppression according to applicable County Health District Air Pollution Control Division dust regulations. Do not allow movement of vehicles or storage of materials on treated areas.

**1.3 RUBBISH CONTROL**

- A. Prepare a trash abatement program and submit to Engineer for review. The program shall include placing all litter, trash, garbage, construction debris, and refuse in scavenger-proof, resealable containers. Trash includes, but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags. During the progress of the Work, keep the Project Site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. Dispose of all rubbish and waste materials of any nature occurring at the Project Site, establish regular intervals of collection and disposal of such materials and waste. Keep haul roads free from dirt, rubbish, and unnecessary obstructions resulting from construction operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.
- B. Clean up and properly dispose of any oil, fuel, and other equipment leaks at the time of occurrence. Service and maintenance vehicles shall carry a bucket and pads to absorb leaks and spills. Notify Engineer of any spills or leaks at the time of occurrence.

**1.4 SANITATION**

- A. Toilet Facilities: Provide fixed or portable chemical toilets wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

- B. Sanitary and Other Organic Wastes: Establish a regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities or organic material wastes from any other source related to the construction operations shall be disposed of away from the Site in a manner satisfactory to Engineer and in accordance with all laws and regulations pertaining thereto.

#### 1.5 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether soil sterilant, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

#### 1.6 CULTURAL RESOURCES

- A. Direct attention to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 and NRS 383.121 which provide for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").
- B. Conform to the applicable requirements of the National Historic Preservation Act of 1966 and NRS 383.121 as they relate to the preservation of cultural resources.
- C. In the event potential cultural resources are discovered during subsurface excavations at the Site of construction, institute the following procedures:
  - 1. Engineer will issue a Field Order directing the cessation all construction operations at the location of such potential cultural resources find. Mark the area in an appropriate manner to ensure that all construction equipment, activities, and personnel remain clear of the area until further notice.
  - 2. Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historic Preservation Office.
- D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Historic Preservation Office, suspend work at the location of the find under the provisions for changes contained in Articles 10, 11, and 12 of the General Conditions.

#### 1.7 AIR QUALITY

- A. Maintain all vehicles and equipment in proper tune.
- B. Use Best Available Control Technology on construction equipment, including a timing retardation.
- C. Use natural-gas powered construction equipment where possible.
- D. Encourage employee car-pooling.

## 1.8 NOISE

- A. Comply with the hours of work as allowed by the local jurisdiction or land management agency.
- B. Noise limits on construction equipment will comply with the noise limits of the local jurisdiction or land management agency. All construction equipment shall be equipped with manufacturer's standard noise control devices (i.e., mufflers, acoustical lagging, and/or engineer enclosures). Take special care not to throttle the engine excessively and keep engine speed as low as possible. Do not leave the equipment running or idling needlessly, especially when near noise-sensitive land uses. Noise-sensitive land uses include, but are not limited to, residences, schools, hospitals, libraries, retirement and elderly care centers, religious and worship facilities, courts of law, certain noise-sensitive professional offices, and quiet recreational areas such as campgrounds and hiking trails.
- C. Use newer equipment whenever possible. Inspect all construction equipment at periodic intervals to ensure proper maintenance and the presence of noise control devices (i.e., mufflers and shrouding, etc.)
- D. Keep heavy, noisier equipment a minimum of 100 feet away from the property line of any noise-sensitive land use for any length of time. Avoid coming closer than 200 feet if multiple pieces of equipment are operating simultaneously. If such cases are unavoidable, avoid throttling the engine excessively or leaving the equipment running needlessly. Heavy equipment shall be operated in a manner to comply with the jurisdiction's noise ordinance and vibration performance standard. In order to comply with these requirements, it may be necessary to operate heavy equipment only 30 minutes out of each one-hour period at distances closer than 200 feet from an occupied property. During the remaining 30 minutes, the equipment should move further away or be shut down, but may resume 30 minutes later.
- E. Locate stationary noisy equipment away from construction boundaries that are near noise-sensitive uses.
- F. Concrete trucks shall perform initial mixing and other activities that require high revving of the truck engine a minimum of 600 feet from noise-sensitive land uses. Keep engine revolutions per minute as low as possible at closer distances.
- G. Whenever possible, use electric hand tools rather than gas-powered tools.
- H. If operation of dewatering pumps and generators is required between the hours of 6 p.m. and 7 a.m. and within 600 feet of a noise-sensitive land use, they shall be treated with acoustical noise control measures (e.g., mufflers, shrouding, and/or enclosures) so as not to exceed 56 dba at 50 feet or other appropriate requirements of the local jurisdiction.
- I. If requested by the Engineer, install temporary noise barriers for construction activities, including staging areas that occur closer than 100 feet from noise-sensitive land uses. Noise barriers can be made of plywood, heavy vinyl curtain material, natural or temporary earth berms, or stockpiles of construction material.

## 1.9 CONTROL OF SURFACE WATER

- A. Be advised that portions of the Work site are subject to flooding from surface waters. Many portions of the site are located directly in washes or drainage ways. Other portions of the Work are located outside major drainage ways, but are still subject to minor channelized flows and overland sheet flow during some rainfall events.
- B. Be responsible for protecting the Work and temporary facilities from damage due to flooding, runoff, surface water flows, and related subsurface flows until final Project closeout. Provide protection for all aspects of the Work whether temporary or permanent. Provide all materials and equipment required to protect the Work. No additional payment will be made by Owner for providing protective measures or for any damage resulting from said flows. All damage from said flows shall be completely replaced in accordance with the Contract Documents at no additional cost to Owner.

## 1.10 EROSION CONTROL

- A. The Contractor shall prepare and submit to the Engineer a drainage and erosion control plan for all soil stockpiles and construction areas. The plan shall include, but not be limited to, measures such as silt fences, straw bales, rerouting of runoff, and sediment traps and basins downslope of the stockpiles and construction areas.
- B. Erosion control and restoration procedures shall be implemented in all areas disturbed during construction, including temporary access roads and access roads that are upgraded to construction traffic standards.
- C. The Contractor shall restore disturbed surfaces to as close to pre-construction conditions as possible and avoid and minimize erosion.
- D. Temporary slope breakers shall be used to reduce runoff velocity and divert water and sediment from the construction right-of-way. They shall be constructed with materials including soil, silt fence, weed-free staked hay or straw bales, or sandbags.
- E. Permanent trench breakers shall be built to stop the flow of subsurface water along trenches. Topsoil shall not be used in trench breakers.
- F. Temporary erosion control measures shall be used at any site where seeding has been delayed.

END OF SECTION

**SECTION 01 58 13**  
**TEMPORARY PROJECT SIGNAGE**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide one project identification sign, complete, in accordance with the Contract Documents.

**PART 2 - PRODUCTS**

2.1 SIGN CONSTRUCTION

- A. Construct each sign of 3/4-inch painted, exterior grade plywood with 4-inch by 4-inch supports and 2-inch by 4-inch cross bracing capable of withstanding 15 psf wind loads.
- B. Each sign face shall be 4-feet vertical by 8-feet horizontal.
- C. Design sign for professional appearance.

2.2 COLORS

- A. Face: White.
- B. Lettering: Black, block letter style.

2.3 SIGN CONTENT

- A. The content and appearance of the project sign shall be as directed by Owner. Content shall include Project Title, Owner, Contractor, Engineer, and scheduled completion date.
- B. Submit a drawing to illustrate proposed sign content to Engineer for approval prior to construction.

**PART 3 - EXECUTION**

3.1 SIGN LOCATION

- A. Locate sign on the Project Site as directed by Engineer.
- B. The sign shall be set four feet above the ground, measured from grade to the lower edge of the plywood sheet.
- C. If the sign will be located outside of an Owner-acquired right-of-way or easement, secure written permission from the owner of the property where the sign will be located and submit to Engineer.

### 3.2 REMOVAL

- A. Remove the project sign upon Substantial Completion of the Work.

END OF SECTION



## **SECTION 01 71 00 MOBILIZATION**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Organization and mobilization of the forces.
- B. Transporting construction plant and equipment to the jobsite and setting up of same.
- C. Transporting various tools, materials, and equipment to the jobsite.
- D. Erection of temporary buildings and facilities as required for field offices, staging, storage, and construction operations.

#### **1.2 RELATED SECTIONS**

- A. Section 01 20 00 – Measurement and Payment
- B. Section 01 31 30 – Safety and Security Program

#### **1.3 PAYMENT FOR MOBILIZATION**

- A. Payment for mobilization shall be as described in Section 01 20 00 – Measurement and Payment.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Mobilization shall include the following principal items:
  - 1. Provide all required insurance certificates and bonds.
  - 2. Move onto the site, or portion of site as available, of all plant and equipment required for first month's operations including office and storage trailers.
  - 3. Install temporary construction power, wiring, and lighting facilities.
  - 4. Develop construction water supply.
  - 5. Provide all on-site communication facilities, including telephones, cordless phone antenna, and radio pagers.
  - 6. Provide on-site sanitary facilities and potable water facilities.
  - 7. Arrange for and erection of work and storage yard.
  - 8. Construct and implement security features and requirements complying with Section 01 31 30 – Safety and Security Program.
  - 9. Obtain all required permits.
  - 10. Post all OSHA required notices and establish safety programs.

11. Provide Superintendent at the job site full time.
12. Project Videotape: Videotape the project area prior to commencing construction. The Engineer shall be present during taping. The taping shall be performed on foot, noting all salient existing features in the project area and the location of the taping shall be clearly indicated. "Drive-by" video tapes will not be accepted. The original video tape shall be submitted to the Engineer a minimum of 5 days prior to starting construction. Preconstruction site surveys shall comply with requirements of Section 01 71 30 – Site Conditions Surveys.

### 3.2 SUBMITTAL REQUIREMENTS

- A. The following submittals are due by the day indicated and must be approved by Owner as a condition precedent to completion of mobilization.

No.	Submittal	Specification Section
1.	Quality Control Plan	01 45 00
2.	Mobilization Plan	01 71 00
3.	Safety Program	01 31 30
4.	Concrete Mix Designs	03 30 00 and 03 30 60
5.	List of Permits and Licenses	01 41 26
6.	Schedule of Submittals	01 33 20

### 3.3 MOBILIZATION PLAN

- A. Within 15 Days after receipt of the Notice to Proceed, submit a mobilization plan to Engineer for approval, which shall include a breakdown showing the estimated value of each component of mobilization as described in paragraphs 3.1 and 3.2 herein.
- B. Include a bar chart schedule showing each item of mobilization listed in paragraphs 3.1 and 3.2 herein and include scheduled start date, finish dates, and total duration. The plan shall also list each activity to be initiated in the first 90 Days following Notice to Proceed, complete, with scheduled start date, finish date, and total duration.

END OF SECTION

**SECTION 01 71 30**  
**SITE CONDITIONS SURVEYS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes requirements to document conditions of the Project Site and adjacent properties before construction begins and after completion of the Work. Methods include still photographs, digital video recordings, and topographic surveys.

1.2 RELATED SECTIONS

- A. Section 31 10 00 – Site Preparation
- B. Section 31 23 00 - Earthwork

1.3 SUBMITTALS

- A. Submit all photographs, digital videos, and topographic survey data of the preconstruction conditions to Engineer for record purposes prior to, but not more than three weeks before, commencement of any construction activities.

1.4 CLOSEOUT SUBMITTALS

- A. Complete and submit all digital videos, still photographs, mapping, and survey data of the postconstruction conditions to Engineer prior to final inspection by Owner and Engineer.
- B. Provide postconstruction survey data to Engineer as follows:
1. Submit topographic mapping for each site hereinbefore identified for topographic mapping and surveys as a separate electronic map (drawing) in AutoCAD Release 2014, or later.
  2. Engineer will review hardcopy plots for accuracy relative to the specified requirements.
  3. Amend mapping files, as required, based on review of the hardcopy plots by Engineer.
  4. The electronic mapping files shall be produced using field survey techniques with sufficient accuracy for reproduction and use as base maps at a scale of 1"=20' horizontal and 1-foot contour intervals as specified for National Map Accuracy Standards.
  5. All electronic mapping files shall be three-dimensional.
  6. Submit lists of survey points for all topographic surveys in ASCII text file format.
  7. Provide mapping and points files on one or more compact discs in a format acceptable to Engineer.
- C. Submit two copies of digital media.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Conduct thorough preconstruction and postconstruction Site conditions surveys of the entire Project. Site conditions surveys shall consist of photographs, digital video recordings, and topographic mapping. Sufficient photographs, supplemented by digital video, shall be provided and submitted to Engineer to resolve any damage claims, which may arise due to the construction of this Project. Develop topographic mapping using the Project coordinates, and referenced to the Project base lines and bench marks. Mapping shall be adequate to ascertain preconstruction and postconstruction conditions (including elevations) of all public and private property within and adjacent to the construction limits.
- B. Digital video or photographic surveys shall include, but not be limited to, all access roads used to transport material or equipment to and from the Site and elevation of roadways, drives, walks, and buildings. Use spot elevation surveys to document the elevation on abutting roadways, drives, and walks, taken at approximately 20-foot intervals and at the point of juncture with any structure to which they are attached or otherwise influenced by the Work. In addition, take elevations of all building slabs along the Project route. Provide topographic mapping as specified herein.
- C. Digital video recordings required as part of this Section and by Section 31 10 00 – Site Preparation and Restoration and Section 31 23 00 - Earthwork may be combined into a single set of media provided the requirements for videos specified in both Sections are met.
- D. As a minimum, note preconstruction and postconstruction conditions and perform digital video surveys of the following:
  - 1. Areas used to access the Site or haul materials and equipment to the Site.
  - 2. The access road, both original and relocated locations and ultimately to the Site.
  - 3. All Work areas, including, but not limited to, access corridors, disposal areas, and staging areas.
  - 4. Any work completed by other contractors at the Site that will be impacted or otherwise affected by Work of this Project.
- E. Supplement digital video surveys with still photographs and spot elevation surveys as required to document the original condition and location of existing features and facilities.
- F. Provide digital video records in DVD-R format.
- G. Topographic mapping shall be conducted to document the post-construction topography of the new tank site and access road.

END OF SECTION

**SECTION 01 71 50**  
**PROTECTION AND RESTORATION OF EXISTING FACILITIES**

**1.1 GENERAL**

- A. Protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, in accordance with the Contract Documents.
- B. Call Bluestakes before commencing any digging for location of underground utility lines and cable locations. The number is (800) 662-4111.
- C. Provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches, and shall remain in place during all non-working hours.
- D. Provide temporary caps over all large diameter pipe during non-working hours to prevent unauthorized access.

**1.2 RELATED SECTIONS**

- A. Section 01 35 53 – Security.

**1.3 RIGHTS-OF-WAY**

- A. Do not perform any work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure. Do not enter upon the rights-of-way involved until notified by Engineer that Owner has secured authority therefore from the proper party.
- B. After authority has been obtained, give said party due notice of intention to begin work, if required by said party, and remove, shore, support or otherwise protect such pipeline, transmission line, ditch, fence, or structure or replace the same.
- C. When two or more contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, the Owner will determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by Owner to the Contractor so desiring, to the extent, amount, in the manner, and at the times permitted and in full conformance with the conditions of the Contract Documents.
- D. No such decision as to the method or time of conducting the Work or the use of territory shall be made the basis of any claim for delay or damage, except as provided for temporary suspension of the Work in the General Conditions of the Contract.

#### 1.4 PROTECTION OF STREET OR ROADWAY MARKERS

- A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. Do not begin pavement breaking or excavation until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Accurately replace survey markers or points disturbed after all street or roadway resurfacing has been completed.

#### 1.5 RESTORATION OF PAVEMENT

- A. General: Replace all paved areas cut or damaged during construction with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing a permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base and pavement. Temporary and permanent pavement shall conform to the requirements of the affected jurisdictional agency. Neatly saw cut pavements, which are subject to partial removal, in straight lines. Refer to Division 02 for specific pavement restoration requirements.
- B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction place temporary surfacing promptly after backfilling and maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement. Refer to plans for minimum dimension of T-patch replacement width over disturbed pipeline trenches in paved areas.
- D. Pavement Crown: In areas where pipeline trenching impacts an existing crown of asphalt, survey, and submit to Engineer documentation showing the pre-construction location of the crown prior to trenching. Replace the crown of asphalt to its pre-construction location to the satisfaction of the governing agency and Engineer.
- E. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, place suitable temporary sidewalks or roadways promptly after backfilling and maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration. If no such period of times is so fixed, maintain said temporary sidewalks or roadways until the final restoration thereof has been made.
- F. Restoration of Curb and Gutter: Wherever curb and gutter, including driveway and sidewalk approaches, have been removed for purposes of construction, replace these improvements following construction to the specific dimension and requirements of the authority having

jurisdiction. Replace improvements, including required ADA access details to the latest version of the authoritative standard regardless of their preconstruction condition.

#### 1.6 EXISTING UTILITIES AND IMPROVEMENTS

- A. General. Protect underground utilities and other improvements, which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Except for utilities specifically located on the Drawings, be responsible for exploratory excavations (potholing) as deemed necessary to determine the exact locations and depths of utilities, which may interfere with Work. Perform all such exploratory excavations as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Work's progress. When such exploratory excavations show the utility locations as shown on the Drawings to be in error, so notify Engineer. Refer to plans for minimum advance distance that potholing must be performed prior to pipeline trenching work.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.
- D. Utilities to be Moved: In case it becomes necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by Owner to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, notify Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- E. Utilities to be Removed: Where the proper completion of the Work requires temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to Engineer and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished 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 as found prior to removal.
- F. Owner's Right of Access: Owner and owners of public utilities and franchises reserve right to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- G. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged facility performs its own repairs, reimburse said owner for the costs of repair.

- H. Underground Utilities Not Indicated: In the event of damage to existing utility lines that are not indicated or the locations of which are not made known prior to excavation, make a verbal report of such damage immediately to Engineer and a written report thereof promptly thereafter. Notify the utility owner of the damage. If directed by Engineer, repairs shall be made under the provisions for changes and extra work contained in the General Conditions.
- I. Damages. Costs of locating and/or repairing damage not due to failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such Work will be paid for as extra Work in accordance with the provisions of the General Conditions.
- J. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.
- K. Fire Hydrants: Keep all fire hydrants and water control valves free from obstruction and available for use at all times.
- L. Maintaining in Service: Unless indicated otherwise, all oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. Be responsible for and repair all damage due to construction operations. The provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.
- M. Utility Service Laterals: Utility service laterals are not shown on the plans. Anticipate that there are no less service laterals than there are homes where project trenches are located in the vicinity of a street between a home and the utility main. Protect in place, or remove and replace to the satisfaction of the utility owner, all utility service laterals encountered during construction. Duration of utility service outages and public notification procedures shall conform to the standards of the controlling agency and these Contract documents.

#### 1.7 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. General: Except where trees or shrubs are indicated to be removed, 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. Do not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner. Trim or replace existing trees and shrubs which are damaged during construction using the services of a certified tree company under permit from the jurisdictional agency and/or the Owner.
- B. Trimming; 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. Do not use spikes 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 kerosenes, coal tar, creosote, or other material injurious to the life of the tree.

- C. Replacement: Immediately notify the jurisdictional agency and/or Owner if any tree or shrub is damaged by construction operations. If, in the opinion of said agency or Owner, the damage is such that replacement is necessary, replace the tree or shrub at no additional expense to Owner. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a small size, the pay to the 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 not be less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, water and maintain the replacement trees and shrubs for 6 months after planting.

#### 1.8 UNIMPROVED AREAS

- A. Remove and stockpile topsoil prior to construction in accordance with Division 01 specifications. Replace topsoil prior to restoration of unimproved areas.
- B. Unimproved areas, including unclassified open spaces, fields, and unimproved rights-of-way, damaged during construction shall be repaired to match pre-construction conditions to the satisfaction of the land owner and Owner. At a minimum, unimproved areas shall be smoothed and finished graded with topsoil to match preconstruction topography, and reseeded using a native seed mix acceptable to the land owner and Owner.
- C. All slopes greater than or equal to 3H:1V shall be protected with erosion control matting prior to reseeding.

#### 1.9 OTHER SURFACE IMPROVEMENTS

- A. Conduct a pre-construction survey of all properties that will be impacted by construction operations. All improvements that have the potential to be impacted by construction, including but not limited to fencing, landscaping, boulders, retaining walls, irrigation systems, and other public and/or private improvements, shall be protected in place, or if necessary, removed and replaced with like kind or better quality following construction.

#### 1.10 NOTIFICATION BY CONTRACTOR

- 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, notify the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation so that a representative of said owner or agencies can be present during such Work if they so desire.
- B. When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance

and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

- C. Contact, cooperate with, and provide written notice (including Contractor's phone number) at least seven days prior to beginning Work on each street. The written notice shall include the approximate schedule and explanation of Work and shall be given to each homeowner, business, all emergency agencies, schools, and residents, which will be affected by the project; particularly in reference to temporary interruptions to vehicular access. At least twenty-four hours prior to initiation of Work, provide a second notice to confirm the scope of scheduled Work. Submit a copy of the notifications to Engineer, for approval, prior to the start of construction. Make verbal door-to-door communication prior to construction to remind all affected parties of the construction to take place. In addition, be responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and the construction personnel.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

END OF SECTION

**SECTION 01 74 19  
DISPOSAL OF WATER**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Prepare a detailed listing of all discharges and overflows that will occur during the disinfection procedure.
- B. All water used in hydrostatic testing shall be disposed of in accordance with water quality regulations. Note that all chlorinated water from pipeline draining and testing, reservoir draining and testing, and all other construction activities shall be dechlorinated prior to discharge to the local drainage.
- C. The rate of disposal of water is limited by the capacity of the existing storm drain located north of the tank site in 6200 South. Large flows are not permitted, as these will exceed the capacity of the storm drain.

**1.2 REFERENCES**

- A. American Water Works Association (AWWA) standards, latest edition.
  - AWWA C651 Disinfection Water Mains
  - AWWA C652 Disinfection of Water Storage Facilities

**1.3 SUBMITTALS**

- A. Submit a listing of every significant discharge from a drain valve, pump well, overflow, drain piping, and from all related appurtenances. "Significant discharge" is defined as a volume that is greater than that required to exercise or fill piping with chlorinated water and briefly flush. The listing shall be utilized as input for the Construction Progress Schedule to identify the volume and duration for every discharge that must be accounted for. Very minor discharges for air-release piping or drains that are exercised briefly to ensure disinfection do not need to be identified on the Construction Progress Schedule for dechlorination or discharge.
- B. Include the proposed method and equipment for dechlorination, including type of agent; temporary feed pumps, and appurtenant feed equipment.
- C. Final Report: Submit to Engineer a final report of each significant discharge, its locations, dates sampled for effectiveness of dechlorination, and the test results.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS FOR DECHLORINATION**

- A. Where dechlorination of water released back to the environment is required, use a sodium bisulfate or equivalent dechlorinator. Sodium bisulfite, if used, shall be applied at a ratio of at least 1.47 parts per every part of chlorine to be removed. This is to remove all of the free active chlorine. Since the reaction produces a byproduct of hydrochloric acid, it will also tend to lower the pH of the water and remove calcium carbonate from the water. If the pH drops below 6.0, add calcium carbonate back into the water during the dechlorination process to restore the pH to an acceptable level of at least 6.0.
- B. The process of dechlorination consists of utilizing a chemical metering pump to inject a 44 percent (or less) solution of sodium bisulfite into a temporary discharge pipe with a static mixer and after a few seconds (plus or minus three) withdrawing sample for a chlorine residual analyzer. Based on the results, the analyzer shall send a signal to adjust the chemical feed rate.

## **PART 3 - EXECUTION**

### **3.1 MAJOR DISCHARGES, RESERVOIRS, OVERFLOWS**

- A. General: List each reservoir, drain valve, pump, and overflow, along with proposed volume and duration of discharge during the disinfection procedure. Locations requiring dechlorination shall be indicated. Refer to Drawings to obtain detailed information on size, location, and layout of facilities and access conditions. Review the site of each proposed discharge for the conditions at the proposed discharge.

END OF SECTION

**SECTION 01 77 00  
CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Contract closeout, including final cleaning, preparation, and submittal of closeout documents, warranties and bonds, and final completion certification.
- B. Closeout submittals and submittal forms in both hard copy and electronic format.

1.2 RELATED SECTIONS

- A. Section 01 45 00 – Quality Control
- B. Section 01 78 39 – Project Record Documents

1.3 SUBMITTALS

- A. Closeout Documents: Submit the following closeout documents prior to making a written request for Final Completion.
  - 1. Project record drawings and documents per Section 01 78 39 – Project Record Documents.
  - 2. Shop drawings.
  - 3. Keys and keying schedule.
  - 4. Post construction survey record documents, where required.
  - 5. Quality Control reports per Section 01 45 00 – Quality Control.
  - 6. Final Operation and Maintenance Manuals.
  - 7. Maintenance stock items; spare parts and special tools.
  - 8. Written warranties and bonds where required.
  - 9. Bonds for roofing or maintenance, if indicated.
  - 10. Access Badges and Parking Permits.
  - 11. Release of liens or release of claims forms submitted by all subcontractors and suppliers, if requested by Owner
- B. Evidence of Compliance With Inspections and Other Requirements of Governing Authorities: Submit the following:
  - 1. Special Inspection Reports.
  - 2. Certificate of Occupancy, if applicable.
  - 3. Release from each affected property owner or agency indicating final acceptance.
- C. Operation and Maintenance Manuals
  - 1. One percent of the contract price will be withheld from any monies due as progress payments, if at the 75 percent construction completion point, the approved *Operations and Maintenance Manual* complying with Section 01 33 20- Submittal Procedures has not been submitted. The aforementioned amount will be withheld by Owner as the agreed, estimated value of the approved *Operations and Maintenance Manuals*. Any such retention of money for failure to submit the approved *Operations*

*and Maintenance Manuals* on or before the 75 percent construction completion point shall be in addition to the retention of any payments due under General Conditions of the Contract.

- D. Final Change Order: A final Change Order shall be submitted and processed if required. Final payment and close-out procedures shall comply with requirements of the Contract Documents.

#### 1.4 CLOSEOUT TIMETABLE

- A. Establish dates for equipment testing, acceptance periods, and on-site instructional periods as required under the Contract Documents. Such dates shall be established not less than one week prior to beginning any of the required activities, to allow Owner, Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

#### 1.5 COMPLETION PROCEDURES

- A. When Contractor believes Substantial Completion has been achieved, request in writing to Engineer that Substantial Completion be recognized as having been achieved and request that Owner issue a Certificate of Substantial Completion. Prior to making such request, the following must be complete:
  - 1. Work necessary for the safe, proper, and complete use or operation of the facility as intended.
  - 2. Punch list of items remaining to be completed, for submission with the request for issuance of a Certificate of Substantial Completion.
  - 3. Submit and receive acceptance of accurate record drawings for all work completed to date.
  - 4. Submit and receive acceptance of all specified warranties, bonds, guarantees and operation and *Operations and Maintenance Manuals*.
  - 5. Complete all required vendor training, testing, and where required, start-up.
  - 6. Deliver all required spare parts, maintenance stock items, and special tools.
  - 7. Complete equipment and communications system testing successfully.
- B. Upon receipt of the request, Engineer and designated representatives will review the request, the Work, and the above requirements to determine whether Substantial Completion has been achieved. If this review fails to support Substantial Completion, Engineer will notify Contractor in writing citing the reasons for rejection. If Engineer determines that Substantial Completion has been achieved, the following procedures will be followed:
  - 1. Engineer, his/her representative, and user representatives will review the Work and the punch list to assure all deficiencies are noted on a final punch list.
  - 2. Engineer will schedule and conduct a pre-final walk-through of the facility with representatives of Owner, Engineer, Contractor, and others, for the purpose of formally reviewing the Work, the final punch list, and the readiness of the Work for use. A copy of the final punch list will be furnished to all participants and any additional items noted during the walk-through will be added to the list.
  - 3. Upon completion of the pre-final walk-through, Engineer will prepare a request to Owner establishing the date for Substantial Completion as date of the walk-through, provided the walk-through has verified that the Work is in fact ready for use and

occupancy by Owner for its intended purpose. Upon approval of this request by Owner, the facility will be considered Substantially Complete.

- C. Final Completion will be deemed to have occurred when Work is completed including the following:
  - 1. All final punch list items have been corrected, signed off by Contractor and Engineer, and demonstrated to Owner during a final walk-through.
  - 2. All updates to record drawings, and *Operations and Maintenance Manuals* have been made.
  - 3. Demobilization and site cleanup are complete.
  - 4. Facilities and/or equipment have been properly demonstrated to be functioning as required.
  - 5. Owner has received releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.
  - 6. New permanent cylinders and key blanks for all locks have been provided to Owner.
- D. Certificate of Final Completion
  - 1. When all items have been completed or corrected, submit written documentation to Engineer that the entire Work is complete in accordance with the Contract Documents and request final inspection.
  - 2. Upon completion of final inspection by Owner and Engineer, Owner will either prepare a Certificate of Final Completion of the entire Work or advise all parties of Work not satisfactorily complete. If necessary, repair or replacement and inspection procedures will be repeated until Owner accepts the Work and issues a Certificate of Final Completion.
- E. Partial Utilization may be desired at Owner's option, as described in the General Conditions. If Partial Utilization is requested, the same procedure for completion of that portion of the Work as indicated in paragraphs A and B above, will be used.

#### 1.6 CLOSE-OUT PROCEDURE

- A. Engineer and Contractor shall meet and resolve all outstanding issues including, but not limited to:
  - 1. Claims and adjustments for time or costs
  - 2. Outstanding, unused allowances
  - 3. Procedures for handling warranty issues.
- B. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with all requirements of the Contract Documents.

#### 1.7 MAINTENANCE AND GUARANTEE

- A. Comply with the maintenance and guarantee requirements contained in General Conditions of the Contract.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless Contractor has obtained a statement in writing from the

affected private authority or public agency releasing Owner from further responsibility in connection with such repair or resurfacing. Submit such release(s) to Engineer.

- C. Make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

## 1.8 BOND

- A. Furnish a Performance Bond as required by General Conditions of the Contract.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### 3.1 FINAL CLEANING

- A. Certificate of Final Completion of the Work by Owner will be withheld until requirements for final cleanup of the Project Site are complete as follows:
  - 1. Perform final cleaning prior to inspections for final acceptance.
  - 2. Employ skilled workers who are experienced in cleaning operations.
  - 3. Use cleaning materials that are recommended by manufacturers of surfaces to be cleaned.
  - 4. Avoid scratching, discoloring, and otherwise damaging surfaces being cleaned.
  - 5. Clean roofs.
  - 6. Broom clean and power wash exterior paved surfaces and rake clean other surfaces of sitework. Police yards and grounds to keep clean.
  - 7. Remove dust, cobwebs, and traces of insects and dirt.
  - 8. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, fixtures, and Equipment.
  - 9. Remove nonpermanent protection and labels.
  - 10. Polish finish hardware.
  - 11. Wash and shine mirrors.
  - 12. Polish glossy surfaces to clear shine.
  - 13. Clean ducts, blowers, and coils when units were operated without filters during construction.
  - 14. Clean light fixtures and replace burned-out or dim lamps.

### 3.2 WASTE DISPOSAL

- A. Remove temporary structures and facilities and arrange for and dispose of surplus materials, waste products, and debris as follows:
  - 1. Prior to making disposal on private property, obtain written permission from owner of such private property.
  - 2. Do not fill ditches, washes, or drainage ways which may create drainage problems.
  - 3. Do not create unsightly or unsanitary nuisances during disposal operations.



4. Maintain disposal site in safe condition and good appearance.
5. Complete leveling and clean-up prior to final acceptance of the Work.

### 3.3 TOUCH-UP AND REPAIR

- A. Touch up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for final acceptance.
- B. Refinish or replace entire surfaces that cannot be touched-up or repaired satisfactorily.

### 3.4 DEMOBILIZATION

- A. Demobilization shall include moving plant and equipment, field trailers, construction materials, debris, and so forth from the Site as well as performing final cleanup.
  1. Disturbed areas shall be restored to their original state or better.
  2. Permanent improvements damaged during construction operations shall be repaired or replaced at no additional cost to Owner.
  3. Remove all equipment, materials, waste, and debris from the site and restore site to original condition upon completion of construction.
  4. The work area shall be restored to its original or better condition and shall be inspected and approved by Engineer.

END OF SECTION

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**SECTION 01 78 39**  
**PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Maintain at the Site for Owner, one record copy of the Drawings, Specifications, Operation and Maintenance manuals, coordination drawings, and Shop Drawings that are clearly marked with a red pen to indicate all changes and or revisions resulting from, but not limited to, the following:
  - 1. Actual Project as constructed.
  - 2. Addenda.
  - 3. Change Orders and other modifications.
  - 4. Engineer's instructions.
  - 5. Field revisions.
  - 6. Requests for Information (RFI).
  - 7. All other changes.
- B. Give special attention to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings.
- C. Record drawings shall be supplemented by any detailed sketches as necessary or directed to fully indicate the Work, as actually constructed.
- D. Section Includes:
  - 1. Maintenance of Documents and Samples
  - 2. Marking Devices.
  - 3. Recording.
  - 4. Close-out Submittal Delivery.

**1.2 RELATED SECTIONS**

- A. 01 77 00 - Project Closeout

**1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES**

- B. Store documents and samples in field office apart from documents used for construction.
- C. Provide files and racks for storage of documents.
- D. Provide locked cabinet or secure storage space for storage of samples.
- E. Maintain documents in clean, dry, legible condition and in good order. Keep record documents separate from those used for construction.
- F. Make documents and samples available at all times for reference by Engineer and Owner.

- G. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- H. During progress meetings, record documents may be reviewed to ascertain that changes have been recorded.
- I. Updated Drawings, when provided by Engineer, will be substituted for the hand markups provided Contractor prints the applicable Drawings and inserts them into the record set each month.
- J. Copies of the record drawings will be audited regularly by Engineer after the month in which the Notice to Proceed is given as well as on completion of the Work. Failure to properly maintain record drawings in a up-to-date condition may result in the withholding of payments due at the sole discretion of Owner.

#### 1.4 MARKING DEVICES

- A. Use a red color pen for recording all information to all documents defined herein.

#### 1.5 RECORDING

- A. Label each document "CONFORMING TO CONSTRUCTION RECORD" in neat large red printed letters.
- B. Record information concurrently with construction progress, at the time the material or equipment is installed. Do not conceal any work until required information is recorded.
- C. Drawings shall be legibly marked to record actual construction per the following:
  - 1. Record actual depths of various elements of foundations in relation to finish first floor datum.
  - 2. Record actual as-built depths, horizontal and vertical location, (at every direction change and a maximum of 100 feet intervals on straight runs), of underground pipes, duct banks, and other buried utilities. Reference horizontal location to Project coordinate system and vertical elevations to Project datum.
  - 3. Identify and record specific details of pipe connections, location of existing buried features and utilities located during excavation, and the final locations of piping, equipment electrical conduits, manholes, and pull boxes (horizontal coordinates and vertical elevation).
  - 4. Identify and record location of spare conduits including beginning, ending, and routing through pull boxes, and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.
  - 5. Record actual schedules, lists, layout drawings, and wiring diagrams.
  - 6. Record field changes of dimension and detail.
  - 7. Record changes made by instruction from Engineer or by Change Order.
  - 8. Record details not on original Contract Drawings.

- D. Specifications and Addenda shall be legibly marked to record:
    - 1. Manufacturer, trade name, catalog number, and supplier for each product and item of equipment actually installed.
    - 2. Changes made by instruction from Engineer or by Change Order.
  - E. Record potholing data and installation of marker balls.
  - F. All surveying for record documents shall be performed by a licensed surveyor.
- 1.6 CLOSEOUT SUBMITTALS
- A. At Contract closeout, deliver complete record documents to Engineer as required in Section 01 77 00 - Closeout Procedures. Final payment will not be acted upon until the record drawings have been prepared and delivered to Engineer.
  - B. The information submitted will be incorporated by Engineer into final drawings to be provided to Owner. Be responsible for the accuracy of submitted construction information. Engineer will assume that the information provided by Contractor is correct and faithfully represents actual construction.
  - C. This submittal shall include the record paper set along with 2 USB drives. Each USB drive shall contain .pdf files and .dwg files of each drawing.
  - D. Prepare submittal with transmittal letter containing:
    - 1. Date.
    - 2. Project title and number.
    - 3. Contractor's name and address.
    - 4. Title and number of each record as-built document.
    - 5. Signature of Contractor's authorized representative and a statement that certifies that the record documents are accurate and reflect what was actually installed during construction.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

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**SECTION 01 81 10**  
**SEISMIC DESIGN CRITERIA**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This section Includes seismic design criteria for the following:
1. Anchorage of mechanical and electrical equipment and piping.
  2. Other structures or items as specified or indicated on the Drawings.

1.2 REFERENCES

- A. International Code Council (ICC) documents as follows:
- |     |  |
|-----|--|
| IBC | International Building Code, 2018 Edition with Utah state amendments |
|-----|--|
- B. American Society of Civil Engineers (ASCE) documents as follows:
- |        |   |
|--------|---|
| ASCE 7 | Minimum Design Loads for Buildings and Other Structures, 2016 Edition |
|--------|---|

1.3 SUBMITTALS

- A. Shop Drawings and Calculations: Submit shop drawings and structural calculations in accordance with Section 01 33 20 - Submittal Procedures. All drawings and calculations shall be signed and sealed by a licensed Civil or Structural engineer as required below under "Qualifications".
- B. ICC-ES reports for concrete anchors.

1.4 QUALITY ASSURANCE

- A. Qualifications
1. Licensed Professionals: Design of items required by this Section and other items not specifically shown in the Contract Documents shall be performed by a Civil or Structural Engineer licensed to practice in the state of Utah.

**PART 2 - PRODUCTS**

2.1 SYSTEM DESCRIPTION

- A. Design Criteria: Design in accordance with the requirements of the International Building Code and ASCE 7.
1. Seismic acceleration variables to be used in design are as follows:
    - a. The design 5 percent damped spectral response acceleration at short periods,  $S_{DS} = 0.77g$ .

- b. The design 5 percent damped spectral response acceleration at a period of 1 second,  $S_{D1} = 0.24g$ .
- c. The mapped maximum considered earthquake, 5 percent damped, spectral response acceleration at short periods,  $S_s = 1.08g$ .
- d. The mapped maximum considered earthquake, 5 percent damped, spectral response acceleration at a period of 1 second,  $S_1 = 0.38g$ .
- e. Site coefficients:
  - 1)  $F_a = 1.07$
  - 2)  $F_v = 1.92$
- f. Soil Site Class = D.
- g. Seismic Design Category = D.
- 2. Seismic Importance Factor for Anchorage of Mechanical and Electrical Equipment: 1.50.
- 3. Do not use friction to resist sliding due to seismic forces.
- 4. Use only headed anchor bolts, adhesive anchors, or welded studs for anchors resisting seismic forces. Embedded anchor bolts used to resist seismic forces shall have a standard hex bolt head.
  - a. Adhesive anchors must have current ICC-ES reports showing that the anchors meet IBC requirements when installed in cracked substrates.
  - b. Do not use other types of anchors unless indicated on the Drawings or approved in writing by Engineer.
  - c. Seismic forces must be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections which use friction to resist seismic forces.

### **PART 3 - EXECUTION (NOT USED)**

END OF SECTION



## **SECTION 01 82 11 WIND DESIGN CRITERIA**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This section Includes design criteria for the following when exposed to wind forces:
  - 1. Anchorage of mechanical and electrical equipment and piping.
  - 2. Other structures or items as specified or indicated on the Drawings.

#### **1.2 REFERENCES**

- A. International Code Council (ICC) documents as follows:

IBC	International Building Code, 2018 Edition with Utah state amendments
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- B. American Society of Civil Engineers (ASCE) documents as follows:

ASCE 7	Minimum Design Loads for Buildings and Other Structures, 2016 Edition
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#### **1.3 SUBMITTALS**

- A. Shop Drawings and Calculations: Submit shop drawings and structural calculations in accordance with Section 01 33 20 - Submittal Procedures. All drawings and calculations shall be signed and sealed by a licensed Civil or Structural engineer as required below under "Qualifications".
- B. ICC-ES reports for concrete anchors.

#### **1.4 QUALITY ASSURANCE**

- A. Qualifications
  - 1. Licensed Professionals: Design of items not specifically shown in the Contract Documents shall be performed by a professional Civil or Structural Engineer licensed to practice in the state of Utah.

### **PART 2 - PRODUCTS**

#### **2.1 SYSTEM DESCRIPTION**

- A. Design Criteria: Design in accordance with the requirements of the International Building Code and ASCE 7.
  - 1. Basic Wind Speed: 109 miles per hour
  - 2. Risk Category: III
  - 3. Exposure: C
  - 4. Topographic Factor: As calculated per ASCE 7.

5. Use only headed anchor bolts, adhesive anchors, or welded studs for anchors resisting wind forces. Embedded anchor bolts used to resist seismic forces shall have a standard hex bolt head.
  - a. Adhesive anchors must have current ICC-ES reports showing that the anchors meet IBC requirements.
  - b. Do not use other types of anchors unless indicated on the Drawings or approved in writing by the Engineer.
  - c. Wind forces must be resisted by direct bearing on the fasteners used to resist wind forces.

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

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

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Equipment testing and startup are required for satisfactory completion of the Contract and, therefore, shall be completed within the Contract Time.
- B. Section Includes:
  - 1. Startup Plan
  - 2. Certificates of Installation and Startup Services
  - 3. Record Keeping
  - 4. Factory Performance Testing
  - 5. Field Performance Testing
  - 6. Special Tools and Lubricating Equipment
  - 7. Startup
  - 8. Lubrication

**1.2 DEFINITIONS**

- A. Component Test and Check Out is the verification that each component of the Work is in compliance with the Contract Documents and is ready to perform its intended function.
- B. Subsystem Test and Startup is the verification that a discrete group of related components is functioning as intended within itself and is ready to perform its intended function in the overall system.
- C. System End-To-End Test and Startup is the operation and verification that all related components and subsystems are functioning as intended and are ready for final commissioning and operation.
- D. Commissioning is placing a complete system or project into service.

**1.3 SUBMITTALS**

- A. Submit startup plan a minimum of 90 days prior to beginning startup procedures.
  - 1. Submit and have an approved detailed and coordinated startup plan for each piece of equipment, subsystem, and the entire system.
  - 2. The Plan and Progress Schedule shall include the following activities:
    - a. Manufacturer's services and startup dates.
    - b. Submittal dates for certificates of installation and startup services.
    - c. Operator training dates for each phase.
    - d. Submittal of operation and Maintenance manuals.
    - e. Functional test dates.
    - f. Operational performance test dates.
    - g. Post operational performance test dates.

3. The plan shall include test logs for each item of equipment and each system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
  4. Provide summary of shutdown requirements for existing systems which are necessary to complete startup of new equipment and systems.
  5. Revise and update startup plan based upon review comments, actual progress, and to accommodate changes in the sequence of activities.
  6. System startup plan shall be coordinated with Owner's operations staff and Engineer to ensure operational intent is achieved.
- B. Submit certified copies of factory test reports.
- C. Startup Records:
1. Maintain and submit the following records generated during each phase of startup defined above in article titled Definitions:
    - a. Daily logs of equipment testing identifying all tests conducted and outcome.
    - b. Logs of time spent by manufacturer's representatives performing services on the Site.
    - c. Equipment lubrication records.
    - d. Electrical phase, voltage, and amperage measurements.
    - e. Insulation resistance measurements.
    - f. Data sheets of control loop testing, including testing and calibration of instrumentation devices and setpoints.
    - g. Detailed, point-by-point, sensor/controlled device/field device to PLC to HMI screen witnessed validation checklist for all telemetry and SCADA tags utilizing a fully functional network or other telemetry system available at the Owner's plant or other Owner-designated facility.
- D. Certificates of Installation and Startup Services
1. At completion of installation and functional testing, furnish Certificate of Installation and Startup Services, signed by manufacturer, Contractor, and Owner's authorized representatives. Each form shall be completed for individual pieces of equipment in a timely manner as construction proceeds.
  2. Submit 3 original copies of each completed form to Engineer.
  3. Certify that:
    - a. Equipment has been properly installed, adjusted, aligned, and lubricated.
    - b. Equipment is free of any stresses imposed by connecting piping or anchor bolts.
    - c. Equipment is suitable for satisfactory full-time operation under full load conditions.
    - d. Equipment operates within the allowable limits for vibration.
    - e. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
    - f. Control logic for startup, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.
    - g. For remotely monitored and controlled devices, functionality shall not be certified until indication and controls are tested using local and remote SCADA based indications.

4. Sign and submit for acceptance the forms and field manufacturer reports along with the manufacturer's representative prior to proceeding with System End-To-End Test and Startup.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY PERFORMANCE TESTING**

- A. Test equipment for proper performance at the point of manufacture or assembly.
- B. Demonstrate equipment meets specified performance requirements.
- C. Submit certified copies of factory test results to Engineer for review and approval.
- D. Do not ship equipment until certified copies of factory test reports have been approved by Engineer. Written acceptance of factory test results does not constitute final acceptance.

### **2.2 FIELD PERFORMANCE TESTING**

- A. Furnish the services of an experienced and authorized representative of the manufacturer of each item of equipment indicated in the equipment schedules (excluding manually-operated valves smaller than 24 inches in size, injectors, tanks, batch-type disc meters, and rotameters, and any other minor items of equipment specifically exempted by Engineer in writing), who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, arrange to have the manufacturer's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to Engineer.
- B. Require that each manufacturer's representative furnish to Engineer a written report addressed to Owner certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily under full-load conditions.
- C. Be responsible for scheduling all operations testing, including the End-To-End Testing performed with other contractors associated with the RTU controls and communications. Be advised that Engineer and Owner's operating personnel will witness operations testing and that the manufacturer's representative shall be required to instruct Owner's operating personnel in correct operation and maintenance procedures. Such instruction shall be scheduled at a time arranged with Owner at least two weeks in advance and shall be performed while the respective manufacturer's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems. Prior to scheduling any operations testing, furnish *Operations and Maintenance Manuals* required by the Contract Documents.
- D. Notify the Engineer at least three Work Days in advance of each equipment test.
- E. Furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests.

## 2.3 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

- A. Furnish, according to manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics, including valve keys and stems.
- B. Time of Delivery: Submit special tools and lubricating equipment to Engineer when unit is placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.
- C. Quality: Provide tools and lubricating equipment of a quality comparable to what the equipment manufacturer uses.

## PART 3 - EXECUTION

### 3.1 STARTUP

- A. Startup is a highly complex operation requiring the combined technical expertise of Contractor, manufacturers, subcontractors, Engineer, and Owner. Coordinate all parties necessary for the successful plant startup.
- B. Be responsible for the complete test, check out, startup, and commissioning of all elements of the Project. Verify these activities through daily inspection reports, test records, on-site vendor certifications, and by other appropriate means. The test and startup requirements specified in this Section are complementary to those indicated elsewhere in the Contract Documents.
- C. Conduct all test, check out, and startup requirements indicated in the Contract Documents and provide documentation of same to Engineer prior to commissioning. Where vendor on-site inspections are required prior to or during startup, require vendor to provide a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup and/or commissioning.
- D. It is not the intent of Engineer to instruct Contractor in the startup; however, Engineer will be available prior to and during startup to provide technical support to the Contractor.
- E. Perform a 7-day functional test of the facility. The intent of the 7-day functional test is to demonstrate that each and all of the components and systems that have been constructed and installed function individually and collectively in accordance with the Contract Documents. The 7-day functional test shall demonstrate the ability of the entire facility to operate continuously for 7-days without failure. In the event of a failure of any of the facility components, the cause of the failure shall be determined and repaired, and the 7-day functional test shall be restarted from time zero.
  - 1. Prepare a plan that details the procedures of the 7-day functional test. The plan shall indicate start and stop times of each of the pumping units, capacity to be pumped during each period, the number of pumps to be operated during each period, auxiliary systems that will be needed during each period, and starting and stopping sequences

of each facility subsystem to be operated during each period. Provide adequate detail in the plan to determine personnel needed to operate and monitor all components to be evaluated during each period but the increments of the schedule shall not be greater than 2 hours. In the plan, identify by name all personnel needed to complete the 7-day functional test and identify the shift that each person will work during the test.

2. As part of the plan for the 7-day test, define, subject to Engineer's approval, what will constitute a failing test. At a minimum, a test shall be considered to have failed if any of the following events occur at any time during the 7-day functional test.
    - a. Failure of a pumping unit or motor.
    - b. Performance of a pumping unit (including pump and motor) outside of its specified acceptable ranges for vibration, noise, temperature, cavitation, efficiency, and capacity.
    - c. A failure of any ancillary component or system that cannot be returned to service within 30 minutes of failure.
    - d. Three failures of an ancillary component or system regardless of the amount of time it takes to return it to service and regardless of whether or not the failures are due to the same cause.
    - e. Three failures of equipment of the same model, regardless of the amount of time it takes to return each to service and regardless of whether or not the failures are due to the same cause.
  3. During the performance of the 7-day functional test, it shall not be acceptable to bypass, deactivate, or in any way disable a protective device, alarm, or control to facilitate completion of the test.
  4. If variable speed pumps are provided as part of the construction, each pump shall be run under automatic control during the 7-day functional test to verify the ability to operate as required by the Contract Documents provided the communications system is available. If the communication is not available, Engineer will prescribe the method and flow rates at which the 7-day functional test will be performed.
  5. Provide adequate staff on Site to operate the facility and make factory personnel available to assist in resolving problems as needed at no additional cost to Owner.
  6. Take readings every hour of the 7-day functional test to record equipment operation, operating speeds, flow rates, temperature of equipment components, system pressures, operating voltage, current, power draw of each operating unit, and any problems encountered during the previous hour. Provide readings to Engineer each morning for the previous day's run for evaluation and acceptance of the preceding day as being satisfactorily completed for the 7-day functional test.
- F. Furnish operating personnel for the duration of the startup. Additionally, furnish all water, power, chemicals, and other consumables required for the test.
- G. Facility startup shall not be commenced until Component Test and Check Out, Subsystem Tests, and System End-To-End Tests, with associated control systems in place and functioning, all have been completed to the satisfaction of Engineer.
- H. All defects in materials or workmanship, which appear during this test period, shall be immediately corrected. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons, which actually interrupt the startup may, at the discretion of Engineer, be justifiable cause for extending startup test duration.

- I. During startup, furnish the services of authorized representatives of the manufacturers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.
- J. During startup, keep records of the operations in accordance with the instructions of Engineer.

### 3.2 LUBRICATION

- A. Where lubrication is required for proper operation of equipment, incorporate the necessary provisions in accordance with the manufacturer's requirements. Where possible, make lubrication automated and positive.
- B. Upon completion System End-To-End Tests and Startup, a qualified manufacturer's representative shall perform preventive maintenance, such as change break-in lubrication, complying with manufacturer's recommendations.
- C. Oil Reservoirs: Where oil is used, provide a reservoir of sufficient capacity to lubricate the unit for a 7-day period.

END OF SECTION



**DIVISION 03**  
**CONCRETE**

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**SECTION 03 11 00  
CONCRETE FORMING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish, fabricate, and install concrete formwork, bracing, shoring, supports, and falsework in accordance with Contract Documents.
- B. Work shall include installation of form ties, clips, supports and other appurtenances necessary to meet Specifications and produce finished concrete structures.

**1.2 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 03 30 60 – Cast-In-Place Concrete Reservoirs

**1.3 REFERENCES**

- A. American Concrete Institute (ACI) standards, most recent editions:
  - ACI 317                                      Standard Tolerances for Concrete Construction and Materials
  - ACI 347                                      Formwork for Concrete
  - ACI 350                                      Code Requirements for Environmental Engineering Concrete Structures
- B. National Sanitation Foundation (NSF), most recent edition:
  - NSF 61                                      Drinking Water System Components, Health Effects
- C. U.S. Department of Commerce, National Institute of Standards and Technology, (NIST) standards, latest editions:
  - PS 1    Structural Plywood
  - PS 20    American Softwood Lumber Standard (ASLS)

**1.4 SYSTEM DESCRIPTION**

- A. Be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

- B. Design and construct falsework to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- C. Falsework Calculations and Drawings: All falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil or structural engineer, registered in the State of Utah. Always maintain a current copy of the falsework plan or shoring layout on the job site.

## 1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings: Submit detailed drawings of the falsework proposed to be used. Such drawings shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions. Submittals shall include the following:
  - 1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
  - 2. Form gaskets.
  - 3. Form releasing agent, including NSF certification when applicable.
  - 4. List of form materials and locations for use.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Except as otherwise expressly accepted by Engineer, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
  - 1. Walls: Steel or plywood panel.
  - 2. Columns: Steel, plywood or fiberglass.
  - 3. Roof and Floor: Plywood.
  - 4. All Other Work: Steel panels, plywood or tongue and groove lumber
- B. Form materials which may remain or leave residues on or in the concrete that is in contact with potable water shall be classified as acceptable for potable water under NSF 61 within 30 days of application or use.

### 2.2 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Form ties (general):
    - a. Burke Penta-Tie, Burke Company.
    - b. Richmond Snap-Tys, Richmond Screw Anchor Company.

- c. Gates Ties, Gates and Sons, Inc.
  - d. Engineer approved equal.
- 2. Form ties (water retaining structures):
  - a. Burke Taper-Tie, Burke Company.
  - b. Taper-Ty, Richmond Screw Anchor Company.
  - c. Engineer approved equal.

## 2.3 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
  - 1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
  - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin-bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
  - 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
- B. Except at the vertical wall joints in the exterior wall of the tank and unless otherwise indicated on the Drawings, provide exterior corners in concrete members with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.

## 2.4 FORM TIES

- A. Provide form ties with integral waterstops with a plastic cone on both sides of walls, or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have an integral waterstop that tightly fits the form so that it cannot be moved from the midpoint of the tie. Removable taper ties may be used when approved by Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

## 2.5 FABRICATION

- A. Tolerances: The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the tolerances of ACI 117.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. Assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at no increased cost to Owner. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. Provide sufficient number of forms of each kind to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations.
- B. Install plumb and string lines before concrete placement and maintain during placement. Such lines shall be used by both Contractor and Engineer and shall be in sufficient number and properly installed. During concrete placement, continually monitor plumb and string line form positions and immediately correct deficiencies.
- C. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

### 3.2 FORM CONSTRUCTION

- A. Construct forms in conformance with ACI 347 and in accordance with the following.
- B. Design and construct forms to allow wall sections to be poured full-height without creating horizontal cold joints. Provide form ties of sufficient strength and number to prevent spreading of forms during the placement of concrete and permit ready removal of the forms without spalling or damaging the concrete.
- C. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Provide suitable and effective means on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided

with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03 30 00 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to Engineer.

- D. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- E. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.
- F. Form Ties
  - 1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers to leave the surface of the holes clean and rough before being filled with mortar as specified for finish of concrete surfaces in Section 03 30 00 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Do not remove ties in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, provide rubber grommets where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 2 inches back from the formed face or faces of the concrete.
  - 2. Removable Taper Ties: Where taper ties are approved for use, locate the large end of taper tie on the inside surface of the tank wall. Fill taper tie form holes that extend through the tank wall as follows:
    - a. Sandblast or roughen all taper tie holes and blow clean prior to filling.
    - b. After sandblasting and cleaning, drive rubber plug with one end open to the center of the taper tie hole. Plug size to be larger in diameter than the diameter of the taper tie hole at the center of the wall.
    - c. Coat the entire annular surface of the taper tie holes with epoxy prior to dry-packing the taper tie holes. Apply epoxy in accordance with manufacturer's instructions.

- d. Dry-pack each side of taper tie holes with non-shrink grout per Section 03 60 00 - Grouting. Apply dry-pack to the inside surface of the wall first. Pack into the hole with an appropriate tool.
- e. Cure the dry-pack surfaces. Coat the inside surface of the dry pack with epoxy coating.

### 3.3 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03 30 00 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by Engineer who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by Engineer and ACI 347.

### 3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to Engineer.

### 3.5 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least 2 weeks in advance of their use. Exercise care to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

### 3.6 FALSEWORK

- A. Place falsework on a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.



END OF SECTION

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**SECTION 03 20 00  
CONCRETE REINFORCING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Furnish, fabricate and install reinforcing steel as shown on Contract Documents.
- B. Work includes installation of tie wires, clips, supports, and other appurtenances necessary to meet Specifications and produce finished concrete structures.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 03 30 60 – Cast-In-Place Concrete Reservoirs
- C. Section 03 60 00 - Grouting

1.3 REFERENCES

- A. American Concrete Institute (ACI) standards, most recent editions:
  - ACI 315                                      Details of Concrete Reinforcement
  - ACI 350                                      Code Requirements for Environmental Engineering Concrete Structures
- B. American Welding Society (AWS):
  - D1.4                                      Structural Welding Code – Reinforcing Steel
- C. ASTM International (ASTM) standards, most recent editions:
  - ASTM A615                                      Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - ASTM A706                                      Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement
  - ASTM A775                                      Standard Specification for Epoxy-Coated Reinforcing Steel Bars
  - ASTM A1064                                      Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- D. Concrete Reinforcing Steel Institute (CRSI) standards, most recent editions:
  - Placing Reinforcing Bars

## Manual of Standard Practice

### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Submit details of the concrete reinforcement steel and concrete inserts at the earliest possible date after receipt of the Notice to Proceed.
- C. Include, but not limit to, the following:
  - 1. Complete bar schedule, bar details and erection drawings to conform to ACI 315.
  - 2. Each type of bar marked with identification corresponding to identification tag on bar.
  - 3. Length, type, and location of all splices.
  - 4. Erection drawings shall be clear, easily legible and to a minimum scale of:
    - a. 1/4 inch = 1 foot.
    - b. 1/8 inch = 1 foot if bars in each face are shown in separate views.
  - 5. Size and location of openings.
- D. Furnish a certified Affidavit of Compliance issued by steel manufacturer that reinforcing steel furnished for project meets requirements of ASTM standards referenced herein, as applicable.
- E. Do not use Contract Documents as erection drawings.

### 1.5 QUALITY ASSURANCE

- A. Qualifications
  - 1. Welding operators, processes, and procedures to be qualified in accordance with AWS D1.4.
  - 2. Welding operators to have been qualified during the previous 12 months prior to commencement of welding.
- B. Certifications
  - 1. Submit manufacturer's certification that products submitted meet requirements of standards referenced.

### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Store reinforcing steel on wood supports in a manner that prevents it from coming in contact with the ground.
- C. Store only bars with same identifying label in same stack.
- D. Cover epoxy coated reinforcement for protection against both moisture and ultraviolet light and so that condensation does not form on the bars.
- E. When handling coated bars, use systems with padded contact areas.

- F. Thoroughly inspect coated steel after delivery to the job site and again after installation to ensure that it is not damaged.
  - 1. Repair damage with patching material meeting manufacturer's requirements.
  - 2. Promptly patch sheared ends and other cuts or exposed areas before detrimental oxidation occurs.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Mechanical Couplers:
    - a. Lenton Form Saver by Erico Products.
    - b. DBDI Splicing System by Dayton Superior Corporation.
    - c. BPI Barsplicer System by Barsplice Products, Inc.
    - d. Engineer-approved equal.

### **2.2 REINFORCEMENT STEEL**

- A. Materials:
  - 1. Reinforcing bars: ASTM A615, Grade 60.
  - 2. Reinforcing bars to be welded: ASTM A706.
  - 3. Smooth dowels: ASTM A615, Grade 60 plain billet steel bars epoxy coated in accordance with ASTM A775. Provide slip dowel sleeves to allow longitudinal movement equal to joint width plus 1/4 inch.
  - 4.
  - 5. Welded wire fabric: ASTM A1064 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.
  - 6. Spiral reinforcement: Cold drawn steel wire conforming to the requirements of ASTM A1064.
  - 7. Welding Electrodes: E90 meeting requirements of AWS D1.4.
- B. Fabrication of Bars:
  - 1. Fabricate with cold bends conforming to recommended dimensions shown in ACI 350.
  - 2. Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel to same tolerances as for shop fabrications.
  - 3. Attach identification tags with identifying mark.
  - 4. Contractor may at his option continue steel reinforcement through openings in walls and slabs, then field cut opening.

### **2.3 BOLSTERS, CHAIRS AND ACCESSORIES**

- A. Conform to ACI 315 and CRSI Manual of Standard Practice.

- B. Provide spacers, bolsters, chairs, ties and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during concrete placement.
- C. Metal accessories shall be stainless steel with plastic coated tips where legs will be exposed in finished concrete surfaces. Color of plastic shall be grey to match concrete color.
- D. Do not use rocks, broken bricks, wood blocks, or concrete fragments for support of steel reinforcement.
- E. Support between Reinforcing Steel and Formed Exposed Surfaces: Metal bar chairs.

#### 2.4 PRECAST CONCRETE BLOCK BAR SUPPORTS (DOBIES)

- A. Supports between Reinforcing Steel for Roof Slabs: Concrete block prohibited.
- B. Minimum Compressive Strength of Blocks: 5,000 psi in seven days.
- C. Minimum Bearing Area: 9 square inches. Place as required to maintain specified clearances.
- D. Wire ties shall be embedded in concrete block bar supports.

#### 2.5 MECHANICAL COUPLERS

- A. Provide mechanical couplers where shown and where approved by Engineer and in accordance with ACI building code standards. The couplers shall develop a tensile strength, which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, supply all components required for a complete splice. This shall apply to all mechanical splices, including those splices intended for future connections.

#### 2.6 EPOXY GROUT

- A. 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 grout shall meet the requirements found in Section -03 60 00 - Grouting.

#### 2.7 FABRICATION

- A. Tolerances:
  - 1. Sheared lengths: plus or minus 1 inch.
  - 2. Overall dimensions of stirrups, ties, and spirals: plus or minus ½ inch.
  - 3. All other bends: +0 inch, -½ inch.
- B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 350.
- C. Ship all reinforcement to job site with attached plastic or metal tags.
  - 1. Place on each tag the mark number of the reinforcement corresponding to the mark number indicated on the shop drawings.

2. Mark numbers on tags to be so placed that the numbers cannot be removed.

## 2.8 TESTING

- A. Perform at mill for each heat.
- B. If requested by Engineer, furnish samples of each type of welded splice used in the Work in a quantity and of dimensions adequate for testing.
- C. At the discretion of Engineer, radiographic testing of direct butt-welded splices will be performed. Provide assistance necessary to facilitate testing. Repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by Owner; except, the costs of all tests which fail to meet specified requirements shall be paid by Contractor at no increase in cost to Owner.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Tolerances:
  1. Rebar Placement:
    - a. Clear distance to formed surfaces: plus or minus  $\frac{1}{4}$  inch.
    - b. Minimum spacing between bars:  $\frac{1}{4}$  inch.
    - c. Top bars in slabs and beams:
      - 1) Members 8 inches deep or less: plus or minus  $\frac{1}{4}$  inch.
      - 2) Members between 8 inches and 2 feet deep: plus or minus  $\frac{1}{4}$  inch.
      - 3) Members more than 2 feet deep: plus or minus  $\frac{3}{4}$  inch.
    - d. Crosswise of members: Spaced evenly within plus or minus 1 inch.
    - e. Lengthwise of members: plus or minus 2 inches.
  2. Minimum clear distance between rebars:
    - a. Beams, walls, and slabs: Distance equal to rebar diameter or 1 inch, whichever is greater.
    - b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1½ inch, whichever is greater.
    - c. Beam and slab rebars shall be threaded through the column vertical rebars without displacing the column vertical rebars and still maintaining the clear distances required for the beam and slab rebars.
- B. Minimum concrete protective covering for reinforcement, unless indicated otherwise on Contract Documents:
  1. Concrete deposited against earth: 3 inches.
  2. Formed surfaces exposed to weather or in contact with earth: 2 inches for all reinforcing bars.
  3. Formed surfaces exposed to any liquid: 2 inches for all rebar sizes.
  4. Interior surfaces: 2 inches for all reinforcing bars.
- C. Splice steel to conform to Chapter 12 of ACI 350 as applicable. Unless indicated otherwise on Contract Documents, provide splices for reinforcing as follows:
  1. Rebar:

- a. Lapped splices shall be not less than a Class B splice for reinforcement unless otherwise indicated.
- b. Mechanical splices shall be used whenever shown on the Contract Documents and may be used at other locations at Contractor's option. Such locations shall be shown specifically on the rebar shop drawings.
- c. Welding:
  - 1) Perform welding of rebars in accordance with requirements of AWS D1.4.
  - 2) Have each welder place an approved identifying mark near each completed weld.
- 2. Welded wire fabric: Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than 1 spacing of cross wires plus 2 inches, or less than 1.5 times the development length, nor less than 6 inches. Development length shall be as required for the basic development length for the specified fabric yield strength in accordance with Section 12 of ACI 350.
- 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.

D. Placing Rebars

- 1. Assure that reinforcement at time concrete is placed is free of mud, oil, or other materials that may affect or reduce bond.
- 2. Reinforcement with rust, mill scale, or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample are not less than required by applicable ASTM specifications that govern the rebar supplied.
- 3. Rebar support:
  - a. Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
  - b. On ground, provide supporting concrete blocks.
  - c. Over formwork, provide plastic-coated metal chairs, runners, boosters, spacers, hangers, and other rebar support. Only tips in contact with the forms need to be plastic coated.
  - d. Bars additional to those shown on the Contract Documents, which may be found necessary or desirable by Contractor for the purpose of securing reinforcement in position, shall be provided by Contractor at his own expense.
  - e. Tie securely at minimum of 33% of intersections with 16-gage or larger annealed iron wire.
  - f. Accommodate placement of formed openings.
  - g. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 inch. Place spacer rebars at 3 feet maximum centers to maintain the required 1-inch clear distance between layers.
  - h. Extend reinforcement to within 2 inches of concrete perimeter edges. If perimeter edge is earth formed, extend reinforcement to within 3 inches of the edge.
  - i. To insure proper placement, furnish templates for all column vertical bars and dowels.
  - j. Provide splices of reinforcement not specifically indicated or specified subject to Engineer's approval.



- k. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer. Do not bend reinforcing by means of heat.
  - l. Tie wires shall be bent away from form surfaces.
  - m. Do not tack-weld reinforcement.
- E. Ensure that steel reinforcement and embedments do not exceed 160 Degrees F at time of concrete placement.

### 3.2 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interfaces:
  - 1. Notify Engineer whenever the specified clearances between rebars cannot be met.
  - 2. Do not place any concrete until Engineer submits a solution to rebar congestion problem.
  - 3. Rebars may be moved slightly to avoid interference with other reinforcement steel, conduits, or embedded items.
  - 4. If rebars are moved more than 1 bar diameter, or enough to exceed above tolerances, obtain Engineer's approval of resulting arrangement of rebars.
  - 5. No cutting of rebars shall be done without written approval of Engineer.
- B. Employ a testing laboratory to perform and report following:
  - 1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
  - 2. Qualify welders in accord with AWS D1.4.
  - 3. Test three samples of each bar size and each type of weld in accord with AWS D1.4. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
  - 4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one random sample for each 10 welds. In addition, if any welds are found defective, test five previous welds performed by the same welder.
  - 5. Visually inspect each weld for presence of cracks, undercuts, inadequate size, and other visible defects.

### 3.3 COORDINATION

- A. Coordination with placement of formwork, formed openings, embedded items, and other Work.

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**SECTION 03 30 00  
CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide cast-in-place concrete work as shown on Contract Drawings and as specified herein.
- B. Section includes:
  - 1. Concrete Materials.
  - 2. Proportioning and Mixing.
  - 3. Ready Mixed Concrete.
  - 4. Curing Materials.
  - 5. Expansion Joint Filler.
  - 6. Elastomeric Bearings.
  - 7. Waterstops.
  - 8. Preparing for Concreting.
  - 9. Placing of Concrete.
  - 10. Finishing.
  - 11. Curing.
  - 12. Field Quality Control.

1.2 RELATED SECTIONS

- A. Section 03 11 00 – Concrete Forming.
- B. Section 03 20 00 – Concrete Reinforcing.
- C. Section 03 30 60 – Cast-In-Place Concrete Reservoir
- D. Section 03 60 00 – Grouting.
- E. Section 07 14 00 – Fluid-Applied Waterproofing.

1.3 REFERENCES

- A. American Concrete Institute (ACI) standards, most recent editions:

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 211	Standard Practice for Selecting Proportions for Concrete
ACI 212	Chemical Admixtures
ACI 301	Specifications for Structural Concrete for Buildings
ACI 305	Recommended Practice for Hot Weather Concreting

ACI 306	Recommended Practice for Cold Weather Concreting
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
B.	ASTM International (ASTM) standards, most recent editions:
ASTM C31	Standard Specification Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specifications for Concrete Aggregates
ASTM C39	Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Standard Specifications for Ready-Mixed Concrete
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM D412	Test Methods for Rubber Properties in Tension
ASTM D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D747	Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
ASTM D1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Test Method for Rubber Property - Durometer Hardness
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
C.	International Concrete Repair Institute (ICRI) standards, latest editions:
Guideline No 310.1R	Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
Guideline No 320.2R	Guide for selecting and specifying Materials for repair of Concrete Surfaces
D.	NSF International (NSF), most recent edition:
NSF 61	Drinking Water System Components, Health Effects
E.	U. S. Army Corps of Engineers standards, most recent editions:
CRD-C 572	PVC Waterstops

#### 1.4 DEFINITIONS

- A. Construction Joints: Fresh concrete placed against a hardened concrete surface; joint between two pours is called a construction joint. Unless otherwise indicated, provide construction joints with a waterstop and sealant groove of the shape indicated.
- B. Expansion Joints: To allow concrete to expand freely, space provided between two pours, formed as indicated. Space is made by placing filler joint material against the first pour; acts as a form for the second pour.
- C. Control Joints: Provide weakened plane in concrete, where shrinkage cracks will likely occur. A groove, shape and dimensions indicated in Drawings, formed or saw-cut in concrete. Groove is filled with joint sealant material.
- D. Laitance: In placement of concrete, accumulation of small inert particles of cement and aggregate on surface, caused by excess of water that, when it evaporates, leaves a thin layer, causing weakened plane for subsequent pour.
- E. Alkalies: Term "alkalies" referred to herein is defined as sum of percentage of sodium oxide and 0.658 times percentage of potassium oxide ( $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ ). These oxides shall be oxide content determined in accordance with ASTM C114.

#### 1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product data:
  - 1. Concrete mix design(s) proposed for use. Proposed concrete mix design submittal to include the following information:
    - a. Sieve analysis and source identification of fine and coarse aggregates. Include sand equivalency.
    - b. Source test results for aggregate organic impurities.
    - c. Source test results for deleterious aggregate per ASTM standards.
    - d. Proportioning of all materials.
    - e. Type of cement with mill certificate for cement.
    - f. Slump.
    - g. Air Content.
    - h. Brand, type, ASTM designation, and quantity of each admixture proposed for use.
    - i. 28-day cylinder compressive test results of trial mixes per ACI 350 and as indicated herein.
    - j. Shrinkage test results.
    - k. Standard deviation value for concrete production facility.
  - 2. Manufacturer and type of joint filler, joint sealant, curing agent, and finishing aid.
  - 3. Waterstops:
    - a. Provide manufacturer's current test reports with written material certification.

- b. Provide samples of extruded or molded sections of each size or shape to be used in the Work. Samples shall represent in all aspects, the material to be furnished under this Contract.
  - c. Provide sample of fabricated cross-construction of each size or shape of waterstop to be used. Fabricate samples so that material and workmanship represent the materials to be furnished in the Work.
  - d. Provide manufacturer's written certification as an integral part of the shipping form, to show that the material shipped to Work meets or exceeds the physical property requirements specified.
- 4. Manufacturer and type of bonding and patching mortar and bonding adhesive used at construction joints.
- 5. Pour plan for concrete pour sequence.

#### 1.6 CONCRETE CONFERENCE

- A. A meeting to review the detailed requirements of the Contractor's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 21 days after the notice to proceed.
- B. All parties involved in the concrete work shall attend the conference, including the following:
  - 1. Contractor's representative
  - 2. Testing laboratory representative
  - 3. Concrete subcontractor
  - 4. Reinforcing steel subcontractor and detailer
  - 5. Concrete supplier
  - 6. Admixture manufacturer's representative
- C. The conference shall be held at a mutually agreed upon time and place. The Engineer shall be notified no less than 5 days prior to the date of the conference.

#### 1.7 QUALITY ASSURANCE

- A. Preconstruction Testing: Perform all preliminary and trial batch laboratory tests on cement, aggregates, and concrete.
- B. Testing Agencies: The testing laboratory shall meet or exceed the requirements of ASTM C1077.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Mixing, transporting, handling, placing, curing and testing of concrete in accordance with applicable ACI and ASTM specifications and as specified.
- C. Storage of material:
  - 1. Cement:
    - a. Protect cement from exposure to moisture until used.
    - b. Do not use if caked or lumpy.

- c. Store sacked cement to permit access for inspection and sampling.
  - 2. Aggregate:
    - a. Store to prevent segregation and contamination with other sizes or foreign materials.
    - b. Obtain samples for testing from aggregates at point of batching.
    - c. Do not use frozen or partially frozen aggregates.
    - d. Do not use the bottom 6 inches of stockpiles in contact with ground.
    - e. Allow sand to drain until moisture content is uniform prior to use.
  - 3. Admixtures:
    - a. Protect from contamination, evaporation, freezing, or damage.
    - b. Maintain within temperature range recommended by manufacturer.
    - c. Completely mix solutions and suspensions prior to use.
- D. Delivery:
- 1. Prepare a delivery ticket for each load of ready-mix concrete delivered to the project. Truck operator shall hand ticket to Engineer at time of delivery, which shows the following information for each load:
    - a. Mix identification mark.
    - b. Quantity delivered (by volume).
    - c. Amount of each material in batch.
    - d. Outdoor temperature in the shade.
    - e. Time at which cement was added.
    - f. Amount of water added at jobsite by Contractor.
    - g. Amount of superplasticizer added where applicable.

## 1.9 SITE ENVIRONMENTAL REQUIREMENTS

- A. When temperature is below 40°F or is likely to fall below 40°F during 24-hour period after placing concrete, heat materials, (not in excess of 140°F) including both water and aggregates and protect concrete so that temperature of the concrete is between 50°F and 90°F for 24-hour period after placing concrete.
- B. During hot weather, shade materials from sun and use cool water so temperature of concrete does not exceed 90°F at time of placing concrete.
- C. Placing of concrete is not permitted where, in opinion of Engineer, wind, rain or inadequate facilities furnished by Contractor prevents proper finishing or curing of concrete.

## 1.10 COORDINATION

- A. Coordination with placement of reinforcing steel, embedded items, and other Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:



1. Expansion joint fillers:
  - a. Ceramar, WR Meadows, Inc.
  - b. Bondtex, Rubberite Cypress Sponge Corporation
  - c. Engineer approved equal.
2. Membrane Curing Compound.
  - a. 1100-Clear, WR Meadows, Inc.
  - b. Clear Resin Cure J11W, Dayton Superior.
  - c. L&M Cure R, L&M Construction Chemicals, Inc
  - d. Engineer approved equal.
3. Evaporation Retardant:
  - a. AquaFilm (J74), Dayton Superior.
  - b. Eucobar, Euclid Chemical Company.
  - c. MasterKure ER50, Master Builders.
  - d. Engineer approved equal.
4. Waterstops, Plastic Serrated Type:
  - a. Sika Vinylex Corporation.
  - b. Sika Greenstreak, Inc.
  - c. DCA Construction Products, LLC.
  - d. Engineer approved equal.
5. Waterstops, Plastic Adhesive Type:
  - a. Synko-Flex, Henry Company.
  - b. Engineer approved equal.
6. Bonding agent:
  - a. Armatec 110 EpoCem, Sika Corporation
  - b. Engineer approved equal.
7. Set Controlling Admixtures
  - a. For air temperature at the time of placement over 80°F; set-retarding and hydration control:
    - 1) MasterSet Delvo, Master Builders.
    - 2) Recover, GCP Applied Technologies.
    - 3) SikaTard 440, Sika Corporation.
    - 4) Engineer approved equal.
  - b. For air temperature at the time of placement under 40°F: Non-corrosive set accelerating:
    - 1) Daraset 400, GCP Applied Technologies.
    - 2) MasterSet FP 20, Master Builders.
    - 3) Plastocrete 161FL by Sika Corporation.
    - 4) Engineer approved equal.
8. Air-entraining Agent:
  - a. MasterAir AE 200, Master Builders.
  - b. Daravair 1000, GCP Applied Technologies.
  - c. Sika AEA-14, Sika Corporation.
  - d. Engineer approved equal.
9. Finishing Aids:
  - a. Day1 Finishing Aid, Solomon Colors.
  - b. Slab Assist, TK Products.
  - c. Engineer approved equal.
10. Crystalline Waterproofing Repair Grout:
  - a. Mortar IC, AquaFin, Inc.

- b. Penecrete Mortar, Penetron International, LTD.
  - c. Concentrate Dry Pac, Xypex Chemical Corporation.
  - d. Engineer approved equal.
- 11. Pigments for Underground Conduit Banks:
  - a. Arizona Oxides, #1835.
  - b. Bayer, Bayferrox #130.
  - c. Davis, #117.
  - d. As currently approved by Rocky Mountain Power Company.

## 2.2 MATERIALS

- A. Blended Hydraulic Cement: Comply with ASTM C595, Type IL (10) (MS), grey color.
  - 1. Cement shall not contain more than 0.60 percent equivalent alkalis.
  - 2. Limestone content is limited to 10 percent.
  - 3. Single brand of cement used throughout Work; brand approved by Engineer.
- B. Fly Ash: Not permitted
- C. Coarse Aggregate: Conforming to ASTM C33 and as noted below.
  - 1. Clean, hard, durable gravel, crushed gravel, crushed rock or combination thereof.
  - 2. Reactivity: Non-reactive or below innocuous behavior level.
  - 3. Prepare and handle coarse aggregates in two or more size groups for combined aggregates with maximum size greater than 3/4 inch.
  - 4. When aggregates are proportioned for each batch of concrete, combine the size groups.
  - 5. Obtain coarse aggregates from sources approved by Engineer.
- D. Combined Aggregates: Well graded from course to fine sizes; uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradation will be established during the trial batch process.
- E. Fine Aggregates: Natural or combination of natural and manufactured sand that is hard and durable.
  - 1. Lightweight Sand for Fine Aggregate: Not permitted.
  - 2. Sand Equivalency: Tested in accordance with ASTM D2419; not less than 80 percent for an average of 3 samples; not less than 80 percent for an individual test.
  - 3. Gradation: In accordance with ASTM C33; 15 to 30 percent passing number 50 screen; 5 to 10 percent passing number 100 screen.
  - 4. Fineness Modulus: Not over 3.00.
  - 5. Reactivity: Non-reactive or below innocuous behavior level.
  - 6. Obtain fine aggregates from sources approved by Engineer
- F. Water: Clean and free from objectionable quantities of organic matter, alkali, salts and other impurities, as determined by Engineer.
- G. Admixtures:

1. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials, and admixtures by weight percent of cement:
  - a. 0.06 For prestressed concrete.
  - b. 0.10 For all other concrete.
2. Do not use calcium chloride.
3. Provide admixtures of same type, manufacturer, and quantity as used in establishing required concrete proportions in the mix design.
4. Air entraining admixtures: ASTM C260.
5. Water reducing admixtures:
  - a. Comply with ASTM C494, Type A.
  - b. Concrete not to contain more than one water-reducing admixture.
  - c. Conform to applicable provisions of ACI 212.3R.
  - d. Follow manufacturer's instructions.
  - e. Use chloride free admixtures only.
6. Set controlling admixtures with or without water-reducing properties.
  - a. ASTM C494, Types B through E.
  - b. Conform to applicable provisions of ACI 212.3R.
  - c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no additional cost to Owner.
  - d. Follow manufacturer's instructions.
  - e. Use chloride free admixtures only.
7. High Range Water Reducers:
  - a. In accordance with ASTM C494, Type F.
  - b. Conform to applicable provisions of ACI 212.3R.
  - c. Follow manufacturer's instruction.
  - d. Slump before Addition: Maximum 2 inches.
  - e. Slump after Addition: Minimum of 6 inches and maximum of 10 inches.
8. Pigments for Underground Conduit Banks: Pigment shall be added to concrete encasing electrical duct banks as required by governing agency.

#### H. Curing Materials

1. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.
2. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU B 790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
3. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
4. Membrane Curing Compound (with fugitive dye added): ASTM C309, Type 1-D, Class B. Sodium silicate compounds shall not be allowed.

- I. Expansion Joint Filler
1. Provide expansion joints in concrete construction where shown on Contract Drawings.
  2. Expansion Joint Filler: Preformed, non-extruding, resilient type, constructed of cellular sponge rubber, extending full thickness of slab, in accordance with ASTM D1752, Type I.

J. Grout: As specified in Section 03 60 00 – Grouting.

K. Waterstop, Plastic Serrated Type:

1. Extruded elastomeric polyvinyl chloride compound: containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements of Specifications.
  - a. Store waterstops to permit free circulation of air around waterstop material.
  - b. Provide manufacturer's factory fabrications for intersections, transitions, and changes of direction.
  - c. In accordance with Specification CRD-C572.

	VALUE	ASTM STD.
<u>PHYSICAL PROPERTY, SHEET MATERIAL</u>		
Tensile Strength-minimum (psi)	1750	D412, Die C
Ultimate Elongation-minimum (%)	350	D412, Die C
Low Temp. Brittle-maximum (°F)	-35	D746
Stiffness in Flexure-minimum (psi)	400	D747
<u>ACCELERATED EXTRACTION (CRD-C572)</u>		
Tensile Strength-minimum (psi)	1500	D412, Die C
Ultimate Elongation-minimum (%)	300	D412, Die C
<u>EFFECT OF ALKALIES (CRD-C572)</u>		
Change in Weight (%)	+.25/-10	-----
Change in Durometer, Shore A	+5	D2240
<u>FINISHED WATERSTOP</u>		
Tensile Strength minimum (psi)	1400	D412, Die C
Ultimate Elongation minimum (%)	280	D412, Die C

- d. Style:
  - 1) Centerbulb, 7/8 inch OD, 6 inches long.
  - 2) Flat Strip, 6 inches long unless noted otherwise.
  - 3) Labyrinth, 4 3/8 inch long minimum

L. Waterstop, Plastic Adhesive Type: Non expansive plastic adhesive strip type conformable, manufactured solely for the purpose of preventing water from passing through construction joints.

1. Primer as recommended by waterstop manufacturer.

M. Elastomeric Bearing Materials:

1. Rubber bearing pads shall be furnished with the dimensions, material properties, and elastomer grade as required by the Drawings and in accordance with ASTM D2240, Type A, Shore 30 or 40 Durometer.
2. Prepare concrete support surfaces and adhere pads to concrete per manufacturer's recommendations.

- N. Finishing Aids:
    - 1. Topically applied colloidal silica compound.
    - 2. Do not use as a curing compound.
    - 3. Only to be used to assist in finishing by working into the surface immediately after application.
  - O. Waterproofing: Refer to Section 07 14 00 – Fluid-Applied Waterproofing.
- 2.3 EQUIPMENT
- A. On-Site Batch Plants:
    - 1. Direct weighing equipment approved by Engineer for measuring cement and aggregate. Scales certified by Bureau of Weights and Measures. Certification current within 6 months.
    - 2. Equip mixer with suitable water meter or other measuring device approved by Engineer.
      - a. Meter capable of measuring water in variable amounts within a tolerance of 1 percent.
      - b. Water feed control mechanism capable of being locked in position to deliver constantly supply of specified amount of water to each batch of concrete.
      - c. Meter equipped with setback register with a readily visible vertical face and double hands indicating in cubic feet and decimals.
      - d. Provide with positive, quick-acting cut-off valve in the water line to the mixer. Operating mechanism must not leak when valves are closed.
    - 3. Batch mixer of an approved type and size, designed to ensure uniform distribution of all component materials throughout the mass during the mixing operation. Install and use a batch timer and counter, including lock release and audible indicator on each concrete mixer.
  - B. Concrete Pumps:
    - 1. Provide pumping equipment with two cylinders, designed to operate with only one cylinder in case one is not functioning. In lieu of this requirement, provide a standby pump on the site during pumping.
      - a. Minimum Diameter of Hose (conduit): 4 inches.
      - b. Aluminum conduits for conveying the concrete will not be permitted.
  - C. Vibrators:
    - 1. Internally vibrated, high speed power vibrators of an approved immersion type. In sufficient numbers with standby units as required.
  - D. Truck Mixers:
    - 1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C94, including the following supplementary requirements.
    - 2. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within 90 minutes after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.

3. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
4. Mix each batch of concrete in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
5. Truck mixers and their operation shall 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 one inch when the specified slump is 3 inches or less, or if they differ by 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.
6. 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 quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

## 2.4 REINFORCEMENT STEEL

- A. Provide in accordance with Section 03 20 00 – Concrete Reinforcing.

## 2.5 CONCRETE MIXES

- A. General: Concrete shall be composed of cement, admixtures, aggregates, and water. These materials shall be of the qualities specified and in accordance with ACI 301 specifications. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Engineer.
- B. Fine Aggregate Composition:
  1. In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table:

Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

2. In all other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

C. Concrete compressive strength, aggregate size and slump in accordance with the following:

Type of Construction	Compressive Strength (psi)	Aggregate Gradation (ASTM C33)	Slump in Inches (Max.)	Max W/C Ratio (by Weight)
Structure walls and top slabs.	4,500	#67 (3/4")	4	0.45
Structure footings; foundations and bottom slabs.	4,500	#467 (1-1/2")	4	0.45
Reinforced concrete encasements; thrust blocks	4,000	#467 (1-1/2")	4	0.50
Site Slabs; Curb and gutter	4,000	#67 (3/4")	4	0.50
Lean Concrete	3,000	#467 (1-1/2")	5	0.60
Site underground conduit banks: Min. 3 lbs. red pigment/sack cement	3,000	#8 (3/8")	5	0.60

1. Compressive Strength: minimum at 28 days of age.
2. Slump as shown above shall be plus or minus 1 inch.
  - a. Slump listed is before addition of any plasticizing agents.
  - b. Measure at point of discharge of the concrete into the concrete member per ASTM C143.
  - c. Concrete of lower than maximum slump may be used provided it can be properly placed and consolidated.
3. Minimum cement content:
  - a. Reinforced Concrete: Six sacks Portland Cement per cubic yard.
  - b. Unreinforced Concrete: Five sacks Portland Cement per cubic yard.
4. Air content: Provide air entrainment resulting in a total air content of 4 to 7 percent for all types of construction.
  - a. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.
  - b. Air may be omitted from interior slabs to be trowel finished.

D. Selection of Proportions:

1. General: Proportion ingredients to produce proper workability, durability, strength, and other required properties. Prevent segregation and collection of excessive free water on the surface.

2. Submit mix design data for approval as required by this specification Section.
3. Proportion mixture to provide desired characteristics using one of the methods described below:
  - a. Method 1 (Trial Mix): Per ACI 350, Chapter 5, except as modified herein.
    - 1) Air content within range specified above.
    - 2) Record and report the temperature of trial mixes.
    - 3) Proportion trial mixes per ACI 211.1.
  - b. Method 2 (Field Experience): Per ACI 350, Chapter 5, except as modified herein.
    - 1) Field test records must be acceptable to Engineer to use this method.
    - 2) Test records shall represent materials, proportions, and conditions similar to those specified herein.
  - c. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of ACI 350, using the standard deviation of the proposed concrete production facility.
4. Shrinkage Limitation
  - a. Shrinkage limitations apply only to structural concrete.
  - b. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent, respectively per ASTM C157, as modified herein.
  - c. Use a mix design for construction that has first met the trial batch shrinkage requirements.

## 2.6 SOURCE QUALITY CONTROL

- A. Trial Batch: Based on submitted concrete mixes for each class of concrete.
- B. Aggregates:
  1. Fine and coarse aggregates shall be tested in accordance with ASTM C1260 or ASTM C1293 to show compliance with ASTM C33 for alkali-silica reactivity and the aggregates shall be non-reactive.
  2. The fine and coarse aggregates shall be tested in accordance with ASTM C586 to show compliance with ASTM C33 for alkali-carbonate reactivity and shall be non-reactive.
  3. The fine aggregate shall be tested in accordance with ASTM C40 to show compliance ASTM C33 for organic impurities.
  4. The fine and coarse aggregate shall be tested in accordance with ASTM C88 to show compliance with ASTM C33.
  5. The fine and coarse aggregate shall be tested in accordance with ASTM C142 to show compliance with ASTM C33.
  6. The fine and coarse aggregate shall be tested in accordance with ASTM C123 to show compliance with ASTM C33.
  7. The fine and coarse aggregate shall be tested in accordance with ASTM C117 to show compliance with ASTM C33.
  8. The coarse aggregate shall be tested in accordance with ASTM C131 to show compliance with ASTM C33.



9. In addition to initial aggregate testing, each type of aggregate shall be tested at no increased cost to the Owner for conformance to ASTM C33 under any of the following conditions:
  - a. Concrete placement extending longer than six months.
  - b. There is a noticeable change in aggregate appearance, consistency, or ease of excavation.
  - c. The aggregate supplier changes pits, or locations in the original pit.
10. If the test results fail to meet the requirements of ASTM C33 and this Section, the Engineer may stop the placement of concrete, and may require additional testing of aggregates or field and trial batch testing of concrete to verify conformance to ASTM C33 and the strength and shrinkage requirements of this Section.
11. The Engineer may conduct any additional testing of aggregates at any time during the concrete placement period. Depending on the test results, testing cost shall be paid by the Contractor or Owner, according to the General Conditions. If test data fails to conform to ASTM C33, the Engineer may stop the placement of concrete or take corrective actions as indicated above.

C. Concrete Testing:

1. Concrete testing to be performed by certified laboratory under direction of professional engineer licensed to practice in the State of Utah. Submit test results to Engineer and obtain approval prior to placement of concrete.
2. When concrete mix design is done per ACI 350, Method 1, (Trial Mix) incorporate shrinkage testing as specified herein into the mix design for all structural concrete mixes.
3. When concrete mix design is done per ACI 350, Method 2, (Field Experience), provide three drying shrinkage with seven compressive strength test specimens for approval of structural concrete mixes, using the actual materials and proportions proposed for the mixes. Provide additional trial batch testing when required by Engineer because of unsatisfactory test results.
4. Test four compression test cylinders at 7 days and three at 28 days:
  - a. Determination of compressive strength in units of psi will be made in accordance with ASTM C31.
  - b. Test in accordance with ASTM C469.
  - c. Modulus of elasticity determined by following formula:
    - 1)  $E_c = 33 * W * 1.5\sqrt{f'_c}$ 
      - a)  $E_c$  = Modulus of Elasticity
      - b)  $W$  = Weight of Concrete, lb/ft<sup>3</sup>.
      - c)  $f'_c$  = Required 28 day strength, psi.
5. Drying Shrinkage Tests:
  - a. Perform drying shrinkage tests for the trial batch.
  - b. Provide one set of three specimens from each class of structural concrete.
  - c. Specimen Prisms: 4 inches by 4 inches by 11 inches with effective 10-inch gauge length, fabricated, cured, dried, and measured in accordance with ASTM C157, modified as follows:
    - 1) Remove specimens from molds at an age of 23 plus/minus 1/2 hour after trial batching; place immediately in water at 73 plus/minus 1 degree F for 30 minutes; and measure within 30 minutes thereafter to determine original length.

- 2) Submerge in saturated lime water at 73 plus/minus 3 degrees F for 7 days.
  - 3) Remove specimens from lime water and measure length at 7 days of age. This is the base length for drying shrinkage calculations ("0" days drying age).
  - 4) After determining base length for drying shrinkage, store specimens immediately in a humidity control room maintained at 73 plus/minus 3 degrees F and 50 plus/minus 4 percent relative humidity for remainder of test.
  - 5) Make measurements to determine shrinkage expressed as percentage of base length: Report separately for 0, 7, 14, 21, and 28 days of drying age, after 7 days of moist curing.
- d. Drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age.
- 1) If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded.
  - 2) Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.

### **PART 3 - EXECUTION**

#### **3.1 PREPARING FOR CONCRETING**

- A. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. Surface shall be free from standing water, mud and debris at the time of placing concrete.
- B. Construct forms to the shape, lines and dimensions of members shown on Drawings and sufficiently tight to prevent leakage of mortar. Take special care when forming concrete containing high range water reducing agents. Brace and tie forms to maintain position and shape.
1. Before placing concrete containing superplasticizing agents, Contractor shall submit a Pour Plan to Engineer for approval. The Engineer may require additional manpower or equipment for these pours as required to limit defects in the concrete. The Pour Plan shall include the following:
    - a. Number of crew members and assignment of each.
    - b. Number of vibrators to be used.
    - c. Number of vibrators in reserve.
    - d. Time of day and anticipated duration of pour.
    - e. Type and capacity of pumping equipment if used.
- C. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or elevated floor slabs to drains.
1. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.

2. Do not place floor drains through beams.
- D. Unless otherwise indicated, provide exterior corners in concrete members with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- E. Complete all formwork, installation of parts to be embedded, reinforcement and surface preparation prior to placing concrete.
1. Use setting diagrams, templates, and instructions for locating and setting embedments and attachments.
  2. Prior to placing concrete, position and support pipe, conduit, dowels, and other ferrous items required to be embedded, to ensure clearance between items and any part of concrete reinforcement as specified below.
  3. Securing such items in position by welding to reinforcement is prohibited.
  4. Embedded electrical conduits and piping:
    - a. Install pipe, conduits and their sleeves passing through slabs or walls so as not to impair the strength of the concrete member.
    - b. Pipes and conduits larger than 3 inches in diameter may be embedded in structural concrete only after submittal and review of location and reinforcement details.
    - c. Pipes and conduits may be installed without the specific permission noted in paragraph b. above as follows:
      - 1) They are 3 inches or less in diameter, are spaced not less than 3 diameters on center (horizontally and vertically) and conform to paragraph 2) and 3) below.
      - 2) Pipes and conduits, including their fittings, which are embedded within a column, do not displace more than 4% of the cross-sectional area within the reinforcing steel cage.
      - 3) Pipes, conduits, and their sleeves embedded within a wall or slab are not larger (outside dimension) than 1/3 the overall thickness of the wall or slab in which they are embedded.
      - 4) There is a minimum of 2 inches between the pipe or conduit and surface of the slab or wall.
    - d. In walls and slabs with 2 layers of reinforcement, install pipes and conduits between layers of reinforcement as close to the middle of the concrete as practical without disturbing the reinforcement. Outside diameter of the pipe or conduit shall not exceed 1/3 the slab or wall thickness. Do not space parallel and crossing runs of pipe or conduit closer than 3 diameters on center, except at cabinet and outlet box locations.
    - e. In slabs with a single layer of reinforcement, install under reinforcement steel with a minimum of 2 inches clear to the concrete surface.
- F. Provide openings in formwork to accommodate other trades. Accurately place and securely support all items built into forms.
- G. Waterstops:
1. Preparation
    - a. Uncoil waterstop minimum of 24 hours prior to installation for ease of handling and fabrication.

- b. Position waterstop to ensure proper distance from steel reinforcing bars and to prevent rock pockets and honeycomb.
    - c. Clean concrete joint and waterstop after first pour to remove debris and dirt.
  - 2. Installation
    - a. Position waterstop across joints as specified herein and as indicated on Drawings.
    - b. Center waterstops on joint unless shown otherwise.
    - c. When centerbulb is present at moving joints, ensure that it is not embedded.
    - d. All waterstops fully continuous for the extent of the joint.
    - e. Secure plastic serrated waterstop in correct position before concrete placement with hog rings and wire to adjacent reinforcing steel at 12-inch maximum spacing. Center-to-center spacing may be increased upon written request and approval of Engineer.
    - f. Take suitable precautions and means to support and protect waterstops during the progress of the work.
    - g. Carefully place concrete without displacing waterstop from proper position.
    - h. For waterstops in slabs, limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.
  - 3. Field Splices
    - a. Only butt splices are permitted in the field. Butt splices shall be made by the method of continuous heat welding using a manufacturer-approved waterstop welding iron.
    - b. Splice PVC waterstops neatly and in accordance with manufacturer's written instructions.
    - c. Excessive PVC weld spatter is not acceptable.
    - d. A maximum of one splice is permitted in any straight 20 feet of waterstop.
- H. Construction, Expansion, and Contraction Joints:
  - 1. Provide at locations indicated or as approved by Engineer.
  - 2. Install construction joints in beams, slabs, and girders perpendicular to the planes of their surfaces.
  - 3. At least 48 hours shall elapse between placing of adjoining concrete construction.
  - 4. Before new concrete is placed against existing concrete, coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.
- I. Thoroughly clean surfaces of metalwork to be in contact with concrete immediately before concrete is placed.
- J. Remove ponded water from the excavation and moisten fill.
- K. Remove laitance, tighten forms, roughen, clean, wet and slush hardened concrete with cement grout prior to placing fresh concrete at construction joints. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

### 3.2 CYLINDER STORAGE DEVICE

- A. Provide and maintain a cylinder storage device at a protected location on the Site, acceptable to Engineer and as follows:
  - 1. Maintain concrete test cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 24-hour curing period.
  - 2. Once placed in the storage device, do not move the cylinders during this period.
  - 3. Equip the storage device with an automatic 24-hour temperature recorder that continuously records on a time/temperature chart with an accuracy of  $\pm 1$  degree F.
  - 4. Have the storage device available at the point of use at least 24 hours before concrete placement.
  - 5. A 24-hour test run may be required before placement of concrete.
- B. Engineer may stop placement of concrete if the storage device cannot accommodate the required number of test cylinders.
- C. Use water containing hydrated lime if water is to be in contact with cylinders.

### 3.3 PLACING OF CONCRETE

- A. Notify Engineer not less than 24 hours in advance of the times and places at which Contractor intends to place concrete.
- B. Place concrete in compliance with ACI Specifications and requirements of this Section.
- C. Place concrete only in presence of duly authorized representative of Engineer.
- D. Remove and replace concrete not placed as specified or of inferior quality, as determined by Engineer: assume associated expense.
- E. Ready Mix Equipment:
  - 1. Do not exceed manufacturer's rated capacity of the mixer.
  - 2. Ensure sufficient mixing time for uniform distribution of materials.
  - 3. Discharge all concrete from mixer prior to mixing new batch.
  - 4. In accordance with ASTM C94.
- F. Transporting:
  - 1. Transport concrete from mixer to place of deposit by methods, which prevent segregation or loss of material.
  - 2. Provide runways when wheelbarrows are used to transport concrete.
  - 3. Do not wheel conveying equipment over reinforcement or support runways on reinforcement.
- G. Placing:
  - 1. Deposit concrete in continuous manner and as rapidly as possible within planned joints or sections.
  - 2. Do not use concrete that has attained initial set or contained mixing water for more than 90 minutes.

3. Uniformly distribute concrete during process of depositing and in no case move deposited concrete in forms more than 6 feet in horizontal direction.
4. Do not drop freely more than 5 feet in unexposed work or more than 3 feet in exposed work; where greater drops are required, use duct or other approved method.
5. Do not place concrete against icy or frost covered earth surfaces.

H. Compacting:

1. Compact by internal type vibrators supplemented by rodding and tamping as necessary, to maximum practicable density, free from pockets of coarse aggregate in such a manner that surfaces are smooth and free from voids.
2. Avoid excessive vibration of concrete; avoid segregation of aggregates.
3. Avoid disturbance of previous lifts where initial set has taken place.
4. Use of form vibrators or tapping of forms is prohibited.

I. Finishing/Trowel Aid:

1. Use finishing/trowel aid on horizontal surfaces where identified on Drawings. The product may also be used on other horizontal surfaces at Contractor's option.
2. Apply finishing/trowel aid directly in front of float or trowel operations and immediately finish into the concrete surface.

J. Protection:

1. Protect all concrete against physical injury until final acceptance by Owner.
2. Protect concrete from reduced strength due to weather extremes.
3. When the temperature is below 40 Degrees F, or is likely to fall below 40 Degrees F during the 24-hour period after placing the concrete, follow the recommendations of ACI 306R, except as modified herein.
  - a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice, or snow.
  - b. Minimum concrete temperature at the time of mixing:

Outdoor Temperature at Placement (In shade)	Concrete Temperature (At mixing)
Below 30 Degrees F	65 Degrees F
Between 30 and 45 Degrees F	60 Degrees F
Above 45 Degrees F	50 Degrees F

- c. Do not place heated concrete that is warmer than 80 Degrees F.
  - d. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 Degrees F for 72 hours, with additional requirements listed under Article 3.4 - Curing below.
  - e. Do not allow concrete to cool suddenly.
  - f. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.
4. When the temperature is 90 Degrees F or above, or is likely to rise above 90 Degrees F within the 24-hour period after concrete placement; or when there is any combination of high air temperature, low relative humidity, and wind velocity which would impair concrete strength or quality, follow the recommendations of ACI 305R and the following:
  - a. Keep concrete as cool as possible during placement and curing.

- b. Do not allow concrete temperature to exceed 90 Degrees F at placement.
- c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
- d. Dampen subgrade and forms with cool water immediately prior to placement of concrete.
- e. Apply an evaporation retardant per manufacturer's instructions between placement and finishing operations.
- f. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
- g. Take appropriate precautions per ACI 305R when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305R.

### 3.4 CURING

#### A. Cure concrete for not less than 14 days after placing as follows:

- 1. Leave forms in place at least 14 days.
- 2. Strictly follow careful procedures for the removal of forms and perform with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted.
- 3. Keep encasement concrete, concrete cradles and anchor blocks moist until covered. The surface shall be covered with moist earth not less than 4 hours, or more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- 4. Concrete slabs may be cured by either of the following two methods:
  - a. Method 1:
    - 1) After finishing slab, wet surface with a fine spray of water and cover with polyethylene-bonded waterproof paper sheeting.
    - 2) Lap sheets 4 inches at sides and ends and seal with adhesive tape to form a continuous watertight joint.
    - 3) Weigh sheeting down with wood planks to keep sheeting in contact with concrete.
    - 4) Repair or replace sheets immediately if damage occurs.
  - b. Method 2:
    - 1) Cover concrete with water-saturated polyethylene-coated burlap curing mats and keep continuously wet for curing period.
    - 2) Lap sheets 4 inches at sides and ends and seal with adhesive tape to form a continuous watertight joint.
    - 3) Weigh sheeting down with wood planks to keep sheeting in contact with concrete.
    - 4) Repair or replace sheets immediately if damage occurs.

#### B. As an alternate to above referenced curing methods for formed and slab concrete, spray surface with liquid curing compound that does not affect bond of paint to concrete surface.

- 1. Apply curing compound in accordance with manufacturer's instructions as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after completion of finish or stripping of forms, if stripped in less than 14 days.
  - a. Maximum coverage rate of 200 square feet per gallon, applied in such a manner as to cover surface with a uniform film to seal thoroughly.

2. Curing vertical surfaces with a curing compound:
    - a. Cover vertical surfaces with a minimum of two coats of the curing compound.
    - b. Apply the first coat of curing compound immediately after form removal. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
    - c. Allow the preceding coat to completely dry prior to applying the next coat.
    - d. Vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.
  3. Curing Compound: As specified herein.
  4. Take care to avoid damage to seal during curing period.
  5. Repair broken or damaged seals occurring before expiration of curing period by application of additional curing compound over damaged portion.
  6. Do not use curing film method where construction joints are to be made.
- C. In hot weather, follow curing procedures outlined in ACI 305R and the following:
1. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After 24-hour interval, continue curing, using one of the following methods:
    - a. Moist cure for six more days.
    - b. Application of curing compound as specified above.
  2. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing, using one of the following methods:
    - a. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for six more days.
    - b. Strip forms and apply curing compound as specified for vertical surfaces above. Do not allow concrete surfaces to dry prior to application of curing compound.
- D. In Cold Weather, following curing procedures outlined in ACI 306R and the following:
1. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
  2. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 Degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 Degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 Degrees F.
  3. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 Degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 Degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 Degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.



4. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

### 3.5 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined, and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Engineer. In no case will extensively patching honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.
- B. All repairs shall be performed in accordance with the manufacturer's recommendations and with ICRI Guideline No 310.1R and Guideline No 320.2R. These guidelines shall be followed for removal geometry, exposing and undercutting of reinforcing steel, cleaning and repair of reinforcing steel, and edge and surface condition of concrete and shall be followed regardless of the amount of corrosion present or not present in the reinforcing steel.
  1. Remove unsound deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16-inch. Remove to provide for minimum thickness specified for mortar. If reinforcing is exposed in this process, then additional concrete shall be removed until the surface is a minimum of 1-inch or 1 bar diameter behind the exposed reinforcing.
  2. Clean exposed reinforcing bars of rust and other deleterious materials which may prevent bonding of the repair product.
  3. Keep surface at saturated surface dry (SSD) condition for a minimum of 24-hours prior to placement of repair material.
  4. Place and cure repair grout as specified in Section 03 60 00 – Grouting and in accordance with manufacturer's written recommendations.
  5. For exposed walls, the cement shall contain such a proportion of white Portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout specified in Section 03 60 00 - Grouting. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout specified in Section 03 60 00 - Grouting.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which

will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

- E. Prior to filling any structure with water, all cracks that may have developed shall be grooved and filled as shown on the Drawings. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

### 3.6 PATCHING HOLES IN CONCRETE

#### A. Patching Small Holes

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill material, shall be filled with nonshrink grout specified in Section 03 60 00 - Grouting. Where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled "Treatment of Surface Defects."
3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

#### B. Patching Large Holes

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified herein.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in drilled holes and epoxy grout as specified in Section 03 60 00 - Grouting. The reinforcing added shall match the reinforcing in the existing wall unless shown.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have either a hydrophilic type or a plastic adhesive type waterstop material placed around the perimeter of the hole as specified herein, unless there is an existing waterstop in place.

### 3.7 CONCRETE FINISH

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified herein. These tolerances are to be distinguished from irregularities in finish as described herein.
- B. Aluminum finishing tools shall not be used.
- C. Formed Surfaces:
  1. Exterior buried surfaces require no treatment after form removal except for curing, repair of defective concrete, and treatment of surface defects.

2. Surfaces exposed to view shall be finished as specified under "Architectural Concrete Finish" below.
- D. Surface holes larger than 1/2 inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
- E. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
1. Finish U1 – Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch. No further special finish is required.
  2. Finish U2 After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.
  3. Finish U3 After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities. Apply floor hardener where no additional floor finish or material is indicated.
  4. Finish U4 Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light broom finish with broom lines perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.

### 3.8 ARCHITECTURAL CONCRETE FINISH

- A. General: Architectural finish shall be required for permanently exposed concrete surfaces and in other locations where specifically called out on the Drawings.
1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired, and all form-tie holes filled as indicated herein.
  2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
  3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.
- B. Smooth Concrete Finish
1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be made by mixing one part Portland cement and one part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint.

The cement used in said grout shall be 1/2 gray and 1/2 white Portland cement, as determined by the Engineer. The freshly applied grout shall be vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all the surface grout has been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.

2. Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.
3. In the event that improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.
4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the Engineer and shall preserve said trial area undisturbed until the completion of the job.

### 3.9 WATERPROOFING

- A. Apply waterproofing to exterior surface of all buried roof slabs and walls of underground concrete structures.
- B. Refer to Section 07 14 00 – Fluid-Applied Waterproofing.

### 3.10 TOLERANCES:

- A. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.
  1. The following non-cumulative construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from plumb.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	Minus 1/4 inch Plus 1/2 inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4 inch

### 3.11 FIELD QUALITY CONTROL

#### A. General

1. Tests on component materials and for slump, temperature, air content, unit weight, compressive strength and shrinkage of concrete will be performed as specified herein.
2. The cost of all laboratory tests for qualification of mix designs on cement, aggregates, and concrete, including strength and shrinkage testing will be borne by Contractor. The cost of all field-testing during construction, including slump, temperature, air, strength, and shrinkage will also be borne by Owner. However, Contractor will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications.
3. Provide access for Engineer to aggregate stockpiles for concurrent sampling during construction.
4. Provide access for Engineer to batch plant for monitoring batching procedures during construction.
5. Concrete for testing shall be supplied by Contractor at no additional cost to Owner, and Contractor shall aid Engineer in obtaining samples, and disposal and cleanup of excess material.
6. Composite samples of concrete placed in the Work shall be taken in accordance with ASTM C172 from the first placement of each class of concrete and at the following minimum frequency for each class:
  - a. Not less than one sample per day on which concrete is placed.
  - b. Not less than one sample for each 50 cubic yards of concrete placed.
  - c. Not less than one sample for each 5,000 square feet of surface area for slabs or walls.
  - d. Not less than 5 samples from randomly selected batches for the Work.

#### B. Slump Tests

1. Perform in accordance with requirements of ASTM C143 at frequency indicated for sampling above.

#### C. Temperature Tests

1. Test concrete temperature per ASTM C1064 at frequency indicated for sampling above.

#### D. Air Content Tests

1. Test air content per ASTM C231 at frequency indicated for sampling above.

#### E. Unit Weight

1. Test unit weight per ASTM C138 at frequency indicated for sampling above.

#### F. Shrinkage Tests

1. Drying shrinkage tests will be made for the first placement of each class of structural concrete, and during construction every 3 months to ensure continued compliance with these Specifications. A minimum of 1 test per structure shall be made regardless of the timing.

2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried, and measured in accordance with ASTM C157 as modified in this Section.
3. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage test value by more than 25 percent.
  - a. If the required shrinkage limitation is not met during construction, take any or all the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

G. Field Compression Tests

1. Field compression test specimens will be made at the frequency indicated for sampling above.
2. Each set of test specimens will be a minimum of five cylinders.
3. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
4. Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and two at 28 days. The remaining cylinders will be held to verify test results, if needed.

H. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 350 and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard of deviation.
5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the Owner.

3.12 APPLICATION OF LOADS

- A. Do not allow traffic, construction equipment, or materials of any kind to be placed on elevated concrete slabs until the concrete has attained a minimum age of 7 days and 80% of the minimum specified 28-day strength as proven by concrete strength tests.

- B. Do not place backfill against cantilevered walls until the concrete has attained a minimum age of 7 days and 100% of the minimum specified 28-day concrete strength as proven by concrete strength tests.
- C. Do not place backfill against walls that are tied to elevated slabs or decks until the both the slabs and walls have attained a minimum age of 7 days and 80% of the minimum specified 28-day strength as proven by concrete strength tests.

### 3.13 SCHEDULES

- A. Grout: As specified in Section 03 60 00 – Grouting.
- B. Unformed Concrete Surfaces: Apply finish as follows.

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs not water bearing	U4
Interior and exterior slabs where Drawings require only light broom finish	U4
Interior slabs and finished floors with architectural finishes	U3
Top surface of walls	U3

END OF SECTION

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**SECTION 03 30 60**  
**CAST-IN-PLACE CONCRETE RESERVOIRS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Provide concrete and form, mix, place, cure, repair, finish, and do other Work incidental to construction of Portland cement concrete reservoir structures. This Section is complementary to Section 03 30 00 – Cast-in-Place Concrete and has precedence regarding the reservoir structures only. Items of construction which are necessary for the reservoirs, but which are not included herein shall conform to the requirements of Section 03 30 00 – Cast-in-Place Concrete.
- B. Section includes:
  - 1. Proportioning and Mixing.
  - 2. Construction Joints.
  - 3. Source Quality Control.
  - 4. Preparation of surfaces for concreting.
  - 5. Placing concrete.
  - 6. Curing and waterproofing concrete.
  - 7. Protection.
  - 8. Field Quality Control.
- C. Products installed but not supplied under this section:
  - 1. Waterstops.
  - 2. Ready mix concrete.

**1.2 RELATED SECTION**

- A. Section 03 11 00 – Concrete Forming.
- B. Section 03 30 00 – Cast-In-Place Concrete.
- C. Section 03 20 00 – Concrete Reinforcing.
- D. Section 07 14 00 – Fluid-Applied Waterproofing.
- E. Section 07 92 00 – Joint Sealants

**1.3 REFERENCES**

- A. American Concrete Institute (ACI) standards, most recent editions:

ACI 211	Standard Practice for Selecting Proportions for Concrete
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305	Recommended Practice for Hot Weather Concreting

- |         |   |
|---------|---|
| ACI 306 | Recommended Practice for Cold Weather Concreting                    |
| ACI 350 | Code Requirements for Environmental Engineering Concrete Structures |
- B. ASTM International (ASTM) standards, most recent editions:
- |           |  |
|-----------|--|
| ASTM C31  | Standard Specification Making and Curing Concrete Test Specimens in the Field                |
| ASTM C114 | Methods of Chemical Analysis of Hydraulic Cement   |
| ASTM C157 | Test Method for Length Change of Hardened Cement Mortar and Concrete                         |
| ASTM C309 | Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete             |
| ASTM C469 | Test Method for Static Modulus of Elasticity and Poisson's Ration of Concrete in Compression |
- C. National Sanitation Foundation (NSF), most recent edition:
- |        |   |
|--------|---|
| NSF 61 | Drinking Water System Components, Health Effects. |
|--------|---|

#### 1.4 DEFINITIONS

- A. Construction Joints: Fresh concrete placed against a hardened concrete surface; joint between two pours is called a construction joint. Unless otherwise indicated, provide construction joints with a waterstop and sealant groove of the shape indicated.
- B. Expansion Joints: To allow concrete to expand freely, space provided between two pours, formed as indicated. Space is made by placing filler joint material against the first pour; acts as a form for the second pour.
- C. Control Joints: Provide weakened plane in concrete, where shrinkage cracks will likely occur. A groove, shape and dimensions indicated in Drawings, formed or saw-cut in concrete. Groove is filled with joint sealant material.
- D. Laitance: In placement of concrete, accumulation of small inert particles of cement and aggregate on surface, caused by excess of water that, when it evaporates, leaves a thin layer, causing weakened plane for subsequent pour.
- E. Alkalies: Term "alkalies" referred to herein is defined as sum of percentage of sodium oxide and 0.658 times percentage of potassium oxide ( $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ ). These oxides shall be oxide content determined in accordance with ASTM C114.

#### 1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

- B. Product data:
1. Concrete mix design(s) proposed for use. Proposed concrete mix design submittal to include the following information:
    - a. Sieve analysis and source identification of fine and coarse aggregates. Include sand equivalency.
    - b. Source test results for aggregate organic impurities.
    - c. Source test results for deleterious aggregate per ASTM standards.
    - d. Proportioning of all materials.
    - e. Type of cement with mill certificate for cement.
    - f. Slump.
    - g. Air Content.
    - h. Brand, type, ASTM designation, and quantity of each admixture proposed for use.
    - i. 28-day cylinder compressive test results of trial mixes per ACI 350 and as indicated herein.
    - j. Shrinkage test results.
    - k. Standard deviation value for concrete production facility.
  2. Manufacturer and type of joint filler, joint sealant, curing agent, and chemical floor hardener.
  3. Manufacturer and type of bonding and patching mortar and bonding adhesive used at construction joints.
  4. Material Safety Data Sheets (MSDS) for compounds used in concrete operations in areas exposed to potable water.
    - a. Compounds for items used in interior of reservoir.
  5. Pour plan for superplasticized concrete pours.

## 1.6 SITE ENVIRONMENTAL REQUIREMENTS

- A. Hot and cold weather concreting: In accordance with ACI 305 and ACI 306 respectively.

## 1.7 COORDINATION

- A. Coordination with placement of reinforcing steel, embedded items, and other Work.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Membrane Curing Compound:
    - a. Atlas Quantum-cure NSF, Atlas Construction Supply, Inc.
    - b. Clear Cure VOC J7WB, Dayton Superior.
    - c. E-Cure, SpecChem, LLC.
    - d. Engineer approved equal.
  2. Shrinkage Reducing Admixture:
    - a. MasterLife SRA 035, Master Builders.
    - b. Eclipse 4500, GCP Applied Technologies, Inc.
    - c. PREVent-C, Vitro Minerals.

- d. Engineer approved equal.

## 2.2 FORMWORK

- A. Provide in accordance with Section 03 11 00 – Concrete Forming.

## 2.3 REINFORCEMENT STEEL

- A. Provide in accordance with Section 03 20 00 – Concrete Reinforcing.

## 2.4 READY-MIXED CONCRETE

- A. Provide in accordance with Section 03 30 00 – Cast-in-Place Concrete, except as modified below.

## 2.5 RESERVOIR JOINT SEALANTS

- A. Provide in accordance with Section 07 92 00 – Joint Sealants.

## 2.6 MEMBRANE CURING COMPOUND

- A. Inside the potable water reservoir, membrane curing compounds shall be water-based compounds, certified for contact with potable water per NSF 61.

## 2.7 CONCRETE MIXES

- A. General: Concrete shall be composed of cement, admixtures, aggregates, and water. Determine exact proportions in which these materials are to be used for different parts of the Work and submit to Engineer for approval prior to use in Work. Design the mixes to produce a concrete capable of being deposited to obtain maximum density and minimum shrinkage and, where deposited in forms, to have maximum smoothness of surface.
- B. Fine Aggregate Composition: Maximum 41 percent of total weight of fine and coarse aggregate, regardless of fineness modulus.
- C. Admixtures
  1. Shrinkage reducing admixture not to exceed 2.0 gallons per cubic yard of concrete without Engineer's approved.
  2. All admixtures in accordance with Section 03 30 00 – Cast-in-Place Concrete.
  3. Quantity of admixture used, and the method of mixing shall be in accordance with the manufacturer's instructions.
- D. Provide concrete in accordance with shrinkage requirements specified in this Section. Low shrinkage concrete required in reservoir footings, floor slabs, walls, and roof.
- E. Minimum compressive strength and cement content of concrete not less than shown in following tabulation.
  1. Engineer may order cement content for any class concrete be increased over quantity specified in tabulation if Engineer determines that such increase is necessary to attain required strength.

2. Increased quantities of cement, if so ordered, furnished by Contractor at no additional cost to Owner.
3. Maximum water-cement (W/C) ratio: 4.7 gallons per sack of cement for 4,500 psi concrete (0.42 by weight), including water in admixtures.
4. Minimum Slump: Batch concrete to a minimum slump of 2 inches before addition of any plasticizer, or as determined by Engineer.
5. Compressive Strength: 28-day minimum.
6. Reservoir floor and footing concrete: Minimum 6 sacks Portland cement per cubic yard.
7. All other concrete: Minimum 5.5 sacks Portland cement per cubic yard.
8. Slump as shown in table below is absolute maximum.
  - a. For plasticized concrete, slump to be measured before addition of any plasticizing agents if added at the job site.
9. Air content: Provide air entrainment resulting in a total air content of 4 to 6 percent.

Type of Construction	Compressive Strength (psi)	Aggregate Gradation (ASTM C33)	Slump in Inches (Max.)	Slump in Inches w/admixture (Max.)
Floor and footings.	4,500	#67 (3/4")	3	4
Roof, columns, walls, other structural concrete.	4,500	#67 (3/4")	4	7

F. Selection of Proportions:

1. General: Proportion ingredients to produce proper workability, durability, strength, and other required properties. Prevent segregation and collection of excessive free water on the surface.
2. Submit mix design data for approval as required by this specification section.
3. Proportion mixture to provide desired characteristics using one of the methods described below:
  - a. Method 1 (Trial Mix): Per ACI 350, Chapter 5, except as modified herein.
    - 1) Air content within range specified above.
    - 2) Record and report the temperature of trial mixes.
    - 3) Proportion trial mixes per ACI 211.1.
  - b. Method 2 (Field Experience): Per ACI 350, Chapter 5, except as modified herein.
    - 1) Field test records must be acceptable to Engineer to use this method.
    - 2) Test records shall represent materials, proportions, and conditions similar to those specified herein.
  - c. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of ACI 350, using the standard deviation of the proposed concrete production facility.
4. Shrinkage Limitation
  - a. For reservoir concrete specified in this Section only, the maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 28-day drying age shall be 0.025 percent per ASTM C157, as modified herein. Use a mix design for construction that has first met the trial batch shrinkage requirements and includes the shrinkage reducing admixture

specified above. Shrinkage requirements for concrete used outside the reservoir shall meet limits given in Section 03 30 00 – Cast-in-Place Concrete.

## 2.8 SOURCE QUALITY CONTROL

- A. Trial Batch: Based on submitted concrete mixes for each class of concrete.
- B. Materials: Aggregates, cement, and admixtures proposed for the Work to be tested as required in Section 03 30 00 – Cast-in-Place Concrete.
- C. Testing to be performed by certified laboratory under direction of professional engineer licensed to practice in Utah. Submit test results to Engineer and obtain approval prior to placement of concrete.
  - 1. Provide three drying shrinkage and seven compressive strength test specimens for approval for reservoir concrete. Provide additional trial batch testing when required by Engineer because of unsatisfactory test results.
  - 2. Test four compression test cylinders at 7 days and three at 28 days:
    - a. Determination of compressive strength in units of psi will be made in accordance with ASTM C31.
    - b. Test in accordance with ASTM C469.
    - c. Modulus of elasticity determined by following formula:
      - 1)  $Ec = 33 * W * 1.5\sqrt{f'c}$ 
        - a)  $Ec$  = Modulus of Elasticity
        - b)  $W$  = Weight of Concrete, lb/ft<sup>3</sup>.
        - c)  $f'c$  = Required 28 day strength, psi.
    - d. Average compressive strength for the three 28-day cylinders prepared for any given trial batch shall be a minimum of 1200 psi greater than the specified compressive strength ( $f'c$ ).
- D. Provide drying shrinkage specimens as specified in this Section.
- E. Drying Shrinkage Tests:
  - 1. Perform drying shrinkage tests for the trial batch.
  - 2. Provide one set of three specimens from each class of concrete.
  - 3. Specimen prisms: 4 inch by 4 inch by 11 inch with effective 10-inch gauge length, fabricated, cured, dried measured in accordance with ASTM C157, modified as follows:
    - a. Remove specimens from molds at an age of 23 plus/minus 1/2 hour after trial batching; place immediately in water at 73 plus/minus 1 degree F for 30 minutes; and measure within 30 minutes thereafter to determine original length.
    - b. Submerge in saturated lime water at 73 plus/minus 3 degrees F for 7 days.
    - c. Remove specimens from lime water and measure length at 7 days of age. This is the base length for drying shrinkage calculations ("0" days drying age).
    - d. After determining base length for drying shrinkage, store specimens immediately in a humidity control room maintained at 73 plus/minus 3 degrees F and 50 plus/minus 4 percent relative humidity for remainder of test.

- e. Make measurements to determine shrinkage expressed as percentage of base length: Report separately for 0, 7, 14, 21 and 28 days of drying age, after 7 days of moist curing.
  - 4. Drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age.
    - a. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded.
    - b. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.
- F. These tests shall be considered a part of the normal compression tests for the project.

### **PART 3 - EXECUTION**

#### **3.1 PREPARING FOR CONCRETING**

- A. As specified in Section 03 30 00 – Cast-in-Place Concrete, with the following modifications.
- B. Construction, Expansion, and Contraction Joints:
  - 1. Provide at locations indicated or as approved by Engineer.
  - 2. Install construction joints in beams, slabs, and girders perpendicular to the planes of their surfaces.
  - 3. Before new concrete is placed against existing concrete, coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.
  - 4. Vertical joints where waterstops are required: Coat joint face with bonding agent in accordance with manufacturer recommendations. Do not coat sealant groove surfaces or waterstops.
- C. Waterstops
  - 1. Provide proper anchoring of waterstops to concrete, including tie-offs.
  - 2. Prevent folding of waterstops during placement of concrete.
  - 3. Provide continuous 3/8 inch diameter pencil rod steel support at top edge of horizontal waterstops attached 12 inches on center or as directed by Engineer.
  - 4. Provide continuous 3/8 inch diameter pencil rod steel support at both edges of vertical waterstops, attached 12 inches on center or as directed by Engineer.
  - 5. Prevent formation of air and rock pockets under waterstops when placing roof and floor slab concrete. Work concrete by hand if required or as directed by Engineer.

#### **3.2 PLACING OF CONCRETE**

- A. Place concrete as specified in Section 03 30 00 – Cast-in-Place Concrete in addition to the following requirements:
  - 1. Place concrete in units as determined by construction joints shown on Drawings; ensure minimal effects of shrinkage.
  - 2. Alternate placement of units: Cure each unit at least 7 days before the contiguous unit or units are placed. Place corner sections of vertical walls after adjacent wall panels have cured for a minimum 14 days.

3. Sequence and order of placement in all parts of Work subject to approval by Engineer.
- B. Remove and replace concrete not placed as specified or of inferior quality, as determined by Engineer; assume associated expense.
- C. Sloping Slabs: Place concrete uniformly from the bottom of slope to the top, for full width of pour; vibrate and carefully work around reinforcement; screed in an up-slope direction.
- D. Horizontal Construction Joints.
  1. Provide level, straight joint on exposed surfaces of walls: Place wood strip, minimum 3/4-inch thick on forms at joint.
  2. Place concrete approximately 1/2 inch above underside of strip.
  3. Remove wood strip approximately one hour after concrete is placed. Remove irregularities at edge formed by wood strip; level with trowel and remove laitance.
- E. Eliminate air and rock pockets around waterstops.
  1. Rod and vibrate.
  2. Reservoir floor and roof slabs: Work concrete by hand under waterstops.
- F. Temperature of Concrete During Placement: Maximum 90 degrees F, minimum 40 degrees F; minimum 50 degrees F during weather conditions when mean daily temperature drops below 40 Degrees F.
  1. Heating concrete ingredients: Heat ingredients to temperature no higher than necessary to maintain specified placement temperature of concrete.
  2. Methods of heating concrete ingredients subject to approval of Engineer.
  3. Pre-cooling of ingredients: Cool ingredients as required to maintain specified placement temperature of concrete.
  4. No additional compensation due to the foregoing requirements.

### 3.3 CONCRETE FINISH

- A. All finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown on Drawings or as prescribed by Engineer. Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth continuous, hard surface.
- B. Except as otherwise specified, unformed top surfaces of concrete shall be brought to uniform surfaces and worked with suitable tools to a reasonably smooth wood-float finish.
  1. Excessive floating of surfaces while the concrete is plastic will not be permitted.
  2. Place slabs monolithically; the slab surface shall not be placed as a separate layer below the footings.
  3. Dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted.
  4. Floor slabs and exposed tops of walls and curbs shall be given a steel trowel finish.
  5. Option: Floor slabs may be finished with a power float after screeding.
  6. Surfaces of floor slabs shall be lightly broomed to provide a skid-resistant surface.

### 3.4 CURING

- A. Cure concrete minimum 14 days after placing, in accordance with methods specified below.



- B. Reduce quantity of water used for curing, with approval of Engineer, during periods when mean daily temperature is less than 40 degrees F. Discontinue water curing during periods when concrete surfaces may freeze.

SURFACE TO BE CURED OR WATERPROOFED	METHOD
Unstripped wooden forms.	1
Construction Joints between footings and walls, and between floor slab and columns.	2
Encasement concrete and thrust blocks.	3
All concrete surfaces not specifically provided for elsewhere in this Section.	4
Exterior buried surfaces of walls.	5
Exterior buried surfaces of roof slabs.	5

- C. Method 1: Wet wooden forms immediately after concrete has been poured; continue until forms are removed. If forms are removed within 14 days of placing the concrete, continue cure in accordance with applicable specified method.
- D. Method 2: Cover with wet burlap mats; continue to wet with water for 14 days or as directed by Engineer. Application of curing compounds prohibited.
- E. Method 3: Cover with moist earth minimum of 4 hours, maximum of 24 hours, after concrete is placed.
- F. Method 4: Spray with liquid water-based curing compound. Apply in accordance with manufacturer's instructions; provide uniform seal; readily distinguishable for 7 days in sunlight. Assume expense for heavier application if required by Engineer.
1. Avoid damage to film during curing period.
  2. Apply additional compound immediately if damaged prior to end of cure period.
  3. Remove curing compound by wet blast wherever curing compound may have been applied to surfaces against which concrete is to be placed and to adhere.
  4. Apply compound within 2 hours after removal of forms. Perform required repairs within the 2-hour period. Repairs that cannot be made within 2-hour period: Perform delayed repairs after the curing compound has been applied; remove compound from repair area by wet blasting prior to making repairs.
- G. Method 5: Coat surface with curing compound in accordance with requirements of Method 4. Coat with waterproofing agent as specified in Section 07 14 00 – Fluid-Applied Waterproofing.

### 3.5 PROTECTION

- A. Protect concrete against injury until final acceptance by Owner.
1. Protect fresh concrete from damage due to rain, hail, sleet or snow.
  2. Provide protection while the concrete is still plastic and whenever such precipitation is imminent or occurring, as determined by Engineer.
  3. Immediately following the first frost in the fall, be prepared to protect concrete against freezing.

4. After the first frost and until the mean daily temperature in the vicinity of the Work site falls below 40 degrees F for more than 1 day, protect concrete against freezing temperatures for not less than 48 hours after it is placed.
  5. After the mean daily temperature in the vicinity of the work site falls below 40 degrees F for more than 1 day, maintain concrete at a temperature above 50 degrees F for at least 72 hours after it is placed.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the 50 degrees F protection for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, protect concrete against freezing temperatures for an additional 72 hours immediately following 72 hours of 50 degrees F. Protect concrete cured by water curing against freezing temperatures for 3 days immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinue protection against freezing temperatures so that drop in temperature of any portion of concrete will be gradual and will not exceed 40 degrees F in 24 hours. In spring, when mean daily temperature rises above 40 degrees F for more than 3 successive days, specified 72-hour protection at temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, take special care to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.
- E. Take particular care to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Concrete found to be damaged or that may have been originally defective or that becomes defective at any time prior to the final acceptance of the completed Work or that departs from the established line or grade or that for any other reason does not conform to the Specifications shall be satisfactorily repaired or removed and replaced with acceptable concrete at Contractor's expense.

### 3.6 FIELD QUALITY CONTROL

- A. General
1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified in Section 03 30 00 – Cast-in-Place concrete except as modified below.
- B. Field Compression Tests
1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein. Perform tests of concrete by independent testing laboratory a minimum of once per 150 cubic yards of poured concrete and once per day for pours of less than 150 cubic yards to ensure continued compliance with these Specifications. Each set of test specimens will be a minimum of five cylinders.

- C. Drying Shrinkage Tests
1. Perform drying shrinkage tests as specified during construction to ensure continued compliance with these Specifications
  2. Provide one set of 3 specimens from the first placement of each class of structural concrete and 3 specimens per 500 cubic yards of placed concrete.
    - a. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 15 percent.
    - b. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.
- D. Waterstop Field Samples:
1. Field samples of fabricated fittings (crosses, tees, and so forth) will be selected at random by Engineer for testing by a laboratory at the Owner's expense.
  2. When tested, they shall have a tensile strength across the joint equivalent to at least 600 psi.
  3. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically controlled heating iron.

END OF SECTION

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## **SECTION 03 60 00 GROUTING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Work includes various types of cementitious grout to be provided and installed per the Contract Documents
- B. Section includes the following types of grout:
  - 1. Cement grout.
  - 2. Nonshrink grout.
  - 3. Epoxy grout.
  - 4. Grout for repair of concrete.
  - 5. Pump and motor grout.
  - 6. Concrete topping grout and concrete fill.

#### **1.2 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-In-Place Concrete

#### **1.3 REFERENCES**

- A. American Concrete Institute (ACI) standards, most recent editions:
  - ACI 308                      Standard Practice for Curing Concrete
  - ACI 350                      Code Requirements for Environmental Engineering Concrete Structures
- B. American Society for Testing and Materials (ASTM) standards, most recent editions:
  - ASTM C78                      Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
  - ASTM C94                      Standard Specifications for Ready-Mixed Concrete
  - ASTM C109                      Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
  - ASTM C307                      Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
  - ASTM C348                      Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
  - ASTM C469                      Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
ASTM C884	Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
ASTM C939	Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
ASTM C1107	Packaged Dry, Hydraulic Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM C1202	Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1339	Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
C.	International Concrete Repair Institute (ICRI) standards, latest editions:
Guideline No 310.1R	Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
Guideline No 320.2R	Guide for selecting and specifying Materials for repair of Concrete Surfaces

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data:
  - 1. Submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein.
  - 2. Submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work.
- C. Certification:
  - 1. Provide manufacturer's independent certification of compliance with ASTM C1107 without modification to the standard methods certifying that the Class B or C grout's post-hardening non-shrink properties are not based on gas expansion.
  - 2. Provide Manufacturer's certification that grouts have strengths of 3500 psi at 1 day, 6500 psi at 3 days and 7500 psi at 28 days when cured at 72 degrees F as well as meeting the 3, 7, and 28-day strengths when tested and cured at the 45 degree F and 95 degree F limits and all other requirements of ASTM C1107.
  - 3. The Contractor shall engage an independent testing laboratory to run a 24-hour grout evaluation in accordance with ASTM C1107 of each grout submitted for approval showing compliance with all aspects of the evaluation. Submit results to the Engineer for review.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Maintain all materials clean, dry and protected against dampness, freezing and foreign matter.
  - 1. Store non-shrink grout materials in temperature controlled environments above 40 degrees F and below 90 degrees F.
  - 2. Store epoxy grout components in temperature controlled environments above 60 degrees F and below 90 degrees F.
- C. Deliver epoxy resin, hardener, and aggregate in sealed pre-measured containers, palletized and shrink-wrapped to prevent shipping damage.
- D. Immediately remove from the Project site any cement-based grout material which becomes damp or otherwise defective.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Nonshrink, nonmetallic grout:
    - a. 5 Star Grout, Five Star Products, Inc.

- b. Masterflow 928, BASF Building Systems, Inc.
  - c. NS Grout, Euclid Chemical Company.
  - d. Sika Grout 212, Sika Corporation.
  - e. Engineer approved equal.
- 2. Epoxy grout:
  - a. HP Epoxy Grout, Five Star Products, Inc.
  - b. Masterflow 648 CP Plus, BASF Building Systems, Inc.
  - c. E<sup>3</sup>-Flowable, Euclid Chemical Company.
  - d. Sikadur 42 Grout-Pak, Sika Corporation.
  - e. Engineer approved equal.
- 3. Grout for pumps and motors:
  - a. Escoweld, ITW Polymer Technologies.
  - b. Chockfast Red, ITW Polymer Technologies.
  - c. DP Epoxy Grout, Five Star Products, Inc.
  - d. Engineer approved equal.

## 2.2 CEMENT GROUT

- A. Cement grout shall be composed of one-part cement, three 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 4,500 psi.
- B. Cement grout materials shall be as specified in Section 03300 – Cast-in-Place Concrete.

## 2.3 NONSHRINK GROUT

- A. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water.
- B. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
- C. 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 herein shall be that recommended by the manufacturer for the particular application. All grouts (Grade B or C) shall be tested for height change of the hardened grout at 1, 3, 14, and 28 days in accordance with ASTM C1090 and shall be tested for compression at 1, 3, 7, and 28 days in accordance with the modified ASTM C109 testing procedure.
- D. Class A non-shrink grouts: Not used.
- E. Class B or C high precision, fluid, extended working time, non-shrink grouts:
  - 1. Minimum 28-day compressive strength of 7500 PSI.
  - 2. No shrinkage (0.0 percent) and a maximum of 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827.
  - 3. No shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state
  - 4. When mixed to a fluid consistency of 20 to 30 seconds per ASTM C939 at temperature extremes of 45 to 90 degrees F shall have an extended working time of 30 minutes when tested in accordance with ASTM C1107.



- F. Application:
1. Class B or C non-shrink grout shall be used for grouting under all base plates for structural steel members, grouting under all equipment base plates except for pumps and motors, and at all locations where grout is required by the Contract Documents except where epoxy grout or grout for pumps and motors is specifically required. Class B or C non-shrink grout shall be used in place of Class A non-shrink grout for all applications. Class B or C non-shrink grout shall not be used for dry packing applications or repair of concrete.

## 2.4 EPOXY GROUT

- A. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive 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. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
- B. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
- C. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C827.
- D. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by testing in accordance with ASTM C1339, for bearing area and flow.
- E. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of  $30 \times 10^{-6}$  inches/inch/degree F when tested according to ASTM C531 or ASTM D696.
- F. Application:
1. Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout and for all other applications in the Contract Documents where grout type is not specifically indicated.

## 2.5 GROUT FOR REPAIR OF CONCRETE

- A. Vertical, overhead, and shotcrete applications:
1. Shall not produce a vapor barrier.
  2. One component, reoplastic, cement based, shrinkage compensated, non-expansive, gray concrete product.
  3. Sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water.

4. Free of chlorides and other chemicals causing corrosion with the following properties:
  - a. Minimum Slant Shear Bond Strength: 2500 PSI at 28 days when tested in accordance with ASTM C882.
  - b. Minimum Compressive strength: 6,500 PSI at 28 days when tested in accordance with ASTM C109.
  - c. Minimum Tensile Bond Strength: 200 PSI at 28 days per ASTM C307.
  - d. Minimum Flexural Strength: 1,200 PSI when tested in accordance with ASTM C348.
  - e. Modulus of Elasticity: 3.6E6 PSI when tested in accordance with ASTM C469.
  - f. Maximum Rapid Chloride Permeability: 772 coulombs when tested in accordance with ASTM C1202.
- B. Horizontal and formed applications:
  1. Shall not produce a vapor barrier.
  2. One component, reoplastic, cement-based, shrinkage compensated, non-expansive, gray concrete product.
  3. Flowable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water.
  4. Free of chlorides and other chemicals causing corrosion with the following properties:
    - a. Minimum Shear Bond Strength: 2150 PSI at 7 days.
    - b. Minimum Compressive Strength: 6000 PSI at 7 days when tested in accordance with ASTM C109.
    - c. Minimum Flexural Strength: 770 PSI at 28 days when tested in accordance with ASTM C78.
    - d. Maximum Chloride Permeability: 1,000 coulombs when tested in accordance with ASTM C1202.
    - e. Modulus of Elasticity: 4.8E6 PSI when tested in accordance with ASTM C469.

## 2.6 GROUT FOR PUMPS AND MOTORS

- A. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
  1. Creep shall be less than 0.005 in/in when tested by ASTM C1181 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 PSI.
  2. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17E-6 in/in/degree F when tested by ASTM C531.
  3. The compressive strength shall be a minimum of 12,000 PSI in 7 days when tested by ASTM C579 Method B, modified.
  4. Bond strength of grout to Portland cement concrete shall be greater than 2,000 PSI when using ASTM C882 test method.
  5. Grout shall pass the thermal compatibility test when overlaid on Portland cement concrete using test method ASTM C884.
  6. Tensile strength and modulus of elasticity shall be determined by ASTM D638. The tensile strength shall not be less than 1,700 PSI and the modulus of elasticity shall not be less than 1.8E6 PSI.
  7. Peak exothermic temperature shall not exceed 110 degrees F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.

8. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 PSI.
- B. Primer, if required, shall conform to the written recommendations of the grout manufacturer.
- C. Surface preparations shall conform to the written recommendations of the grout manufacturer.
- D. Placement and Curing
  1. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
  2. A grouting performance demonstration/training session shall be conducted by the grout manufacturer's representative prior to foundation and baseplate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.

## 2.7 CONCRETE TOPPING GROUT AND CONCRETE FILL

- A. Grout for topping of slabs and concrete fill for built up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures in conformance with Section 03 30 00 – Cast-In-Place Concrete.

## 2.8 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 – Cast-In-Place Concrete for cement grout and as recommended by the grout manufacturer for prepackaged grouts.

## 2.9 CONSISTENCY

- A. Use grouts with the consistency necessary to completely fill space to be grouted for the particular application. Where "dry pack" is called for in the Contract Documents, use grout with a consistency such that the grout is plastic and moldable but will not flow.
- B. Regardless of consistency called for on the Contract Documents, the type of grout to be used shall be as indicated herein for the particular application.

## 2.10 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement will not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the grout manufacturer.

## **PART 3 - EXECUTION**

### **3.1 PERPARATION**

- A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03 30 00 – Cast-In-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.
- B. Do not place grout on concrete or masonry substrates until those substrate materials have attained 28-day design strength unless authorized by Engineer.

### **3.2 MANUFACTURER'S SERVICES**

- A. The manufacturer of nonshrink grout and epoxy grout shall provide onsite technical assistance upon request.
- B. Coordinate with the manufacturer all demonstrations, training sessions, and applicable site visits. The grout manufacturer shall conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurements, cube testing, application, and curing for each category and type of grout.
- C. Training by the manufacturer is required for all types of grout installations. Grout manufacturer's representative shall train Contractor to perform the grout Work including mixing of grouts to required consistency, testing, placing, and curing on actual project base plates, tie holes, rock pockets, and other applications.

### **3.3 GROUTING PROCEDURES**

- A. Prepackage Grouts: All 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. Base Plate Grouting:
  - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a 1 inch thickness of grout or a thickness as indicated on the Contract Drawings.
  - 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. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by Engineer, alternate grouting methods shall be submitted for acceptance by Engineer.
- C. Concrete Topping Grout:
  - 1. All mechanical, electrical, and finish Work shall be completed prior to placement of concrete topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete 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 6-inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or 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.
4. Concrete 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 which shall be immediately eliminated. When the topping and 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.

D. Grout for Repair of Concrete

1. All repairs shall be performed in accordance with the manufacturer's recommendations and with ICRI Guideline No 310.1R and Guideline No 320.2R. These guidelines shall be followed for removal geometry, exposing and undercutting of reinforcing steel, cleaning and repair of reinforcing steel, and edge and surface condition of concrete and shall be followed regardless of the amount of corrosion present or not present in the reinforcing steel.
2. Remove unsound deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16-inch. Remove to provide for minimum thickness specified for mortar. If reinforcing is exposed in this process, then additional concrete shall be removed until the surface is a minimum of 1-inch or 1 bar diameter behind the exposed reinforcing.
3. Clean exposed reinforcing bars of rust and other deleterious materials which may prevent bonding of the repair product.
4. Keep surface at saturated surface dry (SSD) condition for a minimum of 24-hours prior to placement of repair material.
5. Place material in accordance with Manufacturer's written recommendations.
6. Cure material continuously for 7-days with water fog nozzles or other applications which provide a continuous wet curing of the repaired area in accordance with ACI 308.

E. CONSOLIDATION

1. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

**DIVISION 05**  
**METALS**

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**SECTION 05 50 00  
METAL FABRICATIONS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Furnish, fabricate, and install metal fabrications in accordance with Contract Documents.

1.2 RELATED SECTIONS

- A. Section 05 52 13 – Pipe and Tube Railings
- B. Section 07 22 16 – Rigid Polystyrene Board Insulation
- C. Section 07 72 00 – Roof Accessories
- D. Section 09 90 00 – Painting and Coating
- E. Section 09 97 01 – Pipeline Coatings and Linings

1.3 REFERENCES

- A. ASTM International (ASTM) standards, most recent editions:

ASTM A6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Specification for Structural Steel
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Gray Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A197	Standard Specification for Cupola Malleable Iron
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	Specification for Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563	Specification for Carbons and Alloy Steel Nuts
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTMA668	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992	Standard Specification for Steel for Structural Shapes for Use in Building Framing
ASTM A1085	Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B211	Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Standard Specification for Stainless Steel Nuts
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

B. American National Standards Institute (ANSI) standards, most recent editions:

- |  |            |  |
|--|------------|--|
|  | ANSI A14.3 | Standard for Ladders - Fixed - Safety Requirements |
|--|------------|--|
- C. American Welding Society (AWS) Standards, most recent editions:
- |  |                      |   |
|--|----------------------|---|
|  | AWS D1.1             | Structural Welding Code – Steel                           |
|  | AWS D1.2             | Structural Welding Code – Aluminum                        |
|  | AWS D1.6             | Structural Welding Code – Stainless Steel                 |
|  | AWS QC1              | Specification for AWS Certification of Welding Inspectors |
|  | AWS Welding Handbook |   |
- D. American Water Works Association (AWWA) standards, most recent editions:
- |  |           |   |
|--|-----------|---|
|  | AWWA C105 | American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems                              |
|  | AWWA C217 | Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines |
- E. National Sanitation Foundation (NSF), most recent edition:
- |  |        |   |
|--|--------|---|
|  | NSF 61 | Drinking Water System Components, Health Effects. |
|--|--------|---|
- F. Federal Specifications:
- |  |            |  |
|--|------------|--|
|  | MIL-A-907E | Anti-seize Thread Compound, High Temperature |
|--|------------|--|
- G. Occupational Safety and Health Administration (OSHA), most recent editions:
- |  |              |               |
|--|--------------|---------------|
|  | OSHA 1910.27 | Fixed Ladders |
|--|--------------|---------------|
- H. Society for Protective Coatings (SSPC):
- |  |           |  |
|--|-----------|--|
|  | SSPC-PA 1 | Shop, Field, and Maintenance Painting of Steel |
|--|-----------|--|
- 1.4 DEFINITIONS
- A. Metal Fabrications: Defined as items to be fabricated from metal shapes, plates, or bars and their products.
- 1.5 SUBMITTALS
- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings: Submit shop drawings of all metal fabrications to the Engineer for review.
1. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their

- connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
2. Submit layout drawings for grating showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Submit load and deflection tables for each style and depth of grating used.
- C. Submit ICC-ES report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor submitted. Submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review, by Engineer, these instructions shall be followed specifically.
  - D. No substitution for the indicated adhesive anchors will be considered unless accompanied by an ICC-ES report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

#### 1.6 QUALITY ASSURANCE

- A. All weld procedures and welder qualifications shall be available in the Contractor's field office for review.
- B. Qualification of Welders: Use welders with current certifications (previous 12 months) for the material, type, and position of welding used. Certify in accordance with AWS Specifications according to the following:
  1. AWS D1.1, Structural Welding Code – Steel.
  2. AWS D1.2, Structural Welding Code – Aluminum.
  3. AWS D1.6, Structural Welding Code – Stainless Steel.
- C. All welding shall be inspected by a Contractor-furnished inspector qualified in accordance with AWS requirements and approved by the Engineer.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Metal fabrications shall be loaded for transport in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged.
- C. Protect metal fabrications from corrosion and deterioration.
- D. Store material in a dry area and do not place in direct contact with the ground.
  1. Do not place materials on the structure in a manner that might cause distortion or damage to the members or supporting structures.
  2. Repair or replace damaged materials or structures as directed.

#### 1.8 PROJECT CONDITIONS

- A. Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop

drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Concrete anchors:
  - a. Hilti, Inc.
  - b. ITW Ramset/Redhead.
  - c. Simpson Strong Tie Company, Inc.
  - d. Engineer approved equal.
2. Castings, trench covers, and accessories:
  - a. D&L Foundry and Supply
  - b. Deeter Foundry company.
  - c. Neenah Foundry Company.
  - d. Engineer approved equal.
3. All purpose metal framing
  - a. Allied Tube and conduit.
  - b. B-Line Systems.
  - c. Unistrut Building Systems.
  - d. Engineer approved equal.
4. Steel Ladder Rungs:
  - a. Perforated "Traction Tread"; McNichols, Co.
  - b. Engineer approved equal.
5. Floor hatches:
  - a. Babcock Davis Associates.
  - b. Bilco Company.
  - c. EJ Group, Inc.
  - d. Engineer approved equal.
6. Anti-seize lubricant:
  - a. AS-470 by Dixon Ticonderoga
  - b. PURE WHITE by Anti-Seize Technology
  - c. Engineer approved equal.

### **2.2 MATERIALS**

A. Steel:

1. Wide flange steel shapes shall be ASTM A992. Other steel shapes, plates, and bars shall be in accordance with ASTM A6 and ASTM A36, unless otherwise shown.
2. Structural steel pipe shall be ASTM A53, Type E or S, Grade B.

3. Structural tubing shall be ASTM A1085. Furnish members full length without splices unless otherwise noted or approved by Engineer.
  4. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated in the Contract Documents.
- B. Steel Forgings: ASTM A668.
- C. Stainless steel: ASTM A666 and ASTM A276, Type 316 or 316L
- D. Aluminum: Alloy 6061 – T6 conforming to the following specifications:
1. Sheet and plate: ASTM B209.
  2. Rolled Bars and Rods: ASTM B211.
  3. Extruded bars, rods, shapes, and tubes: ASTM B221.
  4. Rolled or extruded structural shapes: ASTM B308.
  5. Extruded structural pipe and tube: ASTM B429.
- E. Iron:
1. Ductile iron: ASTM A536.
  2. Gray cast iron: ASTM A48.
  3. Malleable iron: ASTM A47, A197.
- F. Bolts and Anchors:
1. Standard Service (non-corrosive applications): Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt material, anchor bolts, and cap screws shall be in accordance with the following:
    - a. Anchor bolts: ASTM F1554, Grade 36, of dimensions indicated, with nuts conforming to ASTM A563 and flat washers where indicated.
    - b. Install high-strength structural connections using ASTM A325 bolts and nuts per ASTM A563, coated to match material being connected.
  2. Corrosive Service: All bolts, nuts, and washers in the locations listed below shall be stainless steel.
    - a. All buried locations except as noted below for pipe flange, fitting and coupling connections.
    - b. All submerged locations.
    - c. Inside hydraulic structures, below the top of the structure.
    - d. Inside buried vaults, manholes, and structures that do not have a forced-air ventilation system and either a gravity drain or a sump with a sump pump.
    - e. All chemical handling areas.
    - f. Other locations indicated by the Contract Documents or designated by the Engineer to be provided with stainless steel bolts.
  3. Stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, conforming to ASTM F593 for bolts and to ASTM F594 for nuts. Protect all threads on stainless steel bolts with an anti-seize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E and classified as acceptable for potable water use by NSF. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

4. Pipe Flange, Fitting and Coupling Connection Applications: Unless otherwise noted, all pipe flange, fitting and coupling connection bolts shall be carbon steel per ASTM A307, Grade A hex bolts, with nuts per ASTM A563. All bolts, nuts and washers shall be zinc plated. Protect all threads on bolts and nuts with anti-seize lubricant.
  - a. Exposed Connections: For exposed pipe connections in buried vaults, manholes, and structures with forced-air ventilation and which drain through a gravity sewer or to a sump with a pump, prepare and coat bolts and nuts after installation with the same system as the adjacent flanged piping, in accordance with Section 09 90 00 – Painting and Coating.
  - b. Buried Connections: Coat all buried connections in accordance with Section 09 97 01 – Pipeline Coatings and Linings. Provide wax tape coating per AWWA C217 for steel pipe connections, including sleeve couplings and restrained sleeve couplings. For other pipe materials, grease and wrap connections per AWWA C105.
5. Bolt Requirements:
  - a. The bolt and nut material shall be free-cutting steel.
  - b. The nuts shall be capable of developing the full strength of the bolts.
  - c. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.
  - d. Provide bolts with hexagon heads. Provide nuts conforming to Heavy Hexagon Series.
  - e. Install all bolts and nuts with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification.
  - f. Install lock washers with washers where indicated and fabricated of material matching the bolts.
- G. Provide bolts of length such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.
- H. Epoxy Anchors: Unless otherwise indicated, all drilled concrete or masonry anchors shall be epoxy anchors. No substitutions will be considered unless accompanied with ICC-ES reports verifying strength and material equivalency.
  1. Epoxy anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Provide threaded stainless steel rod, Type 316.
  2. Unless otherwise indicated, epoxy anchors will also be permitted in locations not indicated above.
  3. Products for concrete anchorage:
    - a. HIT-RE 500-V3, Hilti.
    - b. Set XP, Simpson Strong-Tie.
    - c. Red Head C6+, ITW Ramset/Redhead.
    - d. Engineer approved equal.
- I. Expansion Anchors: Expansion anchors will only be permitted when specifically approved by the Engineer. Expansion anchors that are to be fully encased in grout may be carbon steel. For non-encased buried or submerged anchors, provide stainless steel anchors. When expansion anchors are indicated or permitted, provide the following:

1. Kwik-Bolt TZ, Hilti.
2. Strong-Bolt 2, Simpson Strong-Tie.
3. Trubolt, ITW Ramset/Redhead.
4. Engineer approved equal.

J. Corrosion Protection:

1. Hot-dip galvanize all miscellaneous steel metalwork after fabrication.
  - a. Galvanizing: ASTM A123 or A653 with minimum coating of 1.5 ounce per square foot.

## 2.3 MANUFACTURED UNITS

A. Handrails and Guardrails: Refer to Section 05 52 13 – Pipe and Tube Railings.

B. Bollards:

1. Standard weight steel pipe, diameter as shown on Drawings.
2. Minimum 48 inches projection above finish grade.
3. Minimum 42 inches embedment in concrete.
4. Fabricate sleeves for removable bollards from steel pipe with 1/4-inch thick steel plate welded to bottom of sleeve.

C. Ladders:

1. Ladders shall be of stainless steel or galvanized steel as shown on the Contract Documents. When material is not specifically noted, material shall be stainless steel.
2. Design to support minimum 300-pound concentrated vertical load with 150-pound concentrated horizontal load.
  - a. Maximum allowable stresses per AISC manual.
  - b. Maximum lateral deflection: Side rail span/300.
  - c. Design in accordance with OSHA standards.
3. Fabricate ladders for the locations shown, with dimensions, spacings, details, and anchorages as indicated. Comply with requirements of ANSI A14.3.
4. Side rails, minimum sizes: Continuous, 1 1/2-inch nominal diameter pipe. Fabricate with eased edges, spaced 18 inches apart.
5. Rungs: 1-1/8 inch by 1-5/8 inch by 14 gage perforated "traction tread" rungs.
  - a. Top rung level with top platform.
6. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
7. Support each ladder at top and bottom and at intermediate points spaced not more than 4 feet on center with welded or bolted steel brackets.
8. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 9 inches.
9. When required by Drawings, every ladder that does not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

D. Metal Grating:



1. Metal grating shall be of the design, sizes, and types indicated. Completely band at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Support grating at bearings by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used unless indicated otherwise. Such angles shall be mitered and welded at corners.
  2. Bearing Bars:
    - a. Type: Rectangular bar.
    - b. Thickness: 3/16 inch minimum.
    - c. Depth: 1-1/2 inch unless otherwise indicated on Contract Documents.
    - d. Spacing: 1 3/16 inch maximum.
    - e. Configuration of top surface: Plain unless otherwise indicated on Contract Documents.
  3. Cross Bars:
    - a. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.
    - b. Spacing: 4 inches maximum.
  4. All pieces of grating shall be fastened in at least two locations to each support.
  5. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4-inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated moving load of 1000 pounds.
  6. Material:
    - a. Aluminum: Except where otherwise indicated, bar grating shall be fabricated entirely of aluminum. Bearing and banding bars, alloy 6063-T5.
    - b. Grating which may be partially or wholly submerged shall be fabricated entirely of stainless steel.
  7. No single piece of grating shall weigh more than 80 pounds or be wider than 3 feet, unless indicated otherwise on Contract Documents.
- E. Floor Hatches:
1. Where floor access hatches are called for on the Contract Documents to be mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein.
  2. Material: Aluminum alloy 6061-T6 unless otherwise indicated. Provide Type 316 stainless steel hardware.
  3. Design Live Load: Minimum 150 psf.
  4. Provide hatch opening sizes, number and directional swing of door leaves, and locations as indicated on the Drawings. Sizes given are for the clear opening. Where the number of leaves is not indicated, provide double-leaf doors for openings larger than 42 inches in either direction. Unless indicated otherwise, locate hinges on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 36 inches wide by 36 inches long, with the door hinge opposite the ladder.
  5. Hatch shall have oversized recessed padlock hasp that can accommodate a lock with a 2.5" shackle length.
  6. Hatch shall be equipped with recesses safety grating for fall protection.

7. Door leaves shall be a minimum of 1/4-inch checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening from both inside and outside.
  8. Door leaves shall be insulated with 2" thick rigid polystyrene insulation board. Insulation shall be installed by the manufacturer and fully encased with an aluminum plate. See Section 07 22 16 – Rigid Polystyrene Board Insulation for insulation requirements.
  9. Aluminum surfaces in contact with other metals or concrete shall be painted for aluminum metal isolation. Caulk the mounting flange of access hatches for water tightness when mounted to concrete curbs.
  10. Products:
    - a. Type "BFDDP", Babcock Davis Associates.
    - b. Type "J" or "JD", Bilco.
    - c. Type "CLS1", EJ Group, Inc.
    - d. Engineer approved equal.
- F. Roof Hatches:
1. Where indicated on Contract Drawings, hatches mounted on a roof surface of whatever material shall be the integral raised curb type as indicated in Section 07 72 00 – Roof Accessories.
- G. Iron Castings:
1. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shot blasting. Castings shall be prefabricated, conforming to ASTM A48 or A536.
  2. Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding finished surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
  3. Covers and grates with matching frames shall be designed to support the following loadings:
    - a. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no floor loading is given, a minimum of 300 pounds per square foot.
    - b. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.
- H. All Purpose Metal Framing:
1. Material: Carbon Steel.
  2. Channels and inserts:
    - a. Minimum 12 gage.
    - b. Channels to have one side with a continuous slot and inturned lips.
  3. Fittings: Hot-rolled steel strip and plate.
  4. Nuts: Steel, ASTM A563, with toothed grooves in top of nuts to engage the inturned lips of channels.
  5. Finish: Epoxy coated. Galvanize items which cannot be epoxy coated.

## 2.4 FABRICATION

- A. Verify field conditions and dimensions prior to fabrication.
- B. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- C. Form exposed work true to line and level with accurate angles and surfaces straight and sharp edges.
- D. Drill and punch holes with smooth edges.
- E. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
  - 1. Temperature Range: 0 degrees F minimum to 110 degrees F maximum ambient temperature.
- F. Shear and punch metals cleanly and accurately. Remove burrs.
- G. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- H. Remove sharp or rough areas on exposed traffic surfaces.
- I. Welding
  - 1. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
  - 2. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
  - 3. Weld corners and seams continuously to comply with the following:
    - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - b. Obtain fusion without undercut or overlap.
    - c. Remove welding flux immediately.
    - d. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

- J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners whenever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- K. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- L. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- M. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- N. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

## 2.5 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Hot-dip galvanize after fabrication.

## 2.6 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel studs for embedding into concrete.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports.
- C. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection.
- D. Cut, drill, and tap units to receive hardware, hangers, and similar items.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- B. Inspect and verify condition of substrate. Correct any surface defects or conditions which might interfere with or prevent a satisfactory installation.
- C. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

### **3.2 INSTALLATION**

- A. Set metal work level, true to line, plumb.
- B. In fabrication and erection of structural steel, conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- C. Shim and grout as necessary.
- D. To the maximum extent possible, use bolted field connections. Where practicable, conceal the fastenings. When field welding is warranted, comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish/grind exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- E. Unless notes or specified otherwise:
  - 1. Connect steel members to steel members with 3/4-inch diameter high strength bolts.
  - 2. Connect aluminum to aluminum with 3/4-inch diameter aluminum bolts.
  - 3. Connect aluminum to structural steel using 3/4-inch diameter stainless steel bolts.
  - 4. Connect aluminum and steel members to concrete using 3/4-inch stainless steel epoxy anchors. Provide a minimum of 5 1/2 inches of embedment into concrete or masonry.
- F. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing. Provide fully welded splices where continuity is required.
- G. Provide each fabricated item complete with attachment devices as indicated or required to install.

- H. Anchor metal items so that items will not be distorted nor fasteners overstressed from expansion and contraction.
- I. Install bollards in concrete as detailed. Fill pipe with concrete and round off at top of pipe.
- J. Attach grating to end and intermediate supports with grating saddle clips and bolts.
  - 1. Maximum spacing: 2 feet on center with a minimum of two attachments per support.
  - 2. Attach individual units of grating together with clips or attachments at 2 feet on center maximum with a minimum of two clips per side.
- K. Coat ferrous metals in accordance with Section 09 90 00 – Painting and Coating.
- L. Coat surfaces of aluminum that will come in contact with grout, concrete, masonry, wood or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.3 DRILLED ANCHORS

- A. Drilled-in 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, cleaned and dried. Drilled anchors shall not be installed until the concrete has reached the specified 28-day compressive strength. Epoxy anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

### 3.4 SETTING LOOSE PLATES

- A. Clean concrete bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- B. Set loose level and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
  - 1. Use non-shrink grout in concealed locations where not exposed to moisture.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.5 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780

END OF SECTION

**SECTION 05 52 13**  
**PIPE AND TUBE RAILINGS**

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes guardrails and handrails to be fabricated and installed complete, in accordance with the Contract Documents.
1. Steel pipe railings.
  2. Stainless steel pipe railings.

## 1.2 RELATED SECTIONS

- A. Section 03 60 00 – Grouting
- B. Section 05 50 00 – Metal Fabrications
- C. Section 09 90 00 – Painting and Coating

### 1.3 REFERENCES

- |    |  |  |
|----|--|--|
| A. | American Institute of Steel Construction (AISC) standards, most recent editions: |  |
|    | AISC 360   | Specification for Structural Steel Buildings   |
| B. | American Society of Civil Engineers (ASCE) standards, most recent editions:      |  |
|    | ASCE 8   | Specification for the Design of Cold-Formed Stainless Steel Structural Members                 |
| C. | ASTM International (ASTM) standards, most recent editions:                       |  |
|    | ASTM A36   | Standard Specification for Carbon Structural Steel   |
|    | ASTM A47   | Standard Specification for Ferritic Malleable Iron Castings                                    |
|    | ASTM A48   | Standard Specification for Gray Iron Castings  |
|    | ASTM A53   | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
|    | ASTM A123  | Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products       |
|    | ASTM A153  | Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware                   |

ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A510	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM F1267	Standard Specification for Metal, Expanded, Steel
ASTM F1941	Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
D.	American Welding Society (AWS) standards, most recent editions:
D1.1	Structural Welding Code – Steel
D1.6	Structural Welding Code – Stainless Steel
E.	National Association of Architectural Metal Manufacturers (NAAMM) standards, most recent editions:
	Metal Finishes Manual for Architectural and Metal Products
AMP 521	Pipe Railing Systems Manual
F.	The Society for Protective Coatings standards, most recent editions:
SSPC-SP 6	Commercial Blast Cleaning



#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings: Submit shop drawings of all railings to the Engineer for review, including the following information:
  - 1. Manufacturer's installation details.
  - 2. Layout drawings showing location of each railing, type of railing, and type of anchorage to be used.
  - 3. Manufacturer's recommendations on fastening and cleaning after installation.
- C. Mill Certificates: Signed by manufacturers of stainless steel products certifying that products furnished comply with requirements.
- D. Product Test Reports: From a qualified testing agency indicating railings comply with ASTM E985, based on comprehensive testing of current products and current building code required by authority having jurisdiction, whichever is more stringent.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding
  - 1. All weld procedures and welder qualifications shall be available in the Contractor's field office for review.
  - 2. Qualification of Welders: Use welders with current certifications (previous 12 months) for the material, type, and position of welding used. Certify in accordance with AWS Specifications according to the following:
    - a. AWS D1.1, Structural Welding Code – Steel.
    - b. AWS D1.6, Structural Welding Code – Stainless Steel.
  - 3. All welding shall be inspected by a Contractor-furnished inspector qualified in accordance with AWS requirements and approved by the Engineer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Deliver products to site in original, unbroken packages, containers, or bundles and bearing the label of the manufacturer.
- C. Store all materials off the ground and protect from weather until ready for use.

#### 1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. General: Unless otherwise indicated, install all railings complete and ready for use with all anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim, and other items required or necessary for the complete installation.
- B. Height Requirements: Top of upper railing shall be 42 inches above the working surface or toe line of stairs. Toe boards shall be installed not more than 1/4 inch off the working surface and shall be provided where indicated and required by codes or referenced standards. Provide a separate handrail at stair locations.
- C. Guardrail Configuration: Guardrail shall be a three-rail system with equal open spaces between rails (and toe board when required) as required by OSHA and as shown on the Contract Drawings.
- D. Thermal Movements:
  - 1. Exterior railing systems to provide for 1/4 inch expansion and contraction per 20 linear feet of railing.
  - 2. Interior railing systems to provide for 1/8 inch expansion or contraction per 20 linear feet of railing.
  - 3. Temperature change (range): 120 Degrees F, ambient; 180 Degrees F, material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

### **2.2 MATERIALS**

- A. Iron and Steel
  - 1. Pipe: ASTM A53, Type S, Grade A, 1-1/2 inch diameter, x-Strong (Schedule 80).
    - a. Provide galvanized finish for exterior installations and where indicated.
  - 2. Plates, Shapes, and Bars: ASTM A36.
  - 3.
- B. Stainless Steel
  - 1. Pipe: ASTM A312, Grade TP316L, 1-1/2 inch diameter, x-Strong (Schedule 80).
  - 2. Castings: ASTM A743 Grade CF8M or CF3M.
  - 3. Plate and Sheet: ASTM A240 or ASTM A666, Type 316L.
- C. Aluminum
  - 1. Pipe: Alloy 6061-T6 or 6063 - T6, ASTM B429, 1-1/2 inch diameter, Schedule 40.
  - 2. Sheet and plate: Alloy 6061 - T6 or 6063-T6, ASTM B209.
  - 3. Extruded bars, rods, shapes, and tubes: Alloy 6061-T6 or 6063-T6, ASTM B221.
  - 4. Cast fittings: Aluminum, ASTM B108 or ASTM B26.

- D. Brackets: Handrail brackets shall match the handrail or railing of which they are a part, including the finish.
- E. Toe Boards: Toe board material and finish shall match railing system and be not less than 4 inches in height. Toe boards shall be formed in an angle or channel section for strength.
- F. Fasteners:
  - 1.
  - 2. Hot-Dip Galvanized Railings: Type 316 stainless-steel.
  - 3. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
  - 4. Fasteners for anchoring railings to other construction shall be of stainless steel, per requirements of Section 05 50 00 – Metal Fabrications.
  - 5. .
  - 6. Fasteners for interconnecting railing components shall be of the same basic metal as the fastened metal. Do not use metals that are corrosive or incompatible with materials being joined.
- G. Miscellaneous Materials:
  - 1. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded. For both aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
  - 2. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
  - 3. Galvanizing Repair Paint: High-zinc-dust-content paint compatible with coatings specified to be used over it.
  - 4. Grout: Refer to Section 03 60 00 – Grouting.

## 2.3 FABRICATION

- A. General
  - 1. Fabricate handrails and railing systems with welded, internal and mechanical connections to comply with manufacturer's printed requirements, Construction Documents, details, dimensions, finish and member sizes, including post spacing and anchorage, but not less than the structural requirements to support applied loadings.
    - a. Clearly mark component units for site assembly and installation.
    - b. Use only connections that maintain structural capacity of joined members.
  - 2. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
  - 3. Provide weep holes or other means to exit entrapped water from hollow section of railing members exposed to exterior, condensation, or moisture from other sources.
  - 4. Fabricate smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness.
  - 5. Form exposed elements with smooth, long radius bends, accurate angles and straight sharp edges.
    - a. Ease exposed edges to a radius of approximately 1/32 inch.
    - b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the work.

6. Provide for anchorage to side face of support unless shown otherwise in Contract Drawings. Where this is impractical, provide for top face attachment.
  7. Handrail Termination:
    - a. Fit exposed ends of handrails with solid terminations.
    - b. Handrails to extend not less than 12 inches beyond the toe of the top and bottom risers in a run of stairs.
    - c. Ends of handrails to be returned to the wall or to be terminated in posts or safety terminals. Posts and safety terminals may be used only when approved by the Engineer. Close ends of returns unless clearance between end of railing and wall is 1/4 inch or less.
- B. Welded Railing Fabrication:
1. All welding to be continuous.
  2. Remove flux immediately.
  3. All exposed welds to be ground and buffed smooth and flush to match and blend with adjoining surfaces.
  4. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
- C. Form changes in direction by bending or by inserting prefabricated elbow fittings.
1. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of members throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- ## 2.4 FINISH
- A. General
1. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
  2. Protect mechanical finishes on exposed surfaces from damage per manufacturer's recommendations.
  3. Noticeable variations in appearance within the same piece or adjacent pieces are not acceptable.
- B. Steel and Iron Finishes
1. Galvanized Railings:
    - a. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
    - b. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
    - c. Comply with ASTM A123 for hot-dip galvanized railings.
    - d. Comply with ASTM A153 for hot-dip galvanized hardware.
    - e. When galvanized railings are to be coated, do not quench or apply post galvanizing treatments that might interfere with paint adhesion. After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- C. Stainless Steel
1. Remove or blend tool and die marks and stretch lines into finish.

2. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain with long dimension of each piece.
3. Bright, Directional Polish: No. 4 finish.
4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verification of Conditions: Examine system components, substrate, and conditions where railing systems are to be installed. If unsatisfactory conditions exist, notify Engineer in writing of unsatisfactory conditions and do not begin this Work until such conditions have been corrected.
- B. Commencing installation of this Work constitutes acceptance of conditions.

### **3.2 PREPARATION**

- A. Prepare surrounding construction to receive railing system installations complying with railing manufacturer's requirements and the Contract Documents.
- B. Review and coordinate setting drawings, shop drawings, templates, and instructions for assembly and installation of railing system and related items to be embedded in concrete and masonry.

### **3.3 INSTALLATION**

- A. Install railing system and related components in strict accordance with approved shop drawings and manufacturer's printed instructions.
- B. Preassemble railing system, including posts, into the largest practical sections possible.
  1. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members, do not exceed tolerances specified in this Section. Erect work free from distortion or defects detrimental to appearance or performance.
- C. Align railings prior to securing in place to assure proper matching at abutting and expansion joints and correct alignment throughout their length.
  1. Provide for thermal expansion and contraction by use of expansion joints in top rails at 20-foot maximum intervals.
  2. Space posts not more than 6 feet on center.
  3. Space wall brackets not more than 5 feet on center.
- D. Provide anchorage for posts as indicated on Contract Drawings and in the following manner:
  1. Top of concrete walls, slabs, walkways, stairs and removable railing sections:
    - a. Furnish posts with floor flange, welded or mechanically attached to post, with predrilled holes for bolting to surface.
  2. Side of concrete walls, slabs, walkways, stairs and removable railing sections:

- a. Furnish posts with side plate, welded or mechanically attached to post, with predrilled holes for bolting to surface
- 3. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete or attached to side as indicated on Drawings.
- E. Gates and removable sections:
  - 1. Provide safety gates in railing systems where ladder tops occur and at other locations shown on the Contract Drawings. Safety chains will not be accepted. Provide gates with self-closing hinges and self-closing latch bolts.
  - 2. Provide gate section hardware with color to match the railing system of which it is a part.

### 3.4 TOLERANCES

- A. Limit variation of cast-in-place inserts, sleeves, and field-drilled anchor and fastener holes to the following:
  - 1. Spacing:  $\pm 3/8$  inch.
  - 2. Alignment:  $\pm 1/4$  inch.
  - 3. Plumbness:  $\pm 1/8$  inch.
- B. Handrails and Guardrail System Plumb Criteria:
  - 1. Limit variation of completed handrail and guardrail system alignment to  $1/4$  inch in 12 feet with posts set plumb to within  $1/16$  inch in 3 foot.
  - 2. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed  $1/4$  inch in 12 feet.
- C. Provide "hair-line" thin butt joints.

### 3.5 CLEANING

- A. As installation is completed, clean the railings in accordance with the manufacturer's printed instructions.
- B. If cleaning operations remove anodized finish, remove the affected rail and replace with new material.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

### 3.6 PROTECTION

- A. Suitably protect rail surfaces against lime mortar stains, discoloration, surface abrasion, and other construction abuses. Remove stained or otherwise defective work and replace with material that meets specification.

END OF SECTION

**DIVISION 07**  
**THERMAL AND MOISTURE PROTECTION**

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**SECTION 07 14 00**  
**FLUID-APPLIED WATERPROOFING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Provide and apply single-component, fluid-applied liquid waterproofing system to below grade concrete slabs, walls, and footings, including surface preparation.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 07 92 00 - Joint Sealants.

1.3 REFERENCES

- A. ASTM International (ASTM) standards, most recent editions:

ASTM C836	Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
ASTM D41	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D1644	Standard Test Methods for Nonvolatile Content of Varnishes
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions which may be required.

- D. Qualification Data: For qualified Installer.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Field quality-control reports.
- G. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.
- B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, installation procedures, testing and inspection procedures, and protection and repairs.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 Degrees F.
  - 1. Do not apply membrane when air, material, or surface temperatures are expected to fall below 30 Degrees F within four hours of completed application.
  - 2. Do not apply membrane if rainfall is forecast or imminent within 12 hours.
  - 3. Do not apply waterproofing membrane to any surfaces containing frost.
  - 4. Consult manufacturer for applications to green concrete.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

## 1.8 WARRANTY

- A. Special Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents, and shall be in addition to, and run concurrent with, other warranties made under requirements of the Contract Documents.
- B. Provide written warranty signed by waterproofing manufacturer and installer agreeing to repair or replace waterproofing that does not meet requirements or that does not remain watertight within the specified warranty period.
- C. Warranty Period: 3 years after date of Substantial Completion.
- D. Warranty does not include failure of waterproofing due to failure of substrate or formation of new joints and cracks in substrate that exceed 1/16 inch in width.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers and products are acceptable:
  - 1. Fluid Applied Waterproofing:
    - a. Epro Services, Inc., Ecobase Waterproofing Membrane.
    - b. Tremco Barrier Solutions, Tuff-N-Dri H8 Waterproofing.
    - c. Engineer approved equal.

### 2.2 PERFORMANCE CRITERIA

- A. Waterproofing Membrane:
  - 1. Single-component, polymer-enhanced liquid-applied membrane with the following minimum properties:
    - a. Solids content, ASTM D1644, 60% minimum.
    - b. Tensile Strength, ASTM D412: 15 psi, minimum.
    - c. Elongation, ASTM D412: 1100%, minimum.
    - d. Water Vapor Transmission, ASTM E96: 1 perms maximum (40 mil dry coat).
    - e. Hydrostatic Pressure Resistance, 8 feet water head, minimum.
    - f. Adhesion, ASTM C836, minimum 11 lb/inch to peel from concrete and masonry.
- B. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

### **3.3 JOINTS, CRACKS, AND TERMINATIONS**

- A. Prepare and treat substrates to receive waterproofing membrane, including expansion joints, construction joints, cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

### **3.4 MEMBRANE APPLICATION**

- A. Apply using appropriate equipment and nozzles, per manufacturer's recommendations. Start application with manufacturer's authorized representative present.
- B. Membrane: Spray apply asphalt emulsion membrane to substrates and adjoining surfaces indicated. Spread to a minimum wet thickness per manufacturer's specification to achieve listed hydrostatic resistance, minimum of 60 mils.
- C. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- D. Allow product to cure prior to backfilling.

- E. When buried surfaces that have been waterproofed are not backfilled within 30 days of membrane applications, membrane shall be coated with whitewash. Any formula for mixing the whitewash may be used which is not detrimental to the membrane and produces a uniformly coated white surface which remains until backfill is placed.

### 3.5 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of the membrane, flashings, protection, and drainage components; furnish daily reports to Engineer.

### 3.6 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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**SECTION 07 22 16**  
**RIGID POLYSTYRENE BOARD INSULATION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Furnish and install rigid polystyrene insulation board for all buried concrete vault roofs and walls as shown on the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 07 92 00 Joint Sealants

1.1 REFERENCES

- A. ASTM International (ASTM) standards, most recent editions:

ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of Head Flow Meter Apparatus
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Insulation
ASTM D1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D2842	Standard Test Method for Water Absorption of Rigid Cellular Plastics
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96	Standard Test Method for Water Vapor Transmission of Materials

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data
1. Submit manufacturer's technical data for each type of insulation supplied, including adhesive and fasteners.
- C. Samples
1. Submit 12 inch by 12 inch sample of insulation and four fasteners.

- D. Manufacturers' Instructions
  - 1. Submit manufacturer's installation instructions for preparation and installation specific to the Work of this Section.

#### 1.4 QUALITY ASSURANCE

- A. Provide each type of insulation material specified from a single manufacturer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Handle products carefully, ensuring board corners are not broken and boards are not damaged.
- C. Protect roof insulation materials from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

#### 1.6 FIELD CONDITIONS

- A. Ambient Conditions: Apply insulation only when surfaces and ambient temperatures are within manufacturer's prescribed limits.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Rigid Polystyrene Insulation Board
    - a. DuPont, Styrofoam Deckmate Plus.
    - b. Owens Corning, Foamular 250.
    - c. Engineer approved equal.
  - 1. Mechanical Insulation Anchors
    - a. Hilti, IDP Poly Insulation Anchors
    - b. Engineer approved equal.

#### 2.2 MATERIALS

- A. Rigid Polystyrene Insulation Board for Vaults
  - 1. Board: ASTM C578, Type IV, rigid, closed cell type, with integral high density skin.
  - 2. Thermal Resistance: Typical 5-year aged value of R-5 per 1 inch of thickness per ASTM C518.
  - 3. Board Size: As necessary for application - largest practical size.
  - 4. Board Thickness: 2 inches thick.
  - 5. Color: Blue.
  - 6. Compressive Strength: Minimum 25 psi.
  - 7. Water Absorption: Maximum of 0.7% by volume in accordance with ASTM D1621



8. Edges: Square.
  9. Water Vapor Permeance: Maximum 1.5 perms per ASTM E96.
  10. Flame Spread / Smoke Developed Values: 15/175 per ASTM E84.
- B. Bonding Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- C. Mechanical Fasteners
1. Vault Insulation: In addition to adhesive, use mechanical fasteners to mechanically and permanently bind insulation to the concrete and other surfaces.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that the insulation boards and adjacent materials are compatible.
- B. Verify that substrate is sound, clean, and free of oil, grease, and materials or substances that may impede adhesive bond.

#### **3.2 INSTALLATION**

- A. Vaults
1. Install the insulation on the vault walls, from the underside of the roof to a point 4 feet below final exterior grade.
  2. Install insulation on underside of roof slab and access hatches.
  3. Use both adhesive and mechanical anchors.
    - a. Place mechanical anchors at each corner of the insulation board.
    - b. Place a minimum of two rows of three anchors per board.
  4. Place insulation to lines shown on the Drawings and keep all joints and abutments moderately snug without forcing.
  5. Do not apply adhesive to insulation that will deleteriously affect it in any way.

#### **3.3 CLEANING**

- A. Remove from the Site, all containers, wrappings, and scrap insulation material. Leave roofs and floors broom clean.

**END OF SECTION**

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**SECTION 07 72 00  
ROOF ACCESSORIES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes providing and installing roof accessories and appurtenant work, complete, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrication  
B. Section 09 90 00 - Coatings and Painting

1.3 REFERENCES

- A. Trade standards, most recent editions:  
NRCA                                      National Roofing Contractors Association

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.  
B. Product Data: Submit manufacturer's specifications, literature, and published installation instructions for each accessory, product, or system to be installed in the Work.  
C. Shop Drawings: Submit fabrication drawings for all roof hatches, ventilators, and openable fire and smoke hatches with skylights, for approval prior to fabrication.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.  
B. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the manufacturer.  
C. Storage: All materials shall be carefully stored on wood blocking in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of finish.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers and products are acceptable:

1. Roof Hatches:
  - a. Babcock Davis
  - b. Bilco Company
  - c. EJ Company
  - d. Engineer approved equal
2. Prefabricated Curbs
  - a. Pate Company
  - b. S & L Manufacturing Company
  - c. Thybar Corporation
  - d. Engineer approved equal

## 2.2 ROOF VENTS

- A. Provide roof relief vents with bird screens. Product shall be of the type recommended by the National Roofing Contractors Association (NRCA) and approved by the roofing manufacturer.

## 2.3 ROOF HATCHES

- A. Design: Roof hatches (scuttles, equipment hatches) shall be constructed of aluminum unless otherwise indicated, and shall be provided with stainless steel hardware, positive snap latch with padlocking hardware, compression spring operators enclosed in telescopic tubes, extruded EPDM rubber gaskets and seats, fully enclosed insulated curbs with double-wall construction. Roof hatches shall be of the type and size below:
  1. Reservoir access hatch: Reservoir access hatches shall include concealed padlock hasps for drinking water structures. Provide Bilco Type F, SS or D or equal, as required.
  2. Vault access hatches: See Section 05 50 00 – Metal Fabrication.
  3. Roof cover plates shall be as shown on the Contract Drawings.

## 2.4 PREFABRICATED CURBS

- A. Design: Opening dimensions shall be coordinated with skylight penetrations, duct penetrations, and roof-mounted equipment sizes. Heights shall be as required to place top of curb not less than 8 inches above top of insulation. The top edge of the curb shall be a level surface for installation, connection or mounting of equipment and skylights. Sides of curbs shall have heights adjusted per job and field conditions and roof stoops. Base flange shall be not less than 4 inches wide. Curbs shall be fabricated of 14 gauge or thicker galvanized steel with continuously welded corners and shall be provided with pressure preservative treated, kiln dried, and fire-treated wood nailer at top.

## 2.5 LADDER-UP DEVICE

- A. Roof hatch ladder-up device (extendable pole) shall be "Model 2, Ladder-Up Safety Post" of hot-dipped galvanized steel as manufactured by Bilco, Co.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The installation shall conform to applicable codes and the manufacturers published or written recommendations, specifications, and published installation instructions for the type of work being performed. The construction shall be coordinated with the work of other trades.
- B. All roof openings, roof-mounted equipment, duct openings, and skylights shall be provided with a prefabricated curb unless the equipment above the roof opening is supplied with its own curb which extends to 8 inches or higher beyond the top of the roof insulation.
- C. Roof hatches with ladders shall be provided with a ladder-up device.

### **3.2 INSTALLATION**

- A. Roof Hatches, Openable Fire and Smoke Hatches and Roof Ventilators: Units shall be installed over prepared openings with their own curbs or prefabricated curbs, and shall be fastened to roof deck in accordance with the manufacturer's printed directions. Lifting mechanisms and accessories shall be adjusted to insure proper operation. Abraded prime and finish coat surfaces shall be touched-up after completion of installation with the same type finish and the same dry-film thickness.
  - 1. Roof Hatches: Dissimilar metals shall be properly isolated. Thermal movement, up to 100 degrees F change, shall be accommodated without distress in assembly of fasteners.
  - 2. Roof Vents: Roof vents shall be provided on lightweight concrete or lightweight insulating concrete and shall be placed in such a manner so that one vent will be used for venting 1,000 square feet of roof fill. No area shall have fewer than two vents. Vents shall not be installed in walk pads or other traffic areas. Vent pipes shall have a coat of plastic cement applied at the joint between the vent pipe and the roofing before aggregate is applied. Roof insulation shall be removed from below vent per NRCA instructions. Roof vents shall be painted to match roofing color.

### **3.3 PROTECTION**

- A. Protective Coating: All roof accessories shall be coated in accordance with Section 09 90 00 Coatings and Painting, to match the roofing color unless directed otherwise by Engineer. Primer coats shall be compatible with finish coats.

END OF SECTION

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## **SECTION 07 92 00 JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes sealant work associated with joints between similar and dissimilar materials in the Work.
- B. Work included consists of, but is not necessarily limited to the following:
  - 1. Sealing all joints which would otherwise permit penetration of moisture, unless sealing work is specifically required under other sections.
    - a. Exterior wall joints.
    - b. Flooring joints.
    - c. Isolation joints.
    - d. Joints between paving and sidewalks and building.
    - e. Concrete control and expansion joints, exterior and interior.
    - f. Joints at penetrations of walls, floors, and decks by piping and other services and equipment.
    - g. Other joints where calking, sealant, or compressible sealant is indicated.

#### **1.2 REFERENCES**

- A. ASTM International (ASTM) standards, most recent editions:

ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1087	Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1193	Standard Guide for Use of Joint Sealants
ASTM C1247	Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids

- B. Federal Specification (FS), most recent editions:

TT-S-001543A	Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-00230C	Sealing Compound: Elastomeric Type, Single Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-00227E	Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)

- C. National Sanitation Foundation (NSF), most recent edition:

NSF 61

Drinking Water System Components, Health Effects

### 1.3 DEFINITIONS

- A. Words "calk," "sealant," and "calking" mean sealant Work.
- B. "Interior wet areas" mean toilets, showers, sinks, and similar areas.
- C. "Applicator" means the individual actually on site performing the installation.
- D. "Vertical" means any surface with a slope greater than 1.5 horizontal to 1.0 vertical.

### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data
1. Letter of certification that products submitted meet requirements of standards referenced.
  2. Manufacturer's installation instructions.
  3. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling, and bond breaker.
  4. Applicator qualifications.
  5. Warranty.
  6. Certification from sealant manufacturer stating that product being used is recommended for and is best suited for joint in which it is being applied.
- C. Field Samples
1. Cured sample of each color for Engineer's color selection. Color chart not acceptable.
- D. Preconstruction field test reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in below in QUALITY ASSURANCE.
- E. Product test reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- F. Warranties: Special warranties specified in this Section.

### 1.5 QUALITY ASSURANCE

- A. Qualifications:
1. Sealant applicator shall have a minimum of five years of experience on projects with similar scope.
- B. Mock-ups:



1. Before calking work is started, a sample of each type of joint shall be calked where directed by Engineer. The approved samples shall show the workmanship, bond, and color of calking materials as specified or selected for the Work and shall be the minimum standard of quality on the entire Project.
- C. Preconstruction compatibility and adhesion testing:
1. Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
    - a. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    - b. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
    - c. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
    - d. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
    - e. Testing will not be required if sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Preconstruction field-adhesion testing: Before installing elastomeric sealants, field test their adhesion to joint substrates found in the Work as follows:
1. Locate test joints where indicated in the Work or, if not indicated, as directed by the Engineer.
  2. Conduct tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.
  3. Notify Engineer a minimum of 7 days in advance of dates and times when test joints will be evaluated.
  4. Test method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 of ASTM C1193.
  5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of preconstruction field-adhesion test results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Deliver material in manufacturer's original unopened containers with labels intact. Labels shall indicate contents and expiration date of material.

C. Store all materials off the ground and protect from rain, freezing, or excessive heat until ready for use.

D. Condition the specified products before use as recommended by the manufacturer.

## 1.7 ENVIRONMENTAL REQUIREMENTS

A. Schedule Work to be performed when temperature and humidity are as recommended by the sealant manufacturer during and after installation until products are fully cured.

## 1.8 WARRANTY

A. Material and Labor Warranty:

1. Sealant work shall be free of defects for a period of 5 years from date of final acceptance.
2. Failure of watertightness constitutes defect.
3. Remove any defective work and/or materials and replace with new materials.
4. Warranty must be signed jointly by applicator and sealant manufacturer.

B. Special installer's warranty:

1. Installer's standard form in which installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified herein within specified warranty period.
  - a. Warranty period: Five years from date of final acceptance.
2. Special warranties herein specified exclude deterioration or failure of elastomeric joint sealants from the following:
  - a. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design.
  - b. Disintegration of joint substrates from natural causes exceeding design specifications.
  - c. Mechanical damage by individuals, tools, or other outside agents.
  - d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Polyurethane sealants.
  - a. Pecora.
  - b. PSI Polymeric Systems, Inc.
  - c. Sika Chemical Corporation.
  - d. BASF Master Builders.
  - e. Engineer approved equal.
2. Silicone sealants:
  - a. Dow Corning Corporation.

- b. General Electric.
- c. Tremco
- d. Engineer approved equal.

## 2.2 MATERIALS

### A. Sealants – General:

1. Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
2. Where compound is exposed to view in finished Work, provide colors matching materials being sealed.
3. Where compound is not exposed to view in finished Work, provide manufacturer's color with best performance.
4. For joints in potable water reservoirs, provide only 2-component polyurethane sealant with NSF 61 certification.
5. Provide non sagging sealant for vertical and overhead joints.
6. Sealants for horizontal joints:
  - a. Self-leveling pedestrian/traffic grade.
7. Suitability for immersion in liquids: Where elastomeric sealants are indicated for submerged use, provide products that have undergone testing according to ASTM C1247 and qualify for the length of exposure indicated by reference to ASTM C920 for Classes 1 or 2. Liquid used for testing sealants is chlorinated potable water, unless otherwise noted.

### B. Polyurethane Sealant:

1. One or two components.
2. Meet ASTM C920; F.S. TT-S-00230C, Type I or Type II, Class A, or TT-S-00227E, Type I or Type II, Class A.
  - a. Pecora Dynatrol I, Dynatrol II, Urexpan NR-200 or NR-201.
  - b. PSI PSI-270.
  - c. Sika Sikaflex-1A, Sikaflex-2C.
  - d. Master Builders MasterSeal NP-1, NP-II, SL-1.

### C. Silicone Sealant:

1. One component.
2. Meet F.S. TT-S-001543A, Class A:
  - a. Dow Corning 790, 795, 786.
  - b. General Electric Silpruf, Silglaze, Sanitary SCS 1700 sealant.
  - c. Tremco Spectrem.

### D. Bond breaker tape: Polyethylene tape of other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint surfaces of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

1. Unless specifically shown on the Drawings, bond breaker shall not be used in joints within the reservoir.

### E. Joint Cleaner, Primer, Bond Breaker:

1. As recommended by sealant manufacturer.
- F. Sealant Backer Rod: Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, non-absorbent, non-bituminous material recommended by sealant manufacturer to:
1. Control joint depth
  2. Break bond of sealant oat bottom of joint
  3. Provide proper shape of sealant bead.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before using any sealant, investigate its compatibility with adjacent joint surfaces, fillers, and other materials in the joint system.
- B. Use only compatible materials.
- C. Clean and prime joint surfaces in accordance with manufacturer's instructions.
  1. Limit application to surfaces to receive sealant.
  2. Mask off adjacent surfaces.
- D. Commencing sealant installation constitutes acceptance of joints and surfaces.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Where finish coating or covering is to be applied to surface, wait until such coating or covering has been applied before installing sealant; e.g., paint, wall covering, glazed coatings.
- C. Make all joints water and air tight.
- D. Make depth of sealing compounds not more than one-half width of joint, but in no case less than 1/4 inch nor more than 5/8 inch.
- E. Provide correctly sized backer rod in all joints to proper depth
- F. Apply bond breaker where required.
- G. Tool sealants using sufficient pressure to fill all voids.
- H. Upon completion, leave sealant with smooth even neat finish.

### **3.3 CLEANING**

- A. Clean adjacent soiled surfaces free of sealant.

### 3.4 PROTECTION

- A. Protect finished installation.
- B. Protect sealants until fully cured.

### 3.5 SCHEDULES

- A. Furnish sealant as indicated for the following areas:
  - 1. Exterior areas:
    - a. Joints in concrete and masonry:
      - 1) Use 2-component polyurethane only.
    - b. All other joints:
      - 1) Single or 2-component Polyurethane or.
      - 2) Silicone.
  - 2. Interior wet areas:
    - a. Joints in concrete and masonry:
      - 1) Use 2-component polyurethane only.
    - b. All other joints:
      - 1) Single or 2-component Polyurethane or.
      - 2) Silicone.
  - 3. Interior non-wet, corrosive areas:
    - a. Joints in concrete and masonry:
      - 1) Use 2-component polyurethane only.
    - b. All other joints:
      - 1) Single or 2-component Polyurethane or.
      - 2) Silicone.

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**DIVISION 09**  
**FINISHES**

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**SECTION 09 90 00  
COATINGS AND PAINTINGS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. This section covers surface preparation, furnishing, and application of architectural paint and special protective coatings, complete.
- B. Shop or existing surface preparation methods, cleanliness, and existing paint, rust, and mill scale removal is not known nor documented. Contractor shall be solely responsible for determining work effort, abrasive blast requirements, and any other factors that may affect work productivity as required for providing the specified surface preparation cleanliness; regardless of prior system preparation or coating application.

**1.2 ABBREVIATIONS**

ANSI	American National Standards Institute
AWWA	American Water Works Association
FRP	Fiberglass Reinforced Plastic
HCl	Hydrochloric Acid
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
Mil	Thousandths of an Inch
MIL-P	Military Specification - Paint
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council

**1.3 CONTRACTOR SUBMITTALS**

- A. Product Data: Furnish 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. A sample PSDS form is appended at the end of this section.
  2. The required information shall be submitted on a system-by-system basis.
  3. The Contractor shall also provide copies of the paint system submittals to the coating applicator.
  4. Indiscriminate submittal of manufacturer's literature only is not acceptable.
- B. Where ANSI/NSF Standard 60 and 61 approval is required, submit ANSI/NSF certification letter for each coating in the system indicating product application limits on size of tank or piping, dry film thickness, number of coats, specific product tested, colors certified, and approved additives.
- C. Provide TCLP test data for lead and other regulated heavy metals in non-recyclable, slag type abrasive blast media to be used on the project. Acceptable abrasive test data shall indicate the abrasive manufacturer, location of manufacture, and media gradation and type. Surface preparation will not be permitted to begin until acceptable test data has been submitted.
- D. Quality Control Submittals: Furnish the following:
1. Applicator's Experience: List of references substantiating the requirements as specified.
  2. Factory Applied Coatings: 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 manufacturer's written confirmation that materials are compatible.

#### 1.4 QUALITY ASSURANCE

- A. The paint manufacturer shall provide a representative to visit the 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, the manufacturer's products furnished under this Contract.
- B. Applicator's Experience: Minimum of 5 years' practical experience in application of specified products.
- C. Continuity of Contractor: Contractor's site supervisor shall be coordinated with the Engineer. Any replacement of the supervisor on site will require notification of Engineer 72 hours in advance, and will be subject to approval by the Owner.
- D. Inspection:
1. Inspect and provide substrate surfaces prepared in accordance with these specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied.
  2. Provide Engineer minimum 3 days' advance notice prior to start of surface preparation work or coating application work.
  3. Perform work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in Engineer's absence. Approval to perform work in the

Engineer's absence is limited to the current day unless specifically noted to extend beyond the completion of the workday.

4. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve the Contractor of responsibility to perform the work in accordance with these specifications.

#### 1.5 PAINT DELIVERY, STORAGE, AND HANDLING

- A. Delivered 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. Stored paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.
- C. Shipping:
  1. Where precoated items are to be shipped to the jobsite, protect coating from damage. Batten coated items to prevent abrasion.
  2. Use nonmetallic or padded slings and straps in handling.
  3. Items will be rejected for excessive damage.

#### 1.6 WARRANTY

- A. Warranty: The Contractor and coating manufacturer shall jointly and severally warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of 2 years commencing on the date of final acceptance of the work.

### PART 2 - PRODUCTS

#### 2.1 PAINT AND COATINGS MANUFACTURERS

- A. A manufacturer letter code as follows will be found following the generic descriptions of materials outlined in the Specifications. Address is that of the general offices. Contact these offices for information regarding the location of representative nearest the project site.
- B. Manufacturer Code A - Coatings Manufacturers (Able to supply most heavy-duty industrial coatings and architectural paints):
  1. Carboline Coatings Company, St. Louis, MO.
  2. ICI Devoe Coatings Company, Louisville, KY.
  3. International Coatings, Louisville, KY
  4. Pittsburgh Paints (PPG), Pittsburgh, PA
  5. Sherwin Williams, Cleveland, OH
  6. Tnemec Coatings, Kansas City, MO
- C. Manufacturer Code E - Fusion Bonded Coating Applicators:
  1. 3M Co., St Paul, MN.

## 2.2 PAINT MATERIALS

- A. Products shall meet federal, state, and local requirements limiting the emission of volatile organic compounds. Specific information may be secured through the local office of the Air Pollution Control Officer.
- B. Materials Including Primer and Finish Coats: Produced by same paint manufacturer.
- C. Thinners, Cleaners, Driers, and Other Additives: As recommended by paint manufacturer of the particular coating. Where coatings are required to meet ANSI/NSF Standard 60 and 61, addition of thinners, driers, and other paint additives not approved under the ANSI/NSF certification letter will not be permitted without written approval from the Engineer.
- D. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 100 g/L.
  - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - 4. Flat Topcoat Paints: VOC content of not more than 50 g/L.
  - 5. Nonflat/High-Gloss Topcoat Paints: VOC content of not more than 150 g/L.
  - 6. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - 7. Floor Coatings: VOC not more than 100 g/L.
  - 8. Shellacs, Clear: VOC not more than 730 g/L.
  - 9. Shellacs, Pigmented: VOC not more than 550 g/L.
  - 10. Primers, Sealers, and Undercoaters: VOC content of not more than 100 g/L.
  - 11. Dry-Fog Coatings: VOC content of not more than 150 g/L.
  - 12. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
  - 13. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- E. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 2. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.

- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

F. Paint products are listed according to their approximate order of appearance in the paint systems. The letter designating the manufacturer code refers to Article PAINT AND COATING MANUFACTURERS.

Product	Definition
Potable Grade, Polyamide Epoxy Coatings	Amine or polyamine epoxy coating, approved for potable water contact in conformance to ANSI/NSF Standard 60 and 61, suitable for the application temperatures and conditions. MANUFACTURER CODE: A
Polyamide, Epoxy	Polyamine or polyamide epoxy, two parts, suitable for immersion service, 75% volume solids minimum, capable of 4 to 8 MDFT per coat. MANUFACTURER CODE: A
Polysiloxane	Acrylic polysiloxane hybrid coating, single component, suitable for shop or field application at 32 degrees F, minimum, recoat window of not less than 12 months with preference for products with unlimited overcoat capability, solids content of 85% minimum, high gloss, and tintable colors. Tinted colors shall be capable of storage for 30 days or longer prior to application. Coating shall be capable of spray, roller, or brush application on all metal substrates and specified prime and intermediate coats. MANUFACTURER CODE: A
Polyamide, Anti-Corrosive, Epoxy Primer	Polyamide or Polyamine epoxy primer, two parts, containing rust-inhibitive pigments MANUFACTURER CODE: A
Organic Zinc Rich Primer	Converted epoxy, epoxy/phenolic or urethane type, minimum 10 lbs.; metallic zinc content per gallon MANUFACTURER CODE: A
Inorganic Zinc Primer	Solvent or water based, 14 lbs. metallic zinc content per gallon minimum; unlimited recoat window, follow manufacturer's recommendation for top coating. MANUFACTURER CODE: A
Rust-Inhibitive Primer	Single-package steel primers with anti-corrosive pigment loading; may be alkyd, vinyl, epoxy ester, chlorinated rubber.

Product	Definition
	MANUFACTURER CODE: A-B
Alkyd Enamel	Optimum quality, gloss finish, medium long oil. MANUFACTURER CODE: A-B
Wash Primer	Vinyl butyral acid or equivalent coating for enhancing finish coat adhesion to galvanized steel surfaces. MANUFACTURER CODE: A
Aliphatic Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish, suitable for continuous dry service at 200 degrees F without discoloration or peeling. MANUFACTURER CODE: A
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy or polyurethane resin, suitable for this intended service.
Modified Waterborne Acrylate	Single component, modified waterborne acrylate, flexible, breathable coating for concrete. MANUFACTURER CODE: A

## 2.3 COLORS

- A. Provide as selected by the Owner.
- B. 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 matches.
- D. Equipment Colors:
  1. Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
  2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as itemized 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. Pipe Identification Painting:
  1. Color code non-submerged metal piping except electrical conduit, in accordance with Section 40 05 01 – Piping Identification Systems. Paint fittings and valves the same color as the pipe.
  2. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at all connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along the piping not greater than 9 feet on center, with identification labels applied to each exposed run of pipe as specified herein.
  3. Pipe supports: Galvanized steel does not require painting. Mild steel, painted No. 70 light gray as specified in ANSI Z35.1, as manufactured by:
    - a. Tnemec Co., No. 2050

- b. Or equal.
- 4. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, except as noted.

F. Labels for Piping: Provide pipe labels in accordance with Section 40 0506 – Piping Identification Systems.

## 2.4 QA/QC TESTING AND INSPECTION

### A. General

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance.
3. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
4. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.

### 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 profilometer shall be used, where deemed necessary, to verify tester tape measurements.

C. Adhesion testing: Where directed by the Engineer for assessing coating application problems.

### D. Holiday Testing

1. Holiday tests on polyurethane coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE SP 0188 and these specifications.
2. Coating thickness used for high voltage holiday testing setting shall be the average dry coating thickness.

### E. Dry Film Thickness Testing

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off, eddy current, or ultrasonic equipment.
2. 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.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The intention of these specification is for all new, interior and exterior, wood, masonry, concrete, and metal, whether atmospheric or submerged exposure surfaces be painted, whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive prime coat only unless modified herein.
- B. Surface preparation and coating application shall be in conformance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflicts occur between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless approved by the Engineer.
- C. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.

### **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)
- 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 perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees F above the dew point of the ambient air.
- B. Surface preparation power tools and blast equipment shall contain dust collection equipment that will prevent discharge of dust particles into the atmosphere around electrical or mechanical equipment unless otherwise permitted by the Engineer.
- C. Do not apply paint when:
  - 1. Surface temperatures exceeds the maximum or minimum temperature recommended by the paint manufacturer,
  - 2. In dust, smoke-laden atmosphere, damp or humid weather, or under conditions which could cause icing on the metal surface.



3. When it is expected that surface temperatures will drop below 5 degrees above dew point within 8 hours after application of coating.

#### 3.4 DEHUMIDIFICATION

- A. Where environmental conditions cannot be met or controlled, 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 17 degrees or more below surface temperature of metal surfaces to be cleaned and painted. System shall provide ventilation within the environmentally controlled areas and shall 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, and
  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 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 within the environmentally controlled area, 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.
- D. Submit written recommendations from dehumidification subcontractor for bulkhead locations, 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.
- E. Dehumidification equipment 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 insure proper operation of the equipment, achievement of desired environmental control, and to insure Contractor can properly setup, operate, monitor, and maintain the equipment.
- F. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation and coating application and cure.
- G. Reblasting of flash rusted metal surfaces or removal of damaged coatings, as a result of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the 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 the Engineer.

- H. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature both outdoors and within the environmentally controlled area at the start, midpoint, and end of each work shift, minimum, but not more than 5 hours between measurements.
- I. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.

### 3.5 VENTILATION AND ILLUMINATION

- A. Adequate illumination shall be provided while work is in progress. Whenever required by the inspector, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.
- B. Ventilation shall be used to control potential dust and hazardous conditions within the tank. Ventilation flow rates shall be in accordance with OSHA regulations and as required to reduce air contamination to non-hazardous conditions.

### 3.6 SURFACES NOT REQUIRING PAINTING

- A. Unless otherwise stated herein or shown, the following areas or items will not require painting:
  - 1. Concrete and masonry surfaces
  - 2. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
    - a. Required for electrical insulation between dissimilar metals.
    - b. Aluminum is embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
    - c. Color coding of equipment and piping is required.
  - 3. Nonmetallic materials such as glass, PVC, wood, porcelain, and plastic (FRP) except as required for architectural painting or color coding.
  - 4. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, etc.; color coding of equipment is required.
  - 5. Non-submerged electrical conduits attached to unpainted concrete surfaces.
  - 6. Heating and ventilation ducting, unless otherwise specified.
  - 7. Cathodic protection anodes.
  - 8. Items specified to be galvanized after fabrication unless specifically required elsewhere or subject to immersion.
  - 9. Insulated piping and/or insulated piping with aluminum or stainless steel jacket will not require exterior coating, except as required for architectural painting or color coding.

### 3.7 PREPARATION OF SURFACES

- A. Surface Preparation Inspection:

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied.
2. Provide Engineer minimum 3 days' advance notice prior to start of surface preparation work or coating application work.
3. Perform such work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in Engineer's absence.

B. Metal Surface Preparation:

1. General:
  - a. Do not perform a surface preparation blast prior to submission of samples. Workmanship for metal surface preparation as specified shall meet current Steel Structures Painting Council (SSPC) Specifications as follows:
    - 1) Solvent Cleaning: SP 1
    - 2) Hand Tool Cleaning: SP 2
    - 3) Power Tool Cleaning: SP 3
    - 4) White Metal Blast Cleaning: SP 5
    - 5) Commercial Blast Cleaning: SP 6
    - 6) Brush-Off Blast Cleaning: SP 7
    - 7) Pickling: SP 8
    - 8) Near-White Blast Cleaning: SP 10
    - 9) Bare Metal Power Tool Cleaning: SP 11
  - b. All surface preparation shall be assumed to be on a SSPC Grade A steel surface condition, unless specifically noted otherwise.
  - c. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
  - d. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
  - e. Hand tool clean areas that cannot be cleaned by power tool cleaning.
2. Welds and adjacent areas:
  - a. Prepared such that there is:
    - 1) No undercutting or reverse ridges on the weld bead.
    - 2) No weld spatter on or adjacent to the weld or any other area to be painted.
    - 3) No sharp peaks or ridges along the weld bead.
  - b. Grind embedded pieces of electrode or wire flush with the adjacent surface of the weld bead.
3. Preblast Cleaning Requirements:
  - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
  - b. Cleaning methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
  - c. Clean small isolated areas as above or solvent cleaned with suitable solvents and clean cloths.
  - d. Round or chamfered all sharp edges and grind smooth burrs, jagged edges, and surface defects.

4. Blast Cleaning Requirements:
  - a. General:
    - 1) Type of Equipment and Speed of Travel: Designed to obtain specified degree of cleanliness.
    - 2) Select type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendations for the particular coating to be applied or not less than 20 percent of the specified coating thickness, whichever is more stringent.
    - 3) Meet applicable federal, state, and local air pollution control regulations for blast cleaning and disposition of spent aggregate and debris.
    - 4) Do not reuse abrasive, unless abrasive is a recyclable abrasive.
  - b. Shop Blasting
    - 1) Notify Engineer at least 7 days prior to start of shop blast cleaning to allow for inspection of the work during surface preparation and shop application of paints. Work shall be subject to the Engineer's approval before shipment to the jobsite.
    - 2) Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. Blast clean and prime in accordance with these Specifications.
  - c. Field Blasting
    - 1) Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, shall meet requirements of Steel Structures Painting Council.
    - 2) Field blasting in areas with electrical or mechanical equipment, within buildings shall be performed with dustless abrasive systems such as "Sponge-Jet", dry ice abrasive blasting.
5. Post-Blast Cleaning and Other Cleaning Requirements:
  - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wiped with a tack cloth.
  - b. Paint surfaces the same day they are sandblasted. Reblast surfaces that have started to rust before they are painted to original cleanliness prior to occurrence of flash rusting.

C. Masonry Surface Preparation:

1. Complete and cure for 14 days or more before starting surface preparation work.
2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
3. Cleaned masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
  - a. Brush-off blasting.
  - b. Water blasting.
4. Do not damage masonry mortar joints or adjacent surfaces.
5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.

6. Masonry Surfaces to be coated: Uniform texture and free of surface imperfections which would impair the intended finished appearance.
7. Uncoated or Clear Coated Masonry surfaces: Free of discolorations and be uniform in texture after cleaning.

D. Concrete Surface Preparation:

1. Do not begin until 30 days after the concrete has been placed.
2. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
3. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.
4. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.
5. Bug holes, air pockets, and other voids in the concrete will be filled or patched in chemical exposure areas, secondary containment, and where specifically required.
6. Concrete Surface Preparation Inspection:
  - a. Adhesion Testing:
    - 1) Tensile testing of the surface preparation shall be performed by the Engineer as necessary using Type 4 or Type 5 pneumatic adhesion testing equipment in accordance with ASTM D4541 using 2-inch diameter dollies for concrete surface adhesion testing.
    - 2) Concrete surface or applied coating shall be scored for concrete adhesion testing on high cohesive strength or elastomeric coatings or coatings greater than 35 mils in thickness.
    - 3) Adhesive failure greater than 50 percent of the dolly surface area shall indicate inadequate surface preparation.
    - 4) Cohesive failures which results in loss of sound concrete will be acceptable provided the loss is greater than 50 percent of the dolly surface area.
    - 5) Low adhesion cohesive failures with a thin layer of concrete due to weak concrete or laitance over 50 percent of the dolly surface will be rejected.
  - b. Concrete Soundness:
    - 1) Concrete soundness shall be determined using the scratching or hammer impact methods as defined in SSPC SP-13.
  - c. Moisture Content:
    - 1) Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.

E. Plastic Surface Preparation:

1. Hand sand plastic surfaces to be coated with a medium grit sandpaper to provide tooth for the coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so the surface is roughened without removing excess material.

F. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet SSPC-SP 7, Brush-off Blast Cleaning and shall achieve a profile on the coating equivalent to 80 grit sandpaper with no exposed metal.
2. Where metal substrate is exposed, Contractor shall apply full coating system as specified for new metal surfaces.
3. Repair or replace surfaces damaged by blast cleaning, where damage is defined as visible metal substrate. If less than 5 percent of prepared surface has the metal substrate visible, the coating shall be repaired by application of a brush applied intermediate coat. If greater than 5 percent the coating shall be fully removed to meet the specified surface cleanliness and recoated with the specified coating system.
4. Abrasive: Either conventional abrasive blasting with sand, grit, or nut shells or specialized abrasive blasting. Abrasives shall be 60 mesh grit, maximum.
5. Select various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface such that the surface is cleaned without pitting, chipping, or other damage.
6. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
7. The Engineer shall approve trial blast cleaned area and shall use area as a representative sample of surface preparation.

G. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by the use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
2. Method meets SSPC-SP 1.

### 3.8 PROTECTION OF MATERIALS NOT TO BE PAINTED

- A. 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.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering the motors.

### 3.9 PAINT MIXING

A. Multiple-component coatings:

1. Prepare using all of the contents of the container for each component as packaged by the paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed shall not be used beyond their pot life.
4. Provide small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by the paint manufacturer.

6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
  7. Fast set or plural component products shall be applied using an appropriate multipart pump that properly mixes both components at the recommended ratio using equipment recommended by the coating manufacturer. Hot mixing of fast set or plural component products will not be permitted.
- B. Keep paint materials sealed when not in use and provide nitrogen blanket on fast set, plural, or moisture cured coatings on opened product containers when stored or not in use more than 8 hours.
- C. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

### 3.10 APPLICATION OF PAINT

- A. General:
1. Inspection: Schedule with Engineer in advance for cleaned surfaces and all coats prior to the succeeding coat.
  2. Apply coatings in accordance with the paint manufacturer's recommendations. Allow sufficient time between coats to assure thorough drying of previously applied paint.
  3. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
  4. Paint units to be bolted together and to structures prior to assembly or installation.
  5. Shop Primed or Factory Finished Surfaces:
    - a. Inspection: Schedule with Engineer in advance for shop primed or factory-finished items delivered to jobsite for compliance with these Specifications.
    - b. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
    - c. For two-package or converted coatings, consult the coatings manufacturer for specific procedures as relates to top coating of these products. Where scarification of the existing coating is required, Contractor shall prepare the surface in accordance with Brush-off Blasting Cleaning this section.
    - d. Prior to application of finish coats, clean shop primed surfaces of dirt, oil, and grease, and apply a mist coat of specified primer, 1.0 mil dry film thickness.
    - e. After welding, prepare and prime holdback areas as required for the specified paint system. Apply primer in accordance with manufacturer's instructions.
  6. Manufacturer Applied Paint Systems:
    - a. Repair abraded areas on factory-finished items in accordance with the equipment manufacturer's directions.
    - b. Carefully blend repaired areas into the original finish.
- B. Application Safety
1. Performed painting in accordance with recommendations of the following:
    - a. Paint manufacturer's instructions.
    - b. NACE contained in the publication, Manual for Painter Safety.
    - c. Federal, state, and local agencies having jurisdiction.
  2. Contractor will be solely and completely responsible for condition of the project site, including safety of all persons (including employees) and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Safety provisions will conform to U.S. Department

of Labor, Occupational Safety and Health Act, any equivalent state law, and all other applicable federal, state, county, and local laws, ordinances, and codes.

3. Contractor will comply with all safety-training requirements promulgated or required for this project.

C. Film Thickness:

1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC.
2. Applied coating system film thickness per coat shall be applied at the specified coating thickness or the manufacturer's recommended minimum thickness, whichever is greater. Where the manufacturer has not specified a minimum coating thickness on the product data sheets, the minimum recommended coating application thickness shall apply.
3. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.

D. Stripe Coats:

1. Surfaces that are subject to immersion, condensing environments, or where specified shall be stripe coated on all angles, edges, corners, threads, welds, and similar type surfaces.
2. Stripe coat shall be an extra coat of the intermediate or topcoat material and shall be applied between the prime and intermediate coats.
3. The stripe coat shall be a separate coat of paint from coats specified under the coating system.
4. Stripe coats shall be alternated in color similar to a full coat.

E. Number of coats:

1. Apply specified number of coats, minimum, irrespective of the coating thickness.
2. Additional coats may be required to obtain the minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

F. Porous Surfaces, Such as Concrete, Masonry:

1. Prime Coat:
  - a. May be thinned to provide maximum penetration and adhesion.
  - b. Type and Amount of Thinning: Determined by the paint manufacturer and is dependent on surface density and type of coating.
  - c. Surfaces Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of the coating.

G. Existing Coated Surfaces:

1. General:
  - a. Shop primed or coated surfaces shall be reviewed with the Engineer to determine the extent of coating damage and suitability of the finish coats to adhere to the shop applied coats.
  - b. If a cured epoxy, polyurethane, or plural-component material is to be top coated, contact the coating manufacturer concerned for additional surface preparation requirements. At a minimum, existing coated surfaces shall be



- sanded to remove all gloss and roughen the existing surface for adhesion of subsequent coats.
- c. Profile on plural component or two component coatings shall be as specified for by the manufacturer or equivalent of 80 grit sandpaper; whichever is more stringent.
- d. Surface preparation recommendations of the manufacturer shall be subject to approval of the Engineer.
- e. All existing coated surfaces, where demolition of equipment was specified or required, shall be surface prepared, touch-up coating repairs completed, and a cosmetic overcoat applied using the specified coating system on all existing coated surfaces associated with the demolition work, unless otherwise specified.
- f. Existing coatings on immersed equipment shall be removed to bare metal and recoated with the specified coating system where demolition work was specified.
- g. Apply sealer/primer where recommended by coating manufacturer for coating compatibility.
- 2. To be Recoated or Final Coated:
  - a. Detergent wash and freshwater rinse.
  - b. Perform touch-up repairs of existing coating.
  - c. Asphaltic varnish coated ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.
- 3. Touch-up Repairs:
  - a. Clean loose, abraded, or damaged coatings to substrate by Power Tool (SP 3).
  - b. Feather surrounding intact coating.
  - c. Apply one spot coat of the specified primer to bare areas overlapping the prepared existing coating.
  - d. Apply one full finish coat of the specified primer or finish coat(s) overall.
- 4. Application of a Cosmetic Coat:
  - a. The exact nature of shop-applied coatings is not known in all cases.
  - b. Check compatibility by application to a small area prior to starting the coating.
  - c. If lifting or other problems occur, request disposition from the Engineer.
  - d. Cured epoxy, polyurethane, plural component materials or any other coating system that has exceeded its maximum recoat window shall be prepared as specified this section.
- H. Damaged Coatings, Pinholes, and Holidays:
  - 1. Feather edges and repaired in accordance with the recommendations of the paint manufacturer.
  - 2. Repair fusion bonded coatings to be as recommended by the original applicator. Applicator shall provide liquid repair kits for this purpose as recommended by the coating manufacturer.
  - 3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.
- I. Unsatisfactory Application:
  - 1. If the item has an improper finish color, or insufficient film thickness, clean and topcoat surface with specified paint material to obtain the specified color and coverage. Obtain specific surface preparation information from the coating manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required.
3. Evidence of runs, bridges, shiners, laps, or other imperfections shall be cause for rejection.
4. Repair defects in coating system per written recommendations of coating manufacturer and as approved by the Engineer.
5. Leave all staging up until the Engineer has inspected the surface or coating. Replace staging removed prior to approval by Engineer.

### 3.11 COATING INSPECTION

#### A. General

1. Film thickness measurements and electrical inspection of the coated surfaces:
2. Perform with properly calibrated instruments.
3. Recoat and repair as necessary for compliance with the Specifications.
4. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
5. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
6. Give particular attention to edges, angles, flanges, and other areas where insufficient film thicknesses are likely to be present and ensure proper mileage in these areas.

#### B. Coating Thickness Testing:

1. Engineer shall conducted coating thickness testing as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.
2. Measure coating thickness specified in mils with a magnetic type dry film thickness gauge as specified.
3. Check each coat for the correct mileage. Do not make measurement before a minimum of 8 hours after application of the coating.
4. Tests for concrete coating thickness shall be with a Tooke Gauge, which is a destructive test. Contractor shall repair coating after thickness testing.

#### C. Coating Continuity Testing

1. Holiday detect coatings with high voltage units in accordance with NACE RP0188. High voltage detector shall have adjustable voltages in 100 volt increments and shall be operated in accordance with the manufacturer's instructions and the specified standard.
2. Use of an electrical holiday detector, low voltage, wet sponge type holiday detector will be permitted for coating systems less than 20 mils total dry film thickness and are not for immersion or condensing environments.
3. Holiday detect coatings on pipe for buried application with high voltage spark tester in accordance with NACE RP0274.

### 3.12 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroyed at the end of each day.

- B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroyed 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 over spray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of the Contractor.

### 3.13 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.

### 3.14 PROTECTIVE COATING SYSTEMS AND APPLICATION SCHEDULE:

- A. Unless otherwise shown or specified in these Specifications painted or coated the work in accordance with the following application schedule.
- B. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

System No.	Title
1	Submerged Metal – Potable Water
2	Concrete Encased Metal
4	Exposed Metal - Highly Corrosive
5	Exposed Metal - Mildly Corrosive
8	Buried Metal - General
10	Galvanized Metal Conditioning
11	Galvanized Metal Repair
27	Aluminum And Dissimilar Metal Insulation
29	Fusion Bonded Coating

- C. System No. 1 Submerged Metal – Potable Water:

#### 1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
	Potable Grade, Polyamide Epoxy Coating	3 coats, 3 MDFTPC

#### 2. Application:

- a. All metal surfaces, new and existing, below a plane 1 foot above the maximum liquid surface, metal surfaces above the maximum liquid surface which are a part of the immersed equipment, 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, unless otherwise specified:.

b. Use on the following areas:

1) Reservoir:

a) All pipe and metal surfaces (except stainless steel)

2) Piping:

a) Lining for welded steel pipe 10-inches diameter and smaller.

b) Interior of access manways.

3. Special Requirements:

a. (1) All existing immersed metal surfaces with an existing coating system, excluding new shop primed or coated equipment, shall be abrasively blasted to bare metal and recoated with this system.

D. System No. 2 Concrete Encased Metal:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Polyamide Epoxy	2 coats, 12 MDFT

2. Application:

a. Metal surfaces encased in concrete, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel excluding reinforcing steel; and the following specific surfaces unless otherwise specified.

b. Aluminum surface in contact with concrete or grout or embedded in concrete

3. Special Requirements:

a. May be used in lieu of System No. 27 at Contractor's option.

b. Shop coated surfaces shall be prepared as specified.

E. System No. 4 Exposed Metal - Highly Corrosive:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Organic Zinc Rich Primer	1 coat, 2.5 MDFT
	Polyamide Epoxy	1 coat, 5 MDFT
	Polysiloxane	2 coats, 6 MDFT

2. Application:

a. Exposed piping and metal surfaces, new and existing, located inside of structures, manholes, vaults, and the following specific areas unless otherwise specified.

b. Use on the following areas:

1) Inlet and Outlet Valve Vaults

2) Underdrain and Drain Vaults

3) Overflow Vault

4) All underground vaults and manholes.

3. Special Requirements:

a. The surface preparation and primer shall be shop applied to all surfaces prior to installation.

b. Galvanized steel surfaces shall be coated per the coating manufacturer's requirements.

- c. Insulated piping shall be primed and epoxy coated prior to installation of insulation.
- d. All existing exposed metal surfaces with an existing coating system, including new shop primed or coated equipment, shall be prepared as specified under "Coating Application, Existing Coated Surfaces" and final topcoat applied per this system.
- e. Aliphatic polyurethane will not be allowed as a substitute for polysiloxane due to restrictive overcoat requirements.
- f. Dry film coating thickness of polysiloxane, including touch up repairs, shall not exceed the manufacturer's recommended maximum film thickness.

F. System No. 5 Exposed Metal - Mildly Corrosive:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Inorganic Zinc Rich Primer	1 coat, 2.5 MDFT
	Polysiloxane	2 coats, 6 MDFT

2. Application:

- a. Exposed metal surfaces, new and existing, located outside of structures and exposed to weather and the following specific surfaces unless otherwise specified.
- b. Use on the following items or surfaces:
  - 1) Exposed surfaces of overflow and air vent piping, unless hot dip galvanized.
  - 2) Hollow metal doors and frames.

3. Special Requirements:

- a. Surface preparation, primer, and one of two topcoats shall be shop applied to all surfaces prior to installation with final topcoat to be field applied for color uniformity after all touchup repairs have been completed.
- b. Galvanized steel surfaces shall be coated per the coating manufacturer's requirements.
- c. Polysiloxane coating to overlap buried pipe coating a minimum of 4 inches below top of concrete.
- d. Aliphatic polyurethane will not be allowed as a substitute for polysiloxane due to restrictive overcoat requirements.
- e. Dry film coating thickness of polysiloxane, including touch up repairs, shall not exceed the manufacturer's recommended maximum film thickness.

G. System No. 10 Galvanized Metal Conditioning:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Wash Primer	1 Coat, 0.4 MDFT
Followed by Hand Tool (SP 2) or Power Tool (SP 3)	Finish Coats to Match Existing Paint	As Required to Match Surrounding Area

2. Application:

- a. All galvanized surfaces requiring painting and the following specific surfaces unless otherwise specified.

3. Special Requirements:

- a. Sweep blast as specified this section, may be used in lieu of hand or power tool cleaning of galvanized surfaces provided CONTRACTOR can demonstrate that damage to the zinc coating will not result. ENGINEER approval of sweep blasting locations, methods, and surface cleanliness and profile results is required.
- b. See applicable coating systems for finish coating system and coating requirements based on area and/or surface to be coated.

H. System No. 11 Galvanized Metal Repair:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1) Followed by Hand Tool (SP 2), or Power Tool (SP 3), or Brush-off Blast (SP 7)	Organic Zinc Rich Primer or Inorganic Zinc Rich Primer	1 Coat, 3 MDFT

2. Application:

- a. All galvanized surfaces which are abraded, chipped, or otherwise damaged and are not specified to be coated.

I. System No. 27 Aluminum and Dissimilar Metal Insulation:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Wash Primer	1 coat, 0.4 MDFT
	Bituminous Paint	1 coat, 8 MDFT

2. Application:

- a. Use on all non-submerged concrete embedded aluminum surfaces, and the following specific surfaces unless otherwise specified.
- b. Use on the following surfaces:
  - 1) All concrete embedded components of vault hatches
  - 2) All concrete embedded surfaces where electrical isolation from concrete reinforcement is required.

J. System No. 29 Fusion Bonded Coating:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Acid Pickling (SP 8)	Fusion Bonded 100% solids Epoxy or Polyurethane	1 or 2 coats, 10 MDFT

2. Application:

- a. Valves, air valves and equipment.
- b. Concrete embedded anchor bolts, except threads.
- c. Removable handrail sleeves.

3. System Notes:

- a. System 1 may be used as alternative coating system at Contractor's option.

3.15 ARCHITECTURAL PAINT SYSTEMS:

System No.	Title
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130	Concrete Stain and Sealer
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A. System No. 130 Concrete Stain and Sealer:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete Acid wash or as directed by stain manufacturer	Concrete stain and sealer	As directed by manufacturer

2. Application:

- a. All exposed surfaces of Outlet Valve Vault wall (including 1 ft of wall surface below grade).
- b. All exposed surfaces of retaining wall (including wall surface 1 ft below grade).
- c. All exposed surfaces of new Tank (including wall surface 1 ft below grade).
- d. Earth tone stain to be selected by Owner. Submit color chart for review and selection. Contractor to provide 4-ft by 4-ft mockup of up to three different colors for final color selection by Owner.

END OF SECTION

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## Paint System Data Sheet

Attach products' Technical Data Sheet (if applicable) to this sheet for each paint system:

Paint System Number (from Specification):		
Paint System Title (from Specification):		
Coating Manufacturer:		
Name of Representative:		
Surface Preparation Specification:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Minimum Coats, Coverage

Additional Information Required (check applicable items):

- ☐ ANSI/NSF Certification letter for each paint material listed above requiring ANSI/NSF Standard 60 and 61 approval.
  
- ☐ Manufacturer's minimum and maximum recommended coating thickness per coat and for total coating system.
  
- ☐ Immersion coating cure requirements from minimum coating application temperature to 100 deg F in 15-degree temperature increments.

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**SECTION 09 97 01  
PIPELINE COATINGS AND LINING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This section covers the work necessary to apply external coating and internal lining on steel pipe, field coating of joints, and field repair of coating damage, complete.
- B. Steel pipe will be supplied from the fabricator with either a tape wrap or plural component epoxy coating system, and where specifically required the dielectric coating system shall be over coated with cement mortar. The yard piping for this project consists primarily of fittings and special fabrications, with very few straight runs of pipe. For this reason all buried steel pipe is expected to be supplied with the specified plural component epoxy coating system, with no cement mortar over coat.
- C. Exposed steel pipe will be coated as specified in Section 09 90 00 - Coatings and Painting, unless specifically specified otherwise.
- D. Hand applied tape wrap (with the exception of field-applied wax tape at buried fittings and flanges per paragraph 2.4.B) shall not be allowed under any conditions.

**1.2 SUBMITTALS**

- A. Submittals shall be made in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.
- C. Quality Control Submittals: Furnish the following:
  - 1. Applicator's Experience with list of references substantiating compliance.
  - 2. Coating manufacturer's certification stating the applicator meets or exceeds their coating application requirements and recommendations.
  - 3. Coating manufacturer shall provide a copy of the manufacturer's coating application quality assurance manual.
  - 4. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers' that the two coating materials are compatible.

**1.3 QUALITY ASSURANCE**

- A. Coating Applicator's Experience and Certification:
  - 1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
  - 2. Coating application personnel, whom have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.

3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.
- B. Coating and/or lining manufacturer technical representative shall be present for a minimum of one day technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, 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.
  - C. Coating and/or lining manufacturer's technical representative shall be onsite for one working day, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, 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 include 8 hours per month of field or shop coating technical support when requested by the Engineer.
  - E. Technical representative shall provide a written report to the Engineer for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Engineer, work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed; 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.

#### 1.4 ABBREVIATIONS

MDFT	Minimum Dry Film Thickness
mil	Thousandths of an Inch

#### 1.5 DEFINITIONS

- A. Manufacturer's Representative: Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacture is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.

#### 1.6 REFERENCE STANDARDS

- A. This specification recognizes AWWA, NACE, and SSPC standards as minimum industry standards and they are referenced for purpose of conformance, except where modified in this

section. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long term coating performance of 100 years.

AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.
AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines.
AWWA C216	Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
AWWA C217	Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal

#### 1.7 SPECIAL WARRANTY REQUIREMENTS

- A. The Contractor and coating applicator shall warrant to the Owner and guarantee 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 work.

#### 1.8 OBSERVATION OF WORK

- A. The Contractor shall give the Owner Representative a minimum of 14 days advance notice of the start of any work to allow scheduling for shop or field observation.
- B. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.

- C. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.
- D. Observation by the Owner's representative or the waiver of observation of any particular portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.
- E. Materials shall be subject to observation for suitability as the Owner's representative may determine, prior to or during incorporation into the work.

## **PART 2 - MATERIALS**

### **2.1 GENERAL**

- A. Coatings and linings will be stored and handled per manufacturer's written directions.
- B. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer's, and these specifications, whichever is more stringent.
- C. Pipeline coating or lining shall be the product of a single manufacturer. Product substitutions during the project will not be permitted without Engineer approval.

### **2.2 SHOP-APPLIED EXTERIOR COATINGS**

#### **A. General**

- 1. Steel pipe shall be coated in accordance with plural component epoxy or AWWA C214, except as modified herein.
- 2. Mortar over coat of dielectric coating shall be provided over tape wrap coating system (AWWA C214) and where specified or indicated on the Drawings. Steel pipe specified to receive a cement mortar overcoat shall be shop-coated with the required coating system and a 3/4-inch thick, minimum, cement mortar overcoat as specified herein.
- 3. Pipe that is atmospherically exposed shall be shop primed as specified herein and Section 09 90 00 - Coatings and Painting.
- 4. Buried dielectrically coated pipe and fittings passing through a concrete structure wall or floor shall be coated for a minimum of two-inches beyond the interior wall or floor surface.

#### **B. Polyethylene Tape Wrap:**

- 1. Pipe shall be coated with an 80 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
  - a. Primer: Polyken 1019, 1027, 1029, or as recommended by the coating manufacturer.
  - b. Weld Stripe Tape: Polyken 931 (no backing), 25 mils nominal, 4-inches wide minimum.
  - c. Inner Wrap: Polyken 989 YGIII, 20 mils nominal, corrosion protection layer.
  - d. Middle Wrap: Polyken 955 YGIII, 30-mils nominal, mechanical protection layer.
  - e. Outer Wrap: Polyken 956 YGIII, 30 mils nominal, mechanical protection layer.

- f. Surface Preparation:
      - 1) Steel Pipe: SSPC-SP5, White Metal blast, 2.5 mils blast profile, minimum.
  - 2. Tape Coating:
    - a. Tape layers shall have adhesive for the full width of the tape. Adhesive shall have the ability to stick to itself and to the proceeding tape layer or pipe.
    - b. Each layer shall be a different color or shade with the outer layer white.
    - c. Outer wrap shall have sufficient ultraviolet (UV) inhibitors to resist above grade exposure for a minimum of 12 months or the proposed storage and construction time, whichever is greater.
    - d. Tape width shall be 12-inches maximum. Wider tape will be conditionally allowed if the coating applicator can demonstrate that proper tensioning can be maintained and mechanical wrinkling prevented throughout the coating application. If at anytime during the pipe fabrication tape quality becomes inconsistent with a wider tape, the Engineer can require the remainder of the pipe to be coated using the maximum specified tape width.
    - e. Tape coated steel pipe shall be provided with a cement mortar overcoat as specified in this section.
- C. Plural Component Epoxy:
  - 1. General:
    - a. Plural component, epoxy coating system shall be applied as specified herein with the exception that AWWA C210 is incorporated by reference for product qualification and application requirements only.
    - b. Where there is a conflict between C210 and this specification, the more stringent requirement shall apply.
  - 2. Shop Surface Preparation:
    - a. Steel pipe: SSPC-SP5, White Metal blast, 3.00 mil profile, minimum, or as required by the manufacturer, whichever is greater.
  - 3. Shop Applied Coating Requirements:
    - a. Thickness: One coat, 35 mils total dry film thickness, minimum, or as required to meet limits specified for holiday and coating defects, this section.
    - b. Epoxy: Self-priming, plural component, 100 percent solids, non-extended epoxy, suitable for burial or immersion, and meeting the requirements of AWWA C210 and the following, whichever is more stringent:
      - 1) Resistance to Water Immersion (ASTM D870) or Wet Adhesion
        - a) Acceptance criteria:
          - i. Not greater than 10 percent loss of substrate adhesion when compared to substrate adhesion in an unexposed area of the same sample with adhesion tests completed within 12 to 24 hours after test termination. Average of three pulls per exposure area.
          - ii. No blistering or underfilm corrosion when viewed at 10x magnification.
        - b) Adhesion Testing:
          - i. Method: ASTM D4541, Method E
          - ii. Equipment: Type V, Delfesko Automatic AT Positest
          - iii. Dollies: 20 mm and 14 mm, scored to metal substrate

- iv. Test Speed: 100 psi per second (both 14 and 20 mm)
- c) Test Duration: 30 and 60 days
- 2) Cathodic Disbondment (ASTM G95)
  - a) Acceptance criteria: 8 mm, maximum
  - b) Potential: -3.00 volts
  - c) Test Duration: 28 days
  - d) Evaluation: Measured from original holiday radius to edge of staining on metal surface.
- 3) Water Absorption (ASTM D570)
  - a) Acceptance Criteria: 1.80 percent, maximum
  - b) Test Duration: 30 day and 60 day
- 4) Long-Term Adhesion Test:
  - a) Acceptance Criteria: Not more than 10 percent loss of adhesion over duration of test. Differential based on the highest average adhesion result to the lowest average adhesion result.
  - b) Test Duration: 1 day, 7 days, 3 weeks, 2 months, and then monthly for total test duration of 12 months.
  - c) Sample Preparation:
    - i. SSPC-SP5, white metal abrasive blast, 3.00 mils profile, minimum.
    - ii. Test area shall not exceed 18-inches by 18-inches.
    - iii. Steel plate shall be a curved steel plate with a minimum radius of 15 inches to minimize standing water on the test panel.
    - iv. Sample shall be exposed to ambient, outdoor conditions for the full duration of the test.
  - d) Test Procedure:
    - i. Long term adhesion shall be based on an 8 pulls per test period with the 3 lowest pulls discarded.
    - ii. Test results per each test period shall be an average of the five highest pulls.
    - iii. All adhesion pulls and their failure mode shall be recorded and those included in the average calculation shall be identified.
    - iv. All adhesion tests shall be repaired to prevent water runoff from affecting subsequent adhesion tests.
- c. Shall be one of the following products:
- d. Tnemec Series 431, Kansas City, MO
- e. Or approved equal.

D. Exterior Coating for Exposed Steel Pipe

- 1. All atmospherically exposed or vault piping shall be shop primed with the coating system as specified in Section 09 90 00 - Coatings and Painting.
- 2. Exposed pipe to be shop primed per Section 09 90 00 with intermediate and finish coats to be applied in the field after installation is complete.



3. Shop applied inorganic or organic zinc primer shall not be applied at thickness greater than recommended by manufacturer. Excess primer to be removed using 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. Engineer approval of a coating system with two or more coating manufacturer's will require written approval from all coating manufacturer's as to compatibility and acceptance under warranty..
- E. Cement Mortar Coating or Overcoat
1. Cement mortar overcoat shall be applied over tape wrap coating system (AWWA C214) on steel pipe in accordance with AWWA C205, except as modified herein.
  2. Holdback:
    - a. Mortar overcoat shall be held back of dielectric coating a minimum of 3 inches for overlap of field applied joint coating onto dielectric coating system.
    - b. Increase holdback to allow for coating shrinkage with Pritec coating system.
  3. Shop Applied Coating System:
    - a. Cement: Conform to ASTM C150, Type II.
    - 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.

## 2.3 SHOP-APPLIED INTERIOR LININGS

- A. Cement Mortar Lining:
1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
  2. Cement: 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. Cement Mortar Lined Steel Pipe:
    - a. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters centered over the insulated joint.
    - b. Epoxy lining shall be polyamine or polyamide cured, NSF approved for potable water contact in accordance with ANSI/NSF Standards 60 and 61, and capable of achieving full cure before placement in service or exposure to water.
    - c. Application:

- 1) Apply in two coats at equivalent spread rate for 6 mils dry film thickness per coat with coating application efficiency of 80 percent.
  - 2) Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
  - 3) 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. Mortar lining shall be dry when epoxy lining is applied.
  - 4) Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.
2. Steel Pipe Lining:
- a. Where epoxy lining is specified or shown on drawings, epoxy lining shall be applied directly to the steel surface.
  - b. Surface Preparation: SP-5, White Metal Abrasive Blast
  - c. Epoxy Lining: Polyamine or polyamide high build epoxy, NSF 60 and 61 approved, suitable for continuous immersion, and capable of achieving full cure before placement in service or exposing to water.
  - d. Application: Apply in three coats at 5 mils minimum dry film thickness per coat with separate stripe coat at welds.

## 2.4 FIELD APPLIED COATINGS

### A. General

1. All buried miscellaneous metal components installed on the pipeline and that is supplied bare or with a shop coating system that is not equal to the specified pipeline coating shall be coated in the field with one of the following coating systems.
2. Miscellaneous metal components shall include, but not be limited too, all exposed metals surfaces, including bolts, couplings, flanges, valves, adapters, pipe spools, and other miscellaneous metal components.
3. Coating system applied shall conform to the manufacturer's requirements and shall be applied in accordance with the application requirements of the coating system.

### B. Petroleum or Wax Tape Coating:

1. Coating System:
  - a. Surface Preparation: SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
  - b. Primer: petroleum or petrolatum wax
  - c. Filler Material:
    - 1) Filler materials shall be petroleum or petrolatum wax sealer/filler with closed cell plastic filler
    - 2) Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
  - d. Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick
  - e. Outer Wrap: PVC or tape suitable for application to inner tape.
  - f. Wax tape coating system shall be as manufactured by:
    - 1) Denso North American
    - 2) Trenton
    - 3) Or approved equal.
2. Application:

- a. Coating shall be in accordance with AWWA C217, except as modified herein.
- b. Wax tape coatings shall be field applied on all buried couplings, thrust restraint rods and brackets, valves, and on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink coating systems and is not cement mortar over coated.
- c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
- d. Use sand backfill to protect wax coating from damage.

C. Epoxy Coating:

1. Coating System:

- a. Surface Preparation: SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
- b. Primer: As required by the coating manufacturer.
- c. High Build Epoxy Coating:
  - 1) Two component, high build polyamide or polyamine cured epoxy coating, suitable for direct burial or immersion, dries to touch in 2 or more hours, suitable for immersion or burial after full cure of coating.
  - 2) Acceptable manufacturers:
  - 3) ICI Devoe
  - 4) Sherwin Williams
  - 5) Carboline
  - 6) Or approved equal
- d. Fast Cure Epoxy Coating:
  - 1) Two component, 100% solids by volume, fast cure epoxy coating suitable for direct burial or immersion, dry to touch in less than 1 hour at 72 degrees, capable of curing while immersed or buried.
  - 2) Acceptable Manufacturers:
  - 3) TC 7010, Tapecoat Inc
  - 4) Protal 7125, North American Denso

2. Application:

- a. Epoxy coatings on interior of pipe shall be NSF approved coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61, unless otherwise approved by the Engineer.
- b. Contractor shall ensure that epoxy coating selected is suitable for the application temperatures anticipated and that project schedule will allow adequate cure time before backfill or immersion based on surface temperatures at the time of application.
- c. Epoxy coating shall be used for coating concrete embedded surfaces to a distance of 4 inches outside the interior and exterior surfaces of concrete wall or floors. Epoxy coating at concrete penetrations shall be a minimum of 12 mils dry film thickness.

D. Heat Shrink Sleeves:

1. Coating System:

- a. Surface preparation: SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
- b. Filler Material:

- 1) Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.
- 2) Filler mastic for joints subject to weld after backfill shall exceed 500 degrees F melting temperature.
- c. Heat Shrink Sleeve:
  - 1) Heat shrink, cross-linked polyolefin wrap or sleeve with a mastic sealant, 85-mils nominal thickness, suitable for pipeline operating temperature, as recommended by the manufacturer.
  - 2) Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for mechanical or bell and spigot ductile iron pipe, flange joints, and coupling style joints.
  - 3) Width of heat shrink sleeves shall be sufficient to overlap existing coating 2 inches minimum. Overlap on tape coated steel pipe shall be based on a sequential 2-inch wide step from outer wrap to middle wrap to inner wrap.
  - 4) Sleeve shall meet requirements for "Well After Backfill" when allowed and approved by Engineer.
- d. Coating Manufacturer's:
  - 1) Canusa,
  - 2) Raychem-Covalence,
  - 3) Or equal.
- e. Application:
  - 1) Heat shrink sleeves shall be applied to buried or concrete encased pipeline joints only. Application on vault piping or where exposed to the weather will not be allowed.
  - 2) Provide filler material for all rolled or Carnegie joints, flanges, and couplings and all step changes greater than 1/8-inch.
  - 3) Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve.
  - 4) Contractor to consider sleeve shrinkage and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Engineer approval.
  - 5) All transitions from tape wrap to epoxy or other brush, roller, or spray applied protective coating system shall be coated at the transition with a heat shrink sleeve with minimum 3-inch overlap onto both coating systems.

## 2.5 SPECIALS, FITTINGS, AND CONNECTIONS

- A. Coating and lining application for special sections, connections, and fittings for steel or ductile iron pipe shall conform to coating system and application requirements as specified this section.
- B. Specials, fittings, and connections 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 which require special fabrication that

prevents mechanical production application of the specified coating system from end to end of pipe joint.

- C. In addition to the items listed as specials, the following items shall also be considered as specials:
  - 1. All pipe sections entering a structure.
  - 2. Pipe joints with pass through holes.
- D. Hand applied tape coatings will not be permitted on any pipe specials, valves, fittings, connections, and couplings.
- E. Specials, fittings, and connections shall be externally coated with a plural component epoxy coating system, applied from end to end of pipe joint on all specials, fittings, and connections.

## 2.6 EXTERIOR PIPE JOINT FIELD COATING

- A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, except as modified in this section.
- B. Field joint coating shall be compatible with the shop-applied coating system.
- C. All joints on pipe shall be coated with a heat shrink coating material.
- D. Field joint coating materials shall be as specified for Field Applied Coatings, this section.

## 2.7 FIELD APPLIED INTERIOR JOINT COATING

- A. Mortar Lining:
  - 1. 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 flush with the interior surface. Excess shall be removed.
  - 2. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
  - 3. 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.

## 2.8 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.
  - 2. Repair materials shall be as required for the coating system and "major" or "minor" repair classification as defined this section.
- 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. Manufacturer's: Canusa, Raychem (Polyken), or 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; except for "Pritec" coated pipe shall have a minimum overlap of 3-inches in the circumferential direction.
    - c. CRP patch as manufactured by Canusa, PERP patch as manufactured by Raychem (Polyken), or equal.
  - 3. Plural Component Epoxy Coating or Lining
    - a. Major repairs in the shop will be completed using the coating material specified for the coating or the lining. Coating shall be reapplied using plural component spray equipment by a manufacturer certified coating applicator.
    - b. Major repairs in the shop or field shall be completed using heat shrink sleeves as specified this section.
    - c. Coating material for minor repairs shall be single use epoxy kits similar to the existing coating
    - d. Pinhole holidays or adhesion test coating repairs shall be with minor repair coating material specified or fast cure epoxy, such as Protal 7125 as manufactured by North American Denso, Inc.
- C. Exposed Pipe Coating System
- 1. Touch-up repair all damage to the primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 90 00 – Coatings and Painting.

## **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, 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 exceeds 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 expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
    - d. Whenever relative humidity exceeds 85 percent for polyurethane coating application.
  - 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 specified and in accordance with the manufacturers coating application recommendations.
  - 6. Work activities can be restricted by the Engineer until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.
  - 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, preheat pipe to a temperature between 45 and 90 degrees and 5 degrees above dew point, whichever is greater.
  - 2. When temperatures are above or below the coating manufacturers recommended application temperatures, the CONTRACTOR will provide temperature controls as necessary to permit work to precede 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 fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.
- ### 3.2 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. All 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. Requirements:
    - a. Spray applied coating systems do not require weld grinding.
    - b. Grind welds flush on extruded polyolefin coated pipe as specified herein.

- c. Welds on tape wrap coated pipe shall be either ground flush or a weld stripe tape applied over the weld, at the pipe fabricator's option, unless otherwise specified.
  - 2. Weld Grinding:
    - a. Under the weld grinding option, welds higher than 1/32 inch above pipe surface shall be ground to a tolerance of +1/32 inch to 0-inch above the pipe surface as measured on the lowest side of the weld.
  - 3. Weld Stripe Tape:
    - a. Weld stripe tape will be applied to primed metal.
    - b. Tape will either have no polyethylene backing or will 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 as specified 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 specified for 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 specified.
  - 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. Polyurethane coated steel shall have a sharp angular surface profile of the minimum depth specified.
  - 5. After abrasive blasting surfaces and before coating application, the metal surface shall be cleaned of residual dust to a minimum of Grade 2 per ISO standard 8502-3, Test for the Assessment of Surface Cleanliness.
  - 6. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
  - 7. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Engineer's sole discretion.

### 3.3 SHOP-APPLIED COATING SYSTEMS

- A. Tape Wrap Coating
- 1. Applicator shall provide a monitoring system approved by the tape manufacturer that constantly records pipe and tape conditions during coating application. Recorded monitoring parameters shall include, but not be limited too, pipe temperature; line speed, primer and tape roll body temperature, and tape tension.
  - 2. Pipe surface temperature shall be between 45 and 120 degrees and 5 degrees above dew point, whichever is greater.
  - 3. Tape roll temperature shall be in accordance with the manufacturer's recommendations, but shall not be less than 55 degrees for the inner wrap and 65 degrees for the outer wraps.
  - 4. Apply a uniform coat of primer as recommended by the manufacturer without skips, runs, or sags. Allow to properly dry prior to applying the tape as required by the tape



manufacturer and as necessary to achieve maximum tape adhesion. Rug type application will not be allowed.

5. If welds are not ground flush, apply a weld stripe tape to longitudinal or spiral pipe welds prior to application of the inner wrap.
6. Tape layers shall be applied continuously with the use of hydro-tension tape stands. Tension shall be maintained between the manufacturer's minimum and maximum tension recommendations or as required to achieve approximately 2.0 percent reduction in tape width.
7. Inner tape wrap shall adhere tightly to the pipe surface. Coating shall be 100 percent adhering to the metal surface and shall not have any visible damage, wrinkles, voids, disbondment, contamination, or holidays.
8. Tape coating adhesion testing shall be performed on the pipe as specified this section.
9. Holidays testing shall be conducted on the inner layer tape prior to proceeding with subsequent tape layers. All holidays detected shall be primed and patch using coating repair procedures specified herein.
10. Perform coating and lining repairs as specified in this section.

B. Plural Component Epoxy Coating

1. Applicator Qualifications:
  - a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.
  - b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Engineer.
  - c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last three years. The certified applicator shall be present during all coating application work and shall have responsibility for controlling all aspects of the coating application.
2. Pipe surface temperature shall be between 50 and 100 degrees or 5 degrees above dew point, whichever is greater.
3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
4. Coating adhesion and holidays testing shall be tested as specified this section.
5. Coating manufacturer shall provide to the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
6. Unacceptable Coating Application
  - a. Coating applied under improper environmental conditions will be rejected.
  - b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.
  - c. Coating which fails the adhesion or holiday testing as specified this section shall be rejected.

- d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.
  7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the coating manufacturer's written instruction and the requirements of these specifications.
  8. Perform coating and lining repairs as specified in this section.
- C. Cement Mortar and Overcoat Coatings
1. Dielectrically coated steel pipe, when specifically required or specified, shall have a cement mortar overcoat applied over the dielectric pipe coating in accordance with AWWA C205, except as modified herein.
  2. Cement Mortar Overcoat:
    - a. Cement mortar overcoat dielectrically coated steel pipe as specified in AWWA C205, except mortar coating shall be applied over exterior pipe coating.
    - b. Mortar coating shall be held back 3 inches, minimum, behind dielectric coating system cut back at joints.
    - c. Coating Defects:
      - 1) Cracking in the mortar "armor" coat less than 1/8-inch in width will be acceptable.
      - 2) Disbondment of the cement coating over a dielectric coating system should be anticipated and will not be grounds for repair or rejection of the pipe.
      - 3) Losses of cement mortar coating due to impact, movement, or shipping damage shall be repaired in accordance with C205.
    - d. Joint Coating:
      - 1) Joints do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

### 3.4 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 as specified herein.
- C. Holdbacks shall be as required for pipe joints as listed below. Pipe manufacturer may adjust holdback limits as required for special joint assemblies, and with consideration for the joint coating provided and joint welding requirements.

<b>Tape wrap coating</b>	
Push-on joint, spigot	4-inches, minimum
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	4-inches, minimum
<b>Plural component epoxy coating</b>	
Push-on joint, spigot	1-inch before centerline of gasket
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 specified joint coating system and weld after backfill requirements, where applicable.
2. Approved holdback primers are:
  - a. Tnemec Omnithane – Suitable for all joints, except joints subject to weld after backfill
  - b. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer – suitable for all joints, including weld after backfill joints.
  - c. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer – suitable for all joints including weld after backfill joints.
  - d. Polyken Tape Primers – Not allowed
3. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during welding on weld after backfill joints.
4. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
5. Primer application on spigot end of weld after backfill pipe joints shall be held back a minimum of 1 inch from end of spigot to 2-inch maximum or as necessary to prevent toxic fumes during field welding.
6. Any corrosion within the holdback areas shall be abrasively blasted to near white metal in accordance with SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.5 PIPE LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. 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.
2. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.
3. 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.
4. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.
5. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
6. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
7. 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 and to the satisfaction of the Engineer.
8. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

B. Liquid Epoxy Lining:

1. Where epoxy lining is specified or shown on drawings, epoxy lining shall be applied directly to the steel surface after abrasively blasting to SSPC SP-5, White metal blast.
2. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating.
3. 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.
4. 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.
5. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile
6. Mortar lining shall be dry during epoxy lining application.
7. 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.

### 3.6 FIELD COATING JOINTS

#### A. Surface Preparation:

1. All joints shall be prepared as follows:
  - a. Remove all oil and grease contamination from pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
  - b. Without Holdback Primer:
    - 1) Clean pipe surface and adjacent coating of all corrosion and other foreign contaminants in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasive blast joints in accordance with SSPC-SP10, near white metal blast.
    - 2) Clean the full circumference of the pipe and a minimum of 4 inches onto the existing coating.
    - 3) No profile is required with SP-11 preparation and heat shrink sleeve joint coating.
  - c. With Holdback Primer:
    - 1) All joints with a holdback primer shall be prepared by removing all oil and grease in accordance with SSPC-SP1, Solvent Cleaning, followed by spot preparation of visible corrosion or rust in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal.
    - 2) Clean the full circumference of the pipe and a minimum of 4 inches onto the existing coating.
2. Remove all loose or damaged pipe coating at joint and either repair the coating as specified herein or increase the length of the joint coating, where reasonable and practical.
3. Joint bonds shall be installed before application of joint coating as specified in Section 13 47 13 – Cathodic Protection. Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with filler mastic.
4. Contractor to electrically test completed joint coating for holidays with high voltage spark tester at Engineer's direction or if damage to the joint coating occurs..

B. Weld After Backfill Joint Requirements:

1. Post welding of joints (weld after backfill) is not allowed, unless approved by the Engineer and the welding procedure approved meets the most current requirements for weld after backfill coating protection, holdback coating temperature resistance, heat input monitoring, and welding procedures.
2. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.
3. Post welded joints shall be coated and protected as follows:
  - a. Joint coating shall be Canusa AquaWrap heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.
  - b. Provide 6-inch wide Canusa AquaWrap protective layer centered over the interior weld location as recommended by the joint sleeve manufacturer. Heat resistant tape will not be acceptable.
  - c. Hold back primer shall be suitable for post weld conditions as specified this section and shall not exhibit any binder breakdown in the heat affected zone that causes loss of joint coating adhesion to the holdback primer.
  - d. Filler mastic materials shall be high temperature materials with 500 degree F melting point.
  - e. Joints shall be fully buried prior to welding, with not less than 12-inch cover of soil or flowable fill material on all sides. Sand or flowable fill backfill is preferred for weld after backfill joints.
4. Welding of the joints shall be in conformance with the Section 33 11 11, Steel Pipe, and as modified herein:
  - a. All welding shall be with two or more weld passes as required to meet the specified AWS qualified welding procedures and maximum coating temperature limitations. 'Weld after Backfill' procedures on wall thicknesses of  $\frac{1}{4}$  inch or less must be approved by the Construction Manager based on field testing demonstrating the welding procedures can comply with the requirements of this specification.
  - b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 24,000 joules or a maximum surface temperature at the coating/steel interface of 800 degrees F, whichever is least.
  - c. Maximum weld temperature and duration shall not result in carbonization of the joint coating adhesive. Carbonization is defined as the loss of volatile organic compounds that result in loss of tackiness, adhesion to the steel, and corrosion protection properties.
  - d. Finished joint coating shall not have any visual creases or folds in the joint coating backing material that extends through both the inner protective layer and outer joint sleeve.
5. If Contractor elects to post-weld any joints, Contractor shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Engineer. Contractor will remove and replace joint heat shrink sleeve upon completion of the evaluation.
6. In the event that any excavated post welded joint exhibits any heat related damage as defined herein, Contractor shall modify and test a new post welding procedure prior to completing any additional post-welded joints. Contractor shall demonstrate that

the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined this Section, including excavation of the three additional randomly selected joints for destructive evaluation.

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 is required. 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 as recommended by the sleeve manufacturer.
3. Metal surface shall be free of all dirt, dust, and surface corrosion prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations.
4. Where corrosion in the holdback area is visible, surfaces shall be prepared in accordance with SSPC-SP10, near white metal blast, or SSPC-SP11, power tool cleaning to bare metal.
5. 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.
6. Fill all cracks, crevices, gaps, and step-downs greater than 1/8 inch with filler mastic. Application of filler material shall be in accordance with the manufacturer's instructions for the full circumference of the pipe.
7. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2-inch overlap onto the existing pipe coating.
8. 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 as directed by the Engineer. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.
9. 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.
10. 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.
11. 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 the existing coating and recoat the joint.

D. Cement Mortar Coating:

1. Pipe joints on cement mortar over coated steel pipe do not require cement mortar coating.

### 3.7 REPAIR OF COATING AND LININGS

#### A. General:

1. All 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 specified herein for the coating system.

#### B. Tape Wrap Coating Repairs:

##### 1. General:

- a. No more than five repairs per joint of pipe will be permitted with tape wrap coating, excluding adhesion test damage. The coating on any pipe with more than five coating repairs or with more than two areas of coating damage greater than five square feet will be rejected.
- b. Pipes exceeding the maximum number or size of coating defects shall be stripped, reblasted, and recoated.
- c. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the Contractor's expense.
- d. The number of layers and total thickness of the tape repair coating shall be the same as the shop-applied coating; unless heat applied coating materials is used.
- e. Wipe the area to be repaired with solvent for a minimum distance of 4 inches outside the damaged area.

##### 2. Defect Size:

- a. Minor repairs – Any repair that are less than 8 inches in the greatest dimension, measured after cutout of damaged tape layers. Damage to the corrosion protection tape layer will be considered minor if repairs are made using heat applied patch materials.
- b. Major repairs - repairs that exceed 8-inches in the greatest dimension or where damage to the inner tape layer has occurred and hand applied tape repairs will be used.

##### 3. Minor Repairs:

- a. Complete minor repairs using a heat applied coating patch material.
- b. Cut patch material to overlap onto the undamaged coating a minimum of 2 inches on all sides with 1-inch radius on each corner of the patch.
- c. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
- d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.

##### 4. Major Repairs (Over 24-inches Diameter):

- a. Cigarette wrap coating repairs shall be with heat shrink sleeves as specified for joints.
- b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
- c. Holiday test the inner wrap and if a holiday is detected cut outer layers back to fully exposed the holiday(s) and retest for holidays.
- d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.

- e. Width of sleeve shall be the width of the damaged area plus 4-inch overlap. Multiple sleeves may be used for larger repairs, but must be overlapped a minimum of 2 inches.
- 5. Major Repairs (24-inch Diameter or Less)
  - a. Cigarette wrap repairs on pipe less than 24-inches with heat shrink sleeves as specified for major repairs.
  - b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap. Holiday test the inner wrap and if a holiday is detected apply one extra layer of repair tape.
  - c. Clean surfaces by solvent wiping and applying primer over the inner tape layer for a minimum of 6-inches onto the outer wrap in all directions.
- C. Plural Component Epoxy Coating or Lining Repairs
  - 1. General
    - a. Complete coating or lining repairs in accordance with the coating manufacturers written instructions and these specifications, whichever is stricter.
  - 2. Defect Size:
    - a. Minor repairs - repairs that are less than 8-inches in the greatest dimension.
    - b. Major repairs - repairs that exceed 8-inches in the greatest dimension.
  - 3. Maximum Quantity of Defects Allowed:
    - a. Coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.
      - 1) Two or more minor repairs within 6-inches diameter circle will be considered a single repair.
      - 2) Repairs for adhesion testing will not be included in the total number of repairs.
    - b. Major repairs shall not exceed two per pipe joint and the combined area shall not be greater than 40 percent of the pipe.
    - c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.
    - d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the contractor's expense.
  - 4. Minor Repairs:
    - a. Minor repairs
      - 1) Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2-inches around the defect.
      - 2) Shop Repair Materials:
        - a) Single use plural component epoxy coating kits using single use packaging that controls mix ratio.
        - b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.
          - i. Protal 7125, North American Denso Inc, or equal
          - ii. Or equal.
        - c) Coating Manufacturer's plural component epoxy coating repair products subject to Engineer approval.



- 3) Field Repair Materials:
    - a) Heat applied coating materials; CRP Patch, Canusa; PERP Patch, Tyco Adhesives, or approved equal.
    - b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.
      - i. Protal 7125, North American Denso, Inc,
      - ii. Or equal.
    - c) Single use plural component epoxy coating kits using single use packaging that controls mix ratio.
    - d) Coating Manufacturer's plural component epoxy coating repair products subject to Engineer approval.
  - 4) Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coating and feather defect edges minimum of 2 inches.
  - 5) Apply a single coat of the specified patch coating material at the specified coating thickness.
  - 6) Repair coating adhesion shall be 50 percent of the specified coating adhesion.
5. Major Repairs:
- a. Major repairs:
    - 1) Surface Preparation:
      - a) The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.
      - b) Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.
    - 2) Shop Repair Materials:
      - a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
    - 3) Field Repair Materials:
      - a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
      - b) Heat shrink sleeves as specified for pipeline joints.
  - b. One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.
  - c. Repair adhesion shall be equal to the specified coating adhesion.

### 3.8 INSPECTION AND TESTING

#### A. General

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.

3. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.
- 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 profilometer shall be used, where deemed necessary, to verify tester tape measurements.
- C. Adhesion Testing
1. General
    - a. 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 the Contractor.
    - b. Coating adhesion testing shall be conducted on each pipe lot coated. The quantity of coating adhesion tests shall be the greater of the following:
      - 1) Two pipes will be tested for the first 3,000 square feet of coating application plus on additional pipe for each increment of 2,000 square feet of coating application in excess of the first 3,000 square feet
      - 2) Not less than 25 percent of each pipe produced within a lot.
    - c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a 12-hour or less work shift.
    - d. The pipe coating applicator shall repair all coating damage from adhesion testing.
    - e. 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 criteria specified and the test was requested by the pipe fabricator.
    - f. Pipe will be randomly selected for adhesion testing.
    - g. Owner or Owner's Representative has the right to conduct additional adhesion testing as deemed necessary to assure the pipe meets or exceeds the requirements of this specification at any time and location.
    - h. Prior to beginning any QA/QC testing, the pipe fabricator, coating manufacturer, and Engineer shall review dolly attachment procedures, adhesion test procedures, and data recording requirements for the project and ensure that test personnel are qualified and capable of performing the testing in accordance with required test standards and these specifications.
  2. Rejection of Pipeline Coating or Lining
    - a. Each pipe that fails the adhesion criteria, as defined this section, shall be rejected.
    - b. If any pipe within a lot that fails to meet the adhesion criteria specified for the coating type, the pipe coating will be rejected and all pipes within the lot will be classified as rejected. Each remaining pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific to the coating type.

- c. All rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.
- 3. Tape Coating Adhesion Testing:
  - a. Adhesion Acceptance Criteria:
    - 1) Inner tape coating shall have an adhesion to substrate of 20 pounds per inch width, minimum, for steel pipe when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
  - b. Test Procedures
    - 1) Adhesion testing shall be conducted prior to application of the cement mortar overcoat, where applicable. Pipe that has been mortar coated prior to adhesion testing shall have the mortar coating removed by the Contractor as directed by the Engineer and of sufficient dimensional area to permit the adhesion test to be conducted.
    - 2) Adhesion tests shall be conducted at temperatures above 60 degrees and less than 75 degrees.
    - 3) Pulling tension shall be continuous, without stopping, and monitored throughout the length of the pull, which shall be not less than 12-inches in length.
    - 4) Adhesion test shall be prepared by making two parallel cuts through the coating, 1-inch apart, of sufficient length for the test pull. Peel the coating back at one end and attach the tension scale to the coating with a suitable clamp. Mark the coating at one (1) inch increments from 0 to 12 inches.
    - 5) The pull tension shall be recorded for each inch of pull. The two highest and two lowest readings shall be discarded and the remaining values averaged. Pull speed shall be between 5 and 10 seconds per inch. If significant elongation of the tape backing occurs, pull speeds may exceed 10 seconds per inch provided the minimum adhesion rating can still be achieved.
  - c. Adhesion Pull Records and Evaluation
    - 1) Failure shall be by cohesive failure of the adhesive only. Delamination failure, defined as separation of the adhesive from the backing material, will result in rejection of the tape lot.
    - 2) Intermittent skip failures will be counted as zero pounds of adhesion and included in the calculations for average coating adhesion.
    - 3) Adhesive failure, defined as separation of the adhesive from the metal substrate, will be rejected.
    - 4) Pipe that fails the test by delamination will be retested on two other pipes within the same lot of coated pipe. Failure of any two pipes within the lot will result in rejection of all pipes coated with the rejected tape lot.
- 4. Plural Component Epoxy Adhesion Testing:
  - a. General:
    - 1) Adhesion testing shall be performed in accordance with this specification section.
    - 2) Adhesion testing procedures and evaluations per AWWA C210 are specifically excluded under this specification.

- b. Coating and Lining Adhesion Acceptance Criteria
  - 1) Coating applied to each pipe is acceptable if first dolly pull test exceeds 1,750 psi, minimum.
  - 2) If first dolly pull is less than 1,750 psi, two additional tests shall be performed with acceptance based on "Best of Three" evaluation method defined herein.
- c. Pipe Lot Performance Criteria:
  - 1) Each lot of coated pipe shall be evaluated for general coating application based a median value for all coating or lining adhesion tests performed on a lot of pipe, which shall be greater than 2,000 psi.
  - 2) Any pipe lot failing the Pipe Lot Performance Criteria shall be classified as rejected until 100 percent of the pipe within the pipe lot has been tested for adhesion. Each pipe that fails the coating adhesion criteria shall be rejected.
- d. Test Procedures
  - 1) Coating adhesion testing shall be with self-aligning pneumatic pull off equipment, such as the Delfesko Positest AT-A, and test procedures in accordance with ASTM D4541, except as modified in this section.
    - a) All adhesion tests shall be performed at an applied load rate of 100 psi per second, plus or minus 10 psi. Automatic pull rate adhesion test equipment shall be used.
    - b) Adhesion tests shall be based on the ASTM D4541 using standard 20 mm dollies.
    - c) Adhesion testing shall be based on three tests. All three tests shall be conducted by the same person, test equipment, and test procedure, and must be completed within a 30 minute period.
    - d) All adhesion tests shall be conducted within an area not to exceed 6 inches by 6-inches.
    - e) All dollies shall be scored to metal substrate using manual methods and tools, normal to the pipe surface, and in a manner that does not stress or over heat the coating.
    - f) All adhesion tests shall be performed to glue or coating failure or test termination, whichever comes first.
  - 2) Dollies for adhesion testing shall attached to the coating surface using an two part epoxy or cyanoacrylate glue and allowed to cure for a minimum of 12 hours before testing or until full cure, whichever is greater. Glue type used shall be determined by the pipe fabricator and coating manufacturer for the pipe diameter, temperatures, and environmental conditions.
  - 3) Adhesion testing shall be performed at temperatures between 55 and 90 degrees F or at temperatures as recommended by the coating manufacturer. Testing up to 115 degrees F or below 45 degrees will be permitted if tests can demonstrate no statistically detectable effect on test results and subject to Coating Manufacturer and Engineer approval.
- e. Adhesion Test Evaluation and Records

- 1) The "Best of three" evaluation method shall be defined as two of three test values less than the Acceptance Criteria, which shall result in rejection of the pipe coating.
- 2) All adhesion tests shall be considered as valid and suitable for acceptance or rejection of the coating, except where retesting is allowed.
- 3) Adhesion test failure shall be by adhesive or substrate and cohesive failure as defined below:
  - a) Adhesive or substrate failure is defined as a percentage of separation of the coating from the steel substrate or between distinct coating layers.
  - b) Cohesive failure is defined as a percentage of failure within the coating, resulting in coating remaining both on the steel substrate and test dolly.
- 4) Retesting of coating adhesion tests will be allowed when any test is glue failure at 25 percent or more of dolly surface area and the test value is less than the Acceptance Criteria or the Minimum Criteria.
- 5) All coating adhesion retesting shall be within the same 6-inch by 6-inch test area as the original adhesion testing.
- 6) Disputed adhesion tests shall be retested as defined for adhesion retesting. Dolly attachment and adhesion retesting shall be witnessed by the Owner's representative.
- 7) Adhesion tests will be conducted on pipe coating and lining independently and will be accepted or rejected independently.
- 8) Records of all adhesion tests shall be maintained in an electronic spreadsheet that includes the following information:
  - a) Pipe identification,
  - b) Pipe coating date,
  - c) Adhesion test date,
  - d) Surface tested (interior or exterior),
  - e) Surface temperature at time of test,
  - f) Coating thickness,
  - g) tensile force applied,
  - h) Applied load rate per second,
  - i) Mode of failure, and
  - j) Percentage of failure types, previously defined, relative to dolly surface area,
  - k) Dolly size and attachment glue used.
  - l) If different coatings are tested, the records shall include coating manufacturer and product number.

f. Adhesion Test Repairs

- 1) Fabricator or contractor to complete adhesion repairs as specified this section.
- 2) Repair patches on the polyurethane coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair.

D. Holiday Testing

1. Holiday test the inner layer of tape wrap coatings after application and prior to the subsequent tape layer in accordance with AWWA C214 and NACE Standard RP-0274.
  2. Holiday test extruded polyolefin coating after application in accordance with AWWA C215 and NACE Standard RP-0274, whichever is more stringent.
  3. Holiday tests on epoxy coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE Standard RP-0274 and these specifications.
  4. Coating thickness used for holiday testing shall be the minimum specified coating thickness.
- E. Dry Film Thickness Testing
1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
  2. 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.

### 3.9 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, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12-inch wide and of a type that will not damage the coating. Metal chains, cable, 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. All 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 project 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 all contact points.
- F. Pipe shall be inspected by the Contractor at the project site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the Contractor.
- G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when

absolutely necessary and approved by the Engineer. When permitted, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.

H. Long-term Exposure:

1. Pipe shall either be provided with UV inhibitor for lengthy of above grade exposure or covered to prevent UV degradation of outer wrap.
2. Amount of UV stabilizers required will depend on the project location, laying schedule, anticipated length of exposure, and type of coating.
3. Manufacturer shall be consulted for recommended UV inhibitors requirements.
4. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable.
5. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the 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 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.

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**DIVISION 23**  
**HVAC**

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**SECTION 23 00 00**  
**HEATING, VENTILATING, AND AIR CONDITIONING**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall provide all heating, ventilating, and air conditioning systems and equipment complete with all supports, mounting frames, duct work, piping, louvers, panels, filters, grilles, electric drive units and controls, mechanical equipment, electrical work, insulation, appurtenances, complete and operable in accordance with the Contract Documents.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. All Work and materials shall be in full accordance with the latest rules and regulations or publications of the State Energy Resources Conservation and Development Commission, the State Fire Marshall, the Industrial Safety Orders, the Health and Safety Rules (Air Conditioning Systems), the local Plumbing Code, the local Mechanical Code, the local Building Code, and all other applicable local codes. In the absence of applicable codes, the installation and workmanship shall follow the standards set by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

**1.3 CONTRACTOR SUBMITTALS**

- A. Shop Drawings: Shop drawings shall be submitted for equipment in accordance with Section 01 33 20 – Submittal Procedures.
- B. Equipment Numbers: Equipment is identified by assigned numbers for reference and location purposes in the Contract Documents. The appropriate equipment numbers shall be indicated on the Shop Drawings and on other submittals.

**1.4 SPECIAL WARRANTY REQUIREMENTS**

- A. The air conditioners, heaters, and all fans and blowers shall carry the manufacturer's standard warranties, and all such warranties shall be furnished upon final acceptance of the completed systems.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Quality: All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials and shall be of the manufacturer's top line, industrial-commercial grade.

- B. Supports: All equipment and appurtenances shall be firmly anchored or connected to supporting members. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided by the heating and ventilating subcontractor, unless otherwise indicated. Vibrating equipment shall be supported on restrained spring-type vibration isolators.
- C. Noise/Vibration Control: The system shall be free of any objectionable vibrations and noise. Flexible connections shall be provided in all ducts and piping connections to fans, compressors, and any other vibrating equipment.

## 2.2 DUCTWORK AND MISCELLANEOUS ACCESSORIES

- A. Construction: Sheet metal ducts and plenums shall be constructed with airtight joints and seams in accordance with ASHRAE standards, SMACNA Duct Construction Manual, and SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems. All joints on concealed ducts shall be taped with pressureless tape and adhesive, except welded or soldered joints. Ductwork materials shall be galvanized steel or aluminum, unless otherwise indicated. Minimum duct gauges required are as follows:

<u>Maximum Size of Ducts (inches)</u>	<u>Galvanized Steel U.S. Standard Gauge</u>	<u>Aluminum B and S Gauge</u>
12 and less	26	24
13 through 30	24	22
31 through 54	22	20
55 through 84	20	18

- B. Supports: Supports for horizontal ducts and plenums shall be galvanized steel angles with hanger rods. Supports for vertical ducts shall be band iron strap or angle bracket type. Inlet ducts shall be amply braced to withstand maximum negative pressure.
- C. Duct Dimensions: All sheet metal duct dimensions shall be increased by 2 inches for 1 inch acoustically lined ducts.
- D. Insulation: The exterior of all concealed ductwork inside of buildings downstream of air conditioning or heating units, other than ducts located in air conditioned spaces, shall be insulated with 2 inch thick flexible glass fiber insulation with a UL-labeled vapor barrier. All joints shall be taped to provide a continuous vapor seal. The insulation shall be attached to the ducts with adhesive applied in a 50 percent coverage. Insulation also shall be secured to the bottom of rectangular ducts over 24 inches wide with mechanical fasteners spaced 12 inches on centers. Exposed ductwork inside buildings will be internally lined and will not require exterior insulation.
- E. Lining: The interior of supply and return ducts and plenums within 10 feet distance from fans and all ductwork exposed to the weather shall be lined. Duct lining shall be 1 inch thick fiber glass applied to the inside of the ducts with adhesive with 100 percent coverage and mechanical fasteners 12 inches on center in both directions starting approximately 6 inches

from ends of insulation. All exposed edges, ends, and rough surfaces shall be painted with adhesive or taped with 3 inch canvas tape dipped in adhesive.

- F. Balancing Dampers: Butterfly or multiblade dampers shall be provided as indicated or required for balancing air quantities to values indicated. A locking quadrant shall be provided on each manual damper, with easy access for operation.
- G. Bird Screens: Removable bird screens shall be provided on all outside air intakes and exhaust air discharges to outside air. Screens shall be secured in frames of same metal as screens. Bird screens shall be 1/8 inch mesh by 14 gauge and shall be of same material and finish as duct, hood, louver or equipment to which the screens are attached.
- H. Flexible Connectors: Flexible duct connections shall be made with banded or flanged 8 ounce canvas, or reinforced plastic, or equal at each point where a blower unit is connected to a duct. A minimum clearance of 3 inches between the duct and source of vibration shall be maintained.
- I. Diffusers, Grilles, and Registers: All supply air registers and diffusers, return air, and exhaust grilles shall be of aluminum construction, with smooth corners, flanges, and sponge rubber gaskets. All supply and return air registers and diffusers shall have individually adjustable blades and volume control dampers. All ceiling-mounted outlets shall be off-white. Wall-mounted outlets shall be factory prime coated. All diffusers, grilles and registers, shall be Titus; Agitair; Krueger; or equal. See schedule on drawings for types.

## 2.3 FILTERS

- A. All ventilation supply fans and air conditioners shall be provided with filter compartments. The filters shall be of the disposable, medium efficiency, pleated, non-woven cotton media type, with media support grid and enclosing frame. Provide Cam-Farr 30/30 or equal.

## 2.4 CONTROLS

- A. General: All heating, cooling, ventilating, and air conditioning equipment shall be provided with manual or automatic control systems as indicated. Where various items of equipment are operating in conjunction with one another, they shall be controlled by an integrated control system located in a control panel. Such systems shall have 12-hour timers and 7-day time clocks. Unless otherwise indicated, individual cooling fans shall be controlled from HAND-OFF-AUTOMATIC line voltage cooling thermostats, wall-mounted. Individual exhaust fans shall have manual switches for single or two-speed motors as indicated. Exhaust fans operating in conjunction with central ventilating or air conditioning systems shall be interlocked with these systems. Electric unit heaters shall have unit-mounted contactors, unless otherwise indicated, and they shall be controlled from wall-mounted line voltage heating thermostats.
- B. Thermostats: Room thermostats shall be of the modulating electric type, except where two-position action is required. Thermostats shall be located in air-conditioned spaces and shall have 60 to 80 degrees F dials. All thermostats shall have exposed adjustment dials and a thermometer on the front face. Mounting height shall be 4 feet. An insulating back shall be provided. Guards shall be provided for room thermostats installed in areas other than administrative offices or control rooms.

- C.     Controllers and Timers: Motorized step controllers shall be selected to provide a dead band between heating and cooling functions. Each air conditioning unit shall be provided with a manual timer and a timeclock. Manual timer switch shall be 12-hour, spring-wound with "hold" feature to override the timeclock during off-hour operation. Timeclocks shall be 7-day programming type with spring reserve feature and trippers as required. All components of the control system shall be of the same manufacturer, except where a specific manufacturer is listed.
- D.     Fan Timers: All fan timers shall be Tork 8001, no equal.
- E.     Manufacturers: Control system components and thermostats shall be as manufactured by Honeywell; Johnson Controls Company; General Controls; Novar; or equal. All control wiring from thermostat to equipment, and appurtenances shall conform to Section 16050 Electrical General Provisions.

## 2.5 CONTROL PANELS

- A.     General: Control panels shall contain all relays, control switches, transformers, pilot lights, timers, time clocks, step controllers, gauges, thermostats (unless otherwise indicated), and other accessories necessary for the particular system. Panels shall be aluminum with baked enamel finish, hinged front door, and locking handle. All manual switches and direct-reading gauges shall be flush-mounted on the front face, identified by engraved and riveted Bakelite or laminated plastic nameplates with white letters on black background. Manual switches shall be of heavy-duty, oiltight construction.
- B.     Wiring: Control devices shall be prewired internally. All wires leaving the panel shall be terminated at separate numbered terminal strips. Individual connectors shall be provided for every item of mechanical equipment, all integral and remote pilot lights, and other devices described for each panel. Power and control circuit requirements shall be as indicated. All wires shall be identified by color coding or numerical tags at both ends. Each control device shall be wired without splices to the terminal strip. Integral circuit protection shall be provided for all panel-mounted control devices. Each panel shall be wired with a single 20-amp, 120-volt, ac feeder in accordance with Section 26 00 00 – Electrical General Provisions.
- C.     Diagrams: Black and white graphic schematic diagrams shall be provided on the front face of each panel, showing all equipment within the respective systems. All pilot lights and temperature-indicating dials shall appear on the schematic in a location corresponding to the actual system location. Manual selector switches shall be directly below the equipment symbol being controlled. One spare light bulb shall be furnished for each four pilot lights, stored inside the panel in dummy light sockets secured to the back panel surface. Schematics shall be smooth laminated plastic or engraved Formica. Panel electrical wiring diagrams shall be secured to the inside of the panel door.

## 2.6 FANS

- A.     General: Location, type, capacity, and motor horsepower of all fans shall be as indicated. Fans shall be complete with motors, adjustable motor bases, adjustable drives, safety cages, belt guards, flexible connections to supply and/or suction ducts, vibration isolators, and necessary accessories. All fans shall be suitable for continuous operation.

- B. Performance: Fans shall be guaranteed to deliver the quantities of standard air against the respective static pressure without deviating by more than 5 percent. Every fan wheel, regardless of size, shall be statically and dynamically balanced, and shall be free from objectionable vibration or noises.
- C. Inline Exhaust Fans: Inline exhaust fans shall be spun aluminum, duct mounted, and direct motor-driven. Spun aluminum housings shall be constructed of minimum 11 gauge marine alloy aluminum with inlet and outlet flanges. Straightening vanes shall be utilized for uniform airflow. The adjustable mounting brackets shall be constructed of minimum 8 gauge aluminum with extruded rubber isolation between bracket and fan housing. Unit shall bear an engraved aluminum nameplate indicating design CFM and static pressure. Wheel shall be a non-overloading design utilizing airfoil blades for maximum efficiency. The aluminum airfoil blades shall be welded to a spun aluminum dome. The dome shall be bolted to an aluminum hub assembly. The hub shall be keyed and locked to the motor shaft utilizing two setscrews. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
  - 1. Manufacturers, or equal:
    - a. Loren Cook Company (Model CVD).
- D. Corrosion-Resistant Fans: All fans in corrosive atmospheres shall be constructed of materials that are-resistant to the corrosive factors in the environment in which they are installed or they shall be coated with a suitable protective coating in accordance with the manufacturer's printed recommendations.

## 2.7 CONTROL SEQUENCES:

- A. Inlet/Outlet Valve Vault: The Inlet/Outlet Valve Vault shall be continuously ventilated when occupied, and ventilated via timer on a regular schedule when not occupied.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Roughing-In: Ascertain that all inserts, chassis, shafts, and openings are correctly located; otherwise all new openings required shall be cut at no increase in cost to the Owner.
- B. Checking: Test and make tight all Work, furnish all equipment necessary to carry out the tests and thoroughly clean the system before starting same.
- C. System Balancing: After completion of all required Work, have the system, as a whole, checked and balanced by an independent air balancing company, registered by the Associated Air Balancing Council, with one member of the agency certified by the National Examination Board as a test and balance engineer. System balancing shall include the following:
  - 1. Adjusting fans, dampers, diffusers, registers and other devices so that the quantities of air, and refrigerant called for on the Drawings are supplied, returned, or exhausted.
  - 2. Measuring and recording at least once the air temperatures delivered through each on full heating and full cooling. Make all necessary adjustments to obtain the indicated conditions.

3. Measuring and recording current on each fan and motor, and checking for proper operation of all equipment.
4. Adjusting any adjustable blade registers to the correct setting to obtain the design conditions.

END OF SECTION



**DIVISION 26**  
**ELECTRICAL**

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**SECTION 26 05 00**  
**ELECTRICAL GENERAL PROVISIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall provide electrical and appurtenant Work necessary for a complete and operable electrical system, in accordance with the Contract Documents.
- B. Make all field connections and terminations to all motors, switchgear, panels, control equipment and devices, instruments, and to all vendor-furnished packaged equipment. The requirements of this Section shall apply to all electrical items indicated in the various Sections of Division 26 unless otherwise indicated.
- C. Provide all materials and incidentals required to complete the electrical work. Typical materials which may be incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and all control wires required by vendor-furnished equipment to interconnect with other equipment all specifically indicated on the Contract Documents.
- D. All concrete work required for encasement, installation, or construction of the Work specified in the various Sections of Division 26 shall be 4,000 psi concrete, and the following requirements shall apply:
  - 1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration shall be permitted.
  - 2. A workability admixture shall be used in encasement concrete, which shall be a hydroxylated carboxylic acid type in liquid form. Admixtures containing calcium chloride shall not be used.
  - 3. Concrete used to encase conduits shall be made with gravel containing rocks  $\frac{3}{4}$  inch in size or less. It shall be wet enough to flow easily into the spaces around the conduits, but not so fluid as to float the conduits.
  - 4. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

**1.2 INTERFACE TO EQUIPMENT, INSTRUMENTS, AND OTHER COMPONENTS:**

- A. The contract drawings, specifications, and overall design are based on non-certified information furnished by various equipment manufacturers. This "equipment" includes, but not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
- B. The electrical specifications, ladder logic diagrams, and installation details are based on non-certified vendor information and indicate minimum scope of supply from Manufacturers.
- C. Include all labor, material, and others costs in the bid to add additional instrument, wiring, control system inputs/outputs, controls, conduit, interlocks, electrical hardware, etc., into the Work based on the Equipment Manufacturer's final certified Drawings.

- D. Revise or produce new loop diagrams to meet the Equipment Manufacturer's wiring requirements.
- E. Incorporate such changes to Instrumentation and Electrical Work at no additional cost to the Owner in light of the Contractor's knowledge that non-certified vendor information has been used in the design, and due to the fact that the final selection of the vendor may have been by the Contractor.
- F. Submit all such changes and additions to the Engineer for acceptance before starting field installation Work.
- G. The Contractor is responsible for providing all material and labor needed to install the actual equipment furnished, as such the Contractor's bid includes all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the design, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
  - 1. Make all changes necessary to meet the Manufacturer's wiring requirements.
  - 2. Incorporate such changes to the electrical installation into the final "As-Built" Drawings.
- H. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appears on Drawings or Specifications from another discipline in the scope of Work and any costs for these items.

### 1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

#### A. Codes and Standards

NEC National Electrical Code, latest edition

#### B. Government Standards

FS W-C 596E/GEN(1)	Connector, Plug, Receptacle and Cable Outlet, Electrical Power
FS W S 896E/GEN(1)	Switches, Toggle (Toggle and Lode), Flush Mounted (ac)
FS WW C 581D, E	Conduit, Metal, Rigid, And Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated
OSHA	Safety and Health Standards, 29 CFR 1910 and 29 CFR 1926 as applicable

#### C. Commercial Standards

ANSI C80.1	Zinc Coated, Rigid Steel Conduit, Specification for
ANSI C80.4	Fittings for Rigid Metal Conduit and Electrical Metallic Tubing, Specifications for
ANSI/UL 467	Grounding and Bonding Equipment, Safety Standard for

ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft
ASTM B 33	Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S 61 402	Thermoplastic Insulated Wire and Cable
ICEA S 68 516, NEMA WC8	Ethylene Propylene Rubber Insulated Wire and Cable
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA PB 1	Panelboards
UL 6	Rigid Metal Electrical Conduit
UL 514	Electrical Outlet Boxes and Fittings

- D. All equipment furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or an independent testing laboratory acceptable to the local Code-enforcement agency having jurisdiction.
- E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

#### 1.4 PUBLIC UTILITIES REQUIREMENTS

- A. Contact the serving agency, Rocky Mountain Power Co., and verify compliance with their requirements before construction.
- B. Electrical service shall be as indicated by the Contract Documents.
- C. Verify, furnish, and install all service conduits, fittings, transformer pad, grounding devices, and all service wires not furnished by the serving utility.
- D. Verify with the utility the exact location of each service point and type of service.
- E. All charges levied by the serving utility for permanent service will be paid for by the Owner.

#### 1.5 PERMITS AND INSPECTION

- A. Permits shall be obtained, and inspection fees shall be paid for as required by local governmental jurisdictions.

## 1.6 CONTRACTOR SUBMITTALS

- A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01 33 20 – Submittal Procedures.
- B. Submit complete material lists for the Work of this Section. Such lists shall state manufacturer and brand name of each item or class of material. Submit shop drawings for all grounding work not specifically indicated.
- C. Shop drawings are required for materials and equipment listed in other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
  - 1. Front, side, rear elevations and top views with dimensional data.
  - 2. Location of conduit entrances and access plates.
  - 3. Component data.
  - 4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
  - 5. Method of anchoring, seismic requirement; weight.
  - 6. Types of materials and finish.
  - 7. Nameplates.
  - 8. Temperature limitations, as applicable.
  - 9. Voltage requirement, as applicable.
  - 10. Front and rear access requirements.
- D. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Materials and Equipment Schedules: Furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- F. Conduit Layout: Provide drawings for underground and concealed conduits, including but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls. Provide plan and section showing arrangement and location of conduit and duct bank required for: 1) low and medium voltage feeder and branch circuits, instrumentation and control systems, communication systems, empty conduit for future use. Layouts shall be of a reproducible scale not greater than 1 inch equals 20 feet.
- G. O&M Manuals: Furnish manuals as part of the shop drawing submittals under "Operation and Maintenance Manuals" in Section 01 33 20 – Submittal Procedures.
- H. Record Drawings: In addition to the record drawings as a part of the record drawing requirements specified in Section 01 33 20 – Submittal Procedures, show depths and routing of all duct bank concealed below grade electrical installations. Said set of record drawings

shall be available to the Engineer during construction. After final inspection, transfer all record drawing information using a red pen to a set of drawings which shall then be delivered to the Engineer. In addition, the record drawings shall show all variations between the Work as actually constructed and as originally shown on the Drawings, based upon information supplied by the Contractor.

#### 1.7 QUALITY ASSURANCE

- A. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Determine exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
- B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, such locations shall be obtained from the Engineer. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.
- C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the Engineer. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
- E. Protection of Equipment and Materials: Furnish adequate means for and fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the Engineer.
- F. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- G. Replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the Owner.
- H. Tests: Perform all tests required by the Engineer or other authorities having jurisdictions. All such tests shall be performed in the presence of the Engineer. Furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:
  - 1. Insulation resistance tests under "Wire and Cable," below.
  - 2. Operational testing of all equipment furnished and/or connected in other Sections of Division 26, including furnishing of support labor for testing.

- I. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.
- J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the Engineer.
- K. Regulatory Requirements:
  - 1. Perform all Work to meet the requirements of all legally constituted authorities having jurisdiction.
  - 2. Perform all Electrical Work, whether needed for the power, control system, process, HVAC, telephone, security, etc. in accordance with all codes and standards required by Division 26.
  - 3. Perform all Work so as to comply with the accepted editions, amendments, practices, and rulings of the applicable codes and standards, except where the Drawings and Specifications are more stringent.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Acceptance of material and equipment Furnished By Others (F.B.O.):
  - 1. Where equipment or materials are to be F.B.O. to the Contractor for installation and connection, the Contractor must:
    - a. Upon receiving such equipment or materials, make a complete check of all items and provide a transfer of materials document.
    - b. Provide the transfer of materials document as a receipt detailing the products received and the condition of the products delivered to the Contractor.
    - c. After Receiving and accepting the material, assume full responsibility for the safe keeping, handling, and the installation of the materials and equipment, until completed installation and final acceptance by the Engineer.
  - 2. Failure to issue said receipt assumes that all equipment and materials were then delivered to the Contractor in the proper quantities and in perfect condition.
- B. Storage and Protection:
  - 1. Provide for the safe storage and delivery of materials, whether furnished by the Contractor or by others.
  - 2. Replace all equipment or material, damaged before final acceptance by the Engineer in a manner acceptable to the Engineer.
  - 3. Meet all storage requirements of the Manufacturer and provide for the safe storage of all materials and equipment as recommended by the Manufacturer.
  - 4. Protect electrical Work at all times from damage, defacement, or deterioration from any cause whatever:
    - a. Provide proper storage facilities and conduct operations to this effect.
    - b. Perform electrical Work in a manner as to protect the Work of other trades.

## 1.9 AREA DESIGNATIONS

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as



defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.

- B. General Purpose Indoor Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 12.
- C. Outdoor and Damp Locations: In outdoor locations, raceway shall be rigid galvanized steel (GRS) conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be stainless steel. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets shall be NEMA Type 4X unless otherwise noted on the drawings. Switchboards, motor control centers, and panel enclosures shall be weatherproof NEMA Type 3R unless otherwise noted on the drawings. Locations which are indoors and below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pipe galleries, tunnels, vaults, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- D. Splash Locations: Areas shown as splashproof shall have electrical installations as described for "outdoor locations."

#### 1.10 CLEANUP

- A. In addition to the requirements of "Cleanup" in Section 01 77 00 Project Closeout, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped, and all cracks and corners scraped out. Paint touchup shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.
- B. During the progress of the Work, clean the premises and leave the premises and all portions of the site free of debris.

#### 1.11 DEMOLITION AND RELATED WORK

- A. The Contractor shall perform all electrical demolition work as indicated.
  - 1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the Owner in an orderly fashion to a designated location on the site.
  - 2. Wire, conduit, junction boxes, fittings, supports, and miscellaneous hardware removed a part of the demolition work shall not be reused and shall be returned to the Owner for their salvage use.
  - 3. Wires and/or conduits which need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the Contractor unless specified on drawings. Wires and terminals shall be properly identified before disconnection and after reconnection.

4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the Engineer.
6. Electrical demolition work shall be as shown on the Drawings or as required by the Specifications.
7. Exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The Owner has the right to salvage any wire or other electrical equipment removed from the project.
8. Contractor shall be responsible for properly disposing of all electrical demolition materials, except those items to be salvaged to the Owner as directed by the Engineer.

#### 1.12 PROJECT OR SITE CONDITIONS

##### A. Site Conditions:

1. Provide an electrical, instrumentation and control system, including all equipment, raceways and any other components required for a complete installation that meets the Environmental conditions for the Site as specified in the General Requirements and below.
2. Seismic Classification:
  - a. Provide all electrical equipment and construction techniques suitable for the seismic requirements for the Site, as specified in 01 81 10.
3. Wind:
  - a. Provide all electrical equipment and construction techniques suitable for the Site wind loading criteria, as specified in section 01 81 11.
4. Altitude:
  - a. The site is located at approximately 4,750 feet above mean sea level. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.
5. Humidity:
  - a. The facility is located in an area where the relative humidity is 90 percent non-condensing. Furnish all components and equipment fully rated for continuous operation at this relative humidity level.
6. Temperature:
  - a. The facility is located in an area where the temperature will vary from a minimum of -20 degrees Fahrenheit to a maximum of 100 degrees Fahrenheit.
  - b. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature as determined by the equipment Manufacturer's guidelines.
7. Outdoor installations:
  - a. Provide all electrical, instrumentation and control equipment installed outdoors that are suitable for operation in the ambient conditions where the equipment is located.

- b. Provide heating, cooling, and de-humidifying devices incorporated into and included with electrical equipment, instrumentation and control panels located outdoors in order to maintain the enclosures within the rated environmental operating ranges as specified in this Paragraph for the equipment:
        - 1) Provide all wiring necessary to power these devices.
- 8. Site Security:
  - a. Abide by all security and safety rules concerning the Work on the Site.

#### 1.13 WARRANTY

- A. Warrant the performance and the hardware of the complete electrical systems including all lamps, lighting, switchgear, circuit breakers, transformers, MCCs, VFD, etc. for a period of 1 year following the date of substantial completion of the Work:
  - 1. To fulfill this obligation, provide technical service personnel designated by the Electrical Contractor and/ or Manufacturer.
  - 2. Perform services to correct any defect within 3 calendar days after notification by the Owner of a defect.
- B. Warrant the satisfactory performance of the software, equipment, and materials under the specified operating conditions.
  - 1. In the event that operations, tests, or inspections disclose latent defects or failure to meet the specified requirements, upon notification by the Owner, promptly correct or repair any such defects or non-conformance, or furnish such new equipment or parts as may be necessary for conformity to the specified requirements.
- C. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements. Following replacement or modifications retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.
- D. Provide all parts, material, labor, travel, subsistence, or other expenses incurred in providing services and service visits during the warranty period:
  - 1. Furnish spare parts and tools on site at inventory levels sufficient to meet the response and repair times specified.
    - a. All spare parts and tools stored on-site become the property of the Owner upon completion of the warranty period.

#### 1.14 MAINTENANCE

- A. Provide similar items of same Manufacturer throughout the Electrical and Instrumentation portion of the project.
- B. Furnish all spare parts as required by other sections of the Specifications.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label, where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

### **2.2 GROUNDING**

- A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of National Electrical Code Article 250.
- B. Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.
- C. Ground rods shall conform to ANSI/UL 467 and shall be ¾-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
  - 1. Grounding connectors shall be high-strength copper alloy suitable for direct burial.
  - 2. Wire connections shall be exothermic weld by Cadweld of Erico Products.
    - a. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

### **2.3 UNDERGROUND DUCTS AND MANHOLES**

- A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore nonmetallic conduits, with underground manholes and pullboxes. When nonmetallic conduits are required, they shall be rigid Schedule 40 PVC.
  - 1. Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.
- B. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers shall be labeled as shown on drawings.
- C. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
- D. Manholes shall have concrete covers with 30-inch diameter lids. All covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick holes or lifting handles.
  - 1. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel. Porcelain insulators for cable racks shall be provided.
  - 2. Manholes and pullboxes shall be Brooks, Quikset, U.S. Precast, or equal.

- E. The concrete shall have a compression strength of 3,000 psi in accordance with the requirements of Section 03 30 00 Cast In Place Concrete.

## 2.4 RACEWAYS

- A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.
- B. Galvanized Rigid Steel (GRS) Conduit
  - 1. Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.
  - 2. Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI 80-1.
  - 3. Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.
- C. Rigid nonmetallic conduit shall be Schedule 40 PVC.
  - 1. Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.
  - 2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.
- D. Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built in copper ground conductor. Flexible conduit shall be American Brass, Anaconda, Electroflex, or equal.
- E. PVC-coated raceway system shall conform to Federal Specification WW C 581E, ANSI C80.1, and to Underwriter's Laboratories specifications.
  - 1. The zinc surfaces of the conduits and fittings shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing.
  - 2. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.
  - 3. The thickness of the PVC coating shall be a minimum of 40 mils.
  - 4. A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.
  - 5. PVC-coated conduits shall be as manufactured by Robroy, Occidental (OCCAL), or equal.

## 2.5 WIRE AND CABLE

- A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage and temperature rating, and conductor size. Wire and cable shall be products of American, BICC/General, Rome Cable, Okonite, or equal.
- B. Control Cables: All control cables shall be rated for 600 volts and shall meet the following requirements:

1. Control wires shall consist of No. 14 gauge stranded copper conductors and shall be THWN/THWN-2 rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
  2. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.
- C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 600 volts and shall comply with the following requirements:
1. Individual shielded cable shall consist of twisted 2 or 3 No. 18 gauge, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
  2. Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100 percent aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
  3. Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.
- D. Building Wire and Cable: Building wires and cables shall be rated at 600 volts and shall meet the following requirements:
1. Building wire shall be single conductor copper cable listed by UL as Type THWN/THWN-2 rated 75 degrees C in wet locations and rated 90 degrees C in dry locations.
  2. Building wire; **all conductors shall be stranded.**
  3. No wire smaller than No. 12 AWG shall be used unless specifically indicated.
- E. Cable Terminations: Cable terminations shall be in accordance with the following:
1. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
  2. Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
  3. Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
  4. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
  5. Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.
  6. Motor load termination kits shall be 3M.

## 2.6 PULL AND JUNCTION BOXES

- A. Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.

- B. Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.
- C. Control station, pull and junction boxes, including covers, for installation in corrosive locations shall meet the NEMA 4X requirements and shall be stainless steel or fiber glass-reinforced polyester and shall be furnished with mounting lugs.
- D. All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.

## 2.7 CONDUIT FITTINGS

- A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings for use with rigid steel conduit, shall be cast or malleable ferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.
- B. Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O Z/Gedney, or equal.
- C. Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, - by T & B, - no substitutions.
- D. Crouse Hinds UNF or UNY unions shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used.
- E. Liquid-tight fittings shall be manufactured by T & B, no substitutions.
- F. Hubs for threaded attachment of steel conduit to sheet metal enclosures shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal.
- G. Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.
- H. Conduit sealant shall be Chico, or equal.
- I. Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3 foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

## 2.8 WIRING DEVICES

- A. All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards and be UL listed. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be white. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W C 596E and W S 896E, respectively.
1. Receptacles
    - a. General purpose duplex receptacles shall be grounding type, 125-volt, ac, 20-amperes, **backwired** NEMA Configuration 5-20R, such as Hubbell 5362, or equal.
  - B. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of Melamine.
    1. Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.
    2. Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N 1, or equal.
    3. Receptacles at corrosive locations shall be Hubbell 52CM62 15 ampere, 53CM62 20 ampere, or equal.
  - C. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 milliamperes of ground current and shall comply with NEMA WD 1 1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.
  - D. Switches
    - a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.
    - b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.
    - c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT 10k, or equal.
  - E. Toggle switches shall be suitable for backwiring and shall conform to the following table, or equal:

	Hubbell No.	Bryant No.	Hubbell No.	Bryant No.
Single Pole	1221 (white)	4901 (white)	1221W (white)	4901W (white)
Three Way	1223	4903	1223W	4903W
Momentary	1556	4821	1556W	4821W
Four Way	1224		1224W	

## 2.9 CABINETS AND ENCLOSURES

- A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508.



1. Relay or control, and terminal cabinets or outdoor cabinets shall be NEMA 4 enclosures. Sizes shown on the Drawings are minimum. Interiors of cabinets shall be finished white including internal back mounting plate.
  2. Pull boxes and fan timer enclosure in vault shall be fiberglass, NEMA type 4X.
- B. Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600-volts and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section.
- C. All terminal block requirements shall be as manufactured by Entrelec with cage clamp, Phoenix, or equal.
- D. Engraving shall be as shown or as directed by the Engineer. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.
- E. Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

## 2.10 DISCONNECT SWITCHES

- A. Unfused and fused disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600-volts. All switches rated at 100 amperes or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.
- B. Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.
- C. Switch enclosure shall be NEMA 1 and shall be as manufactured by Square D, Cutler-Hammer, or equal.

## 2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

- C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide red polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

## 2.12 LIGHTING AND POWER PANELBOARDS

- A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/240-volt for single phase operation as shown.
  - 1. Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping. Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.
  - 2. Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.
  - 3. All circuit breakers shall be bolt-in type.
- B. Lighting Panelboards
  - 1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Bus bars shall be copper. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.
  - 2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers as required and branch circuit breakers with 10,000 AIC.
  - 3. Provide control enclosures under common panel trim. All panelboard doors shall be keyed alike.

## 2.13 PROCESS CONTROL DEVICES

- A. Liquid Level Control: Liquid level controls shall be as indicated. Level settings shall be determined by Design Engineer and received from the Engineer.
  - 1. High level flood switches shall be as shown on the drawings.

## 2.14 CONTROL STATIONS

- A. Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.
- B. Control stations shall be as follows:

1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
  2. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts and shall be rotary type with number of position and poles as indicated.
  3. Indicating Lights: Pilot lights shall be LED type and with plastic color caps: green color for running, yellow for ready, white for power status, and red for failure status.
  4. Control station enclosures shall be NEMA 4X in corrosive, below grade, or wet areas.
- C. Manufacturers shall be Square D Class 9001, or equal.

### **PART 3 - EXECUTION**

#### **3.1 GROUNDING**

- A. General: Grounding cable shall be sized in accordance with code requirements when sizes are not indicated on the Drawings.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing a grounding conductor in all raceways.
1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 volts to ground, or any ac conductors, shall contain a copper-grounding conductor insulated green. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
  2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.
- C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with National Electrical Code Article 250.
1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
  2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
  3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.
- D. Shield Grounding
1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.
  2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the RTU or otherwise at the "receiving" end of the signal carried by the cable, unless shop drawings indicate that the shield shall be grounded at both ends.

3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

### 3.2 UNDERGROUND DUCTS AND MANHOLES

- A. The underground duct bank shall be installed in accordance with the criteria below:
  1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
  2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the duct is a minimum of 24 inches below grade.
  3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
  4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of backfill.
  5. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
  6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8 inch polypropylene pull cord installed throughout the entire length of the raceway.
- B. Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 6-inch bed of gravel as recommended by the manufacturer or as required by field conditions.
- C. Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one-foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.
- D. Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.
- E. Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.

### 3.3 RACEWAYS

- A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be accomplished with tools designed for the purpose intended. Bends in metallic conduit shall

be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the National Electrical Code.

B. Raceways shall be installed in accordance with the following schedule:

1. Low Voltage Raceway (control and power):
  - a. Rigid Schedule 40 PVC shall be used for burial in earth.
  - b. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
  - c. Galvanized rigid steel or PVC shall be used for conduits embedded in concrete slab on grade and above grade.
  - d. Schedule 40 PVC or HDPE shall be used for fiber optic data hi-way system for buried in earth. See drawings.
  - e. Galvanized rigid steel shall be used in exposed installations in outdoor areas.
2. Exposed Raceways
  - a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
  - b. Intervals between supports shall be in accordance with the National Electrical Code.
3. All underground elbows shall be GRS (PVC coated).

C. Conduit Terminations

1. Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
2. Both rigid and flexible conduit shall be sealed against water at each entrance to enclosures. Unless indicated otherwise, rigid and flexible conduit shall enter panels through the top, shall continue down from the top to the bottom, and shall turn upward at the bottom.

D. Conduit Installations

1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab and shall be encased with a minimum cover of 3 inches of concrete. Maximum size of conduit that can be cast in slab above grade shall be 3 inches, in slab on grade shall be 1-1/2 inches.
2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances, conduit shall be placed at least 12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red.

Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.

3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible liquid-tight conduit shall be used for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing.
5. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.
6. Conduit penetrations on walls, concrete structures, pull boxes, and equipment cabinets shall be performed in accordance with the following:
  - a. Seal all raceways entering structures at the first box or outlet with conduit sealant to prevent the entrance into the structure of gases, liquids, or rodents.
  - b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
  - c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
  - d. Where an underground raceway without concrete encasement enters a structure through a nonwaterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.
7. All underground GRS conduit shall be PVC coated.
8. Minimum size of buried conduit: 1".
9. Minimum size of exposed conduit:  $\frac{3}{4}$ "

### 3.4 WIRES AND CABLES

- A. General: Conductors shall not be pulled into raceway until:
  1. Raceway system has been inspected and accepted by the Engineer.
  2. Plastering and concrete have been completed in affected areas.
  3. Raceway system has been freed of moisture and debris.

- B. Wire and Cables
1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
  2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.
- C. Splices and Terminations
1. The Contractor shall provide, install, and terminate the conductors required for power and controls to electrical equipment instrumentation terminal cabinets, control and instrumentation equipment except where indicated elsewhere. There shall be no splices in underground manhole or pullboxes of conductors smaller than #10 AWG.
  2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
  3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of the various Sections of Division 26 of the Specifications, "control conductors" are defined as conductors operating at 120 volts or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
  4. All 120/208-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor.
  5. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
  6. Splices in 600-volt wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using in-line copper compression splices with heat shrink insulation.
  7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape. Provide 3M motor lead termination kits.
  8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop drawings.
  9. Control devices, such as solenoid operated valves that are normally supplied with conductor pigtails shall be terminated as described for control conductors.
- D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication No. S-68-516 and other relevant ICEA publications. The following tests shall be the minimum requirements:
1. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
  2. All cables rated at 600 volts shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmmeter.

3. All field testing mentioned above shall be done after cables are installed in the raceways.
  4. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.
- E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.
- 3.5 PULL AND JUNCTION BOXES
- A. Pull and junction boxes shall be sized in accordance with the requirements of the National Electrical Code or as shown on drawings.
  - B. Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.
  - C. Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet or as shown on drawings.
- 3.6 CABINETS AND ENCLOSURES
- A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 5 ft 6 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.
  - B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.
- 3.7 CONCRETE HOUSEKEEPING
- A. Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.
  - B. Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.
- 3.8 EQUIPMENT ANCHORING
- A. Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung



from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.

- B. Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations. Area between the channels shall be grouted perfectly flat.
- C. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop drawings in Section 013320S – Submittal Procedures.

### 3.9 CABLE AND EQUIPMENT IDENTIFICATION

- A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:
  - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.
  - 2. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase 1-black, Phase 2-red, Phase 3-blue, and Neutral-white. The 480/277-volt system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color-coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase 1-2-3, top to bottom, or left to right, facing the front of the equipment.
  - 3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.
  - 4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
  - 5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.
- C. Equipment: Equipment and devices shall be identified as follows:
  - 1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
  - 2. Control devices within enclosures shall be identified similar to the paragraph above.

3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than 2 switches, shall have suitable inscribed finish plates.
5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.
7. Install identification tape directly above buried unprotected raceway; install tape 8 inches below grade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

### 3.10 EXAMINATION

- A. Study all Drawings and Specifications and to report to the Engineer before bidding:
  1. Any errors.
  2. Any omissions
  3. Any Electrical Code problems
  4. Any Local Building Code problems.
  5. Or any points of conflict with other trades.
- B. Review the existing site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.
- C. The Contractor is responsible for the complete electrical and instrumentation Work:
  1. Install extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, power, and Process Control and Instrumentation System.

### 3.11 GENERAL INSTALLATION

- A. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:
  1. Verify all dimensions indicated on the Drawings:
    - a. Actual field conditions govern all final installed locations, distances, and levels.
  2. Review all information shown on the Contract Drawings, including architectural, structural, mechanical, instrumentation, and the accepted electrical and mechanical shop drawings, and coordinate Work as necessary to adjust to all conditions that arise due to such changes.
- B. Cutting and patching:
  1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:

- a. Actual field conditions govern all final installed locations, distances, and levels.
      - 1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made.
        - a) Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables etc.
        - b) Use tone-locate system or X-ray to ensure that area is clear of obstructions.
      - 2) Review the complete Drawing set to ensure that there are not conflicts or coordination problems before cutting, channeling, or core drilling any surface.
  2. Perform all patching to the same quality and appearance as the original Work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:
 

a.	3M	CP25	Caulk
b.	3M	303	Putty
c.	T&B	S-100	Caulk
d.	T&B	FS-500	Putty
e.	T&B	FST-601	Putty
  3. Seal around conduit penetrations of below grade walls with a waterproof, non-shrink, nonmetallic grout. Use Fox Industries FX-225 or equal. Install in accordance with manufacturer's recommendations.
- C. Earthwork and Concrete:
  1. Install all trenching, shoring, concrete, backfilling, grading, and resurfacing associated with the electrical work.
  2. Notify the Engineer before encasing or backfilling any electrical work and arrange for inspection.
- D. Terminations:
  1. Terminate all conductors required to interconnect power, controls, instruments, panels and other equipment otherwise specifically identified.
- E. Miscellaneous Installation Requirements:
  1. In case of interference between electrical equipment shown on the Drawings and the other equipment, notify the Engineer in writing of the proposed change:
    - a. Obtain Engineer's acceptance of the proposed changes before they are made.
  2. Location of manholes and pullboxes shown on Drawings are approximate. Coordinate exact location of manholes and pullboxes with mechanical and civil Work.
  3. Provide additional manholes or pullboxes to those shown where they are required to make a Workable installation.
  4. Circuits of different service voltage:
    - a. Install in separate raceways, hand holes, pullboxes, and junction boxes.
    - b. In manholes, install all cables operating at less than 50 VDC PVC coated flexible metallic conduit.
    - c. The voltage and service levels are:
      - 1) Medium voltage: 12:47 KV
      - 2) Low voltage: 120V, 208V, 480V

3) Control: less than 50VDC

F. Labeling:

1. Provide all nameplates and labels as required on equipment.

G. Equipment Tie-Downs:

1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing requirements, which apply to the site.
2. All control panels, VCPs, LCPs, RTUs, PCMs, etc., must be permanently mounted and tied down to structures.

3.12 FIELD QUALITY CONTROL

A. Inspection:

1. Conduct inspection of electrical, instrumentation and control system installation.
2. Allow Owner, Engineer, or Owner's Representative access to site for inspection of materials, equipment, or installation at any time.
3. Provide any technical data or other assistance necessary to support inspection activities.
4. Electrical inspections include, but not limited to, the following:
  - a. Inspect equipment and materials for physical damage.
  - b. Inspect installation of compliance with plans and specifications
  - c. Inspect installation for obstructions and adequate clearances around equipment.
  - d. Inspect equipment installation for proper leveling, alignment, anchorage and assembly.
  - e. Inspect equipment nameplate data to verify compliance with design requirements.
  - f. Inspect raceway installation quality Workmanship and adequate support.
  - g. Inspect cable terminations.
  - h. Schedule Structural Engineer to inspect all mounting of electrical devices and all penetrations and connections to structures.
5. Inspection activities conducted during construction do not satisfy inspection requirements outlined in each section of the Division 26 specifications.

B. Testing:

1. When the electrical Work is substantially completed, notify the Engineer that the project is ready for Field Acceptance Testing.
2. Perform the acceptance test in conformance with each section of the Division 26 specifications.
3. Record results of the required tests along with the date of test:
  - a. Use conduit schedule identification numbers to indicate portion of circuit tested.

C. Workmanship:

1. Use only competent and skilled personnel experiences in their trade, Working under continuous competent supervision, to perform all Work, including installation, connection, calibration, testing, and adjustment.

- a. Perform all Work, including aesthetic as well as electrical and mechanical aspects, to standards consistent with the best practices of the trade.
2. All Work is subject to review by the Engineer or Owner at any time.
3. Provide all Work to the complete satisfaction of the Engineer or Owner.
4. Repair or replace any Work, which, in the sole opinion of the Engineer, does not conform to these Specifications, or trade practices.
5. Make all changes of any installed items to meet the intent of the Drawings and Specifications.
6. Install all materials and equipment in accordance with the Manufacturer's printed installation instructions.
  - a. Where Contractor asks to deviate from the Manufacturer's recommendations, such changes shall be reviewed by the Engineer and Manufacturer before installation.

### 3.13 CLEANING

- A. General Requirements:
  1. Maintain all surfaces to be painted in a clean and smooth condition.
  2. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.
  3. Remove all debris, rubbish, and scraps, etc. each night.
  4. Leave all areas swept clean each night.
  5. Wipe clean all exposed threads of conduit of the KOPR-SHIELD compound after installation.
- B. Vacuum clean all electrical enclosures of any debris before any wire or cable is installed.
- C. Clean and re-lamp all new and luminaries that were used in the area affected by the construction and return all used lamps to Owner.
- D. As specified in other Sections of the Specifications.
- E. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
  1. Neatly coil and label spare wiring lengths.
  2. Shorten re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

END OF SECTION

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**SECTION 26 05 83  
WIRING CONNECTIONS**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

- A. ASTM International.
- B. Code of Federal Regulations.
- C. International Electrical Testing Association, NETA.
- D. National Electrical Manufacturers Association.
- E. NFPA 70, National Electrical Code.
- F. Underwriters Laboratories Inc.

1.3 SUMMARY

- A. Section Includes:
  - 1. Wiring connecting devices.
  - 2. Terminations.
  - 3. Splices.
- B. Related Sections:
  - 1. Contract Documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the CONTRACTOR and its Sub-contractors to review all sections to ensure a complete and coordinated project.

1.4 DEFINITIONS

- A. Definitions of terms are specified in Section 26 05 00.

1.5 SYSTEM DESCRIPTION

- A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.6 SUBMITTALS

- A. Furnish complete submittals in accordance with Sections 01 33 20 and 26 05 00.

- B. Product Data:
  - 1. Catalog cut sheets.
- C. Shop drawings:
  - 1. Drawings showing the installation of junction modules, splices and terminators.
- D. Instruction and Operating Manuals:
  - 1. Include drawings and data for medium voltage cable connectors, splices and junction modules in the operating manuals.

## 1.7 QUALITY ASSURANCE

- A. As specified in Section 26 05 00.
- B. All materials shall be UL listed.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- A. Control Connections:
  - 1. Use insulated ring type wire terminators for connections to all screw terminals:
    - a. With chamfered/funneled terminal barrel entry.
    - b. Deep internal serrations.
    - c. Long barrel design to reduce electrical resistance and increased insulator- barrel surface area to ensure that the insulator remains in contact with the barrel.
    - d. Electroplated-tin copper conductor.
    - e. Manufactured by the following or equal:
      - 1) Thomas and Betts, Stakon.
  - 2. For process equipment connections work from manufacturer's drawings.
- B. Joints, Splices, Taps, and Connections:
  - 1. For 600-volt conductors use solderless connectors.
  - 2. Use only plated copper alloy connectors or lugs:
    - a. Aluminum connectors or lugs are not acceptable for copper conductors.
  - 3. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
  - 4. For wire Number 10 AWG and smaller use compression splice caps, with insulating caps.
    - a. Manufactured by the following or equal:
      - 1) Buchanan 2006S or 2011S with 2007 or 2014 insulating caps.
  - 5. For wire Number 8 AWG and larger, use heavy duty copper compression connectors:
    - a. Manufactured by one of the following or equal:
      - 1) Burndy.
      - 2) Thomas and Betts.
  - 6. Where waterproof splices are required:



- a. Suitable for indoor, outdoor, weather exposed, direct buried or submersed applications.
  - b. Utilizing an epoxy, polyurethane, and re-enterable compounds.
  - c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kV.
  - d. Two-part mold body with tongue and groove seams and built in spacer webbing.
  - e. Manufactured by the following or equal:
    - 1) 3M – Scotchcast 72-N
7. Optical Fiber terminations:
- a. All multimode optical fiber cable installed shall be terminated with a split-ferrule alignment sleeve and a precision ceramic tip. All multimode optical fiber connectors shall meet the following technical specifications:
    - 1) Connector Type: ST
    - 2) Fiber Outside Diameter: 125 microns Nominal
    - 3) Loss Repeat: < 0.2 dB per 100 reconnects
    - 4) Axial Load Minimum: 35 Pounds
    - 5) Temperature Stability: +0.1 dB Maximum from -40°C to 75°C
  - b. All single mode optical fiber cable installed shall be terminated utilizing a split-ferrule alignment sleeve and a precision ceramic tip. All single mode connectors shall meet the following technical specifications:
    - 1) Connector Type: SC
    - 2) Fiber Outside Diameter 125 Microns
    - 3) Loss Repeat: < 0.2 dB per 1000 reconnects
    - 4) Axial Load, min. 30 pounds
    - 5) Temperature Stability: -40°C to 85°C
  - c. Contractor shall provide multimode optical fiber patch cords. The multimode optical fiber patch cords shall be Lucent Technologies ML2SC-SC-XX, and shall meet the following technical specifications:
    - 1) Number of fibers: 2
    - 2) Approximate loss, mean, variance 0.1, 0.1
    - 3) Minimum bandwidth: 160 MHz-km @ 850 nm
  - d. Contractor shall provide single mode optical fiber patch cords. The single mode optical fiber patch cords shall be Lucent Technologies MS2SC-SC-XX, and shall meet the following technical specifications:
    - 1) Number of fibers 2
    - 2) Approximate Loss, mean, variance 0.1dB, 0.7dB
- C. Insulating Tape:
- 1. General purpose insulating tape:
    - a. Minimum 7 mil vinyl tape.
    - b. Suitable for application in an ambient of -18°C
    - c. (0°F).
    - d. Operating range up to 105°C (220°F).
    - e. Flame retardant, hot- and cold- weather resistant, UV resistant.
    - f. For use as a primary insulation for wire cable splices up to 600 VAC.
    - g. Meeting and complying with:
      - 1) ASTM D-3005 Type I
      - 2) UL 510

- 3) CSA C22.2
  - h. Manufactured by the following or equal:
    - 1) 3M – Scotch Number Super 33+.
- 2. General-purpose color-coding tape:
  - a. Minimum 7 mil vinyl tape.
  - b. Suitable for application on PVC and polyethylene jacketed cables.
  - c. For use indoors and outdoors in weather protected enclosures.
  - d. Available with the following colors;
    - 1) Red.
    - 2) Yellow.
    - 3) Blue.
    - 4) Brown.
    - 5) Gray.
    - 6) White.
    - 7) Green.
    - 8) Orange.
    - 9) Violet.
  - e. For use as phase identification, marking, insulating, and harnessing.
  - f. Meeting and complying with:
    - 1) UL 510.
    - 2) CSA C22.2
  - g. Manufactured by the following or equal:
    - 1) 3M – Scotch Number 35.
- 3. Fire and Electric Arc Proofing tape:
  - a. Minimum 30-mil, flexible, elastomer tape that expands in fire to form an insulating firewall between flame and cable.
  - b. Bind in place with glass cloth electrical tape.
  - c. Manufactured by the following or equal:
    - 1) 3M – Scotch Number 77.
- 4. Glass cloth electrical tape:
  - a. 7.4-mil thermosetting silicone adhesive that performs at Class H temperatures 180°C (356°F).
  - b. Use for the following applications:
    - 1) To secure no-PSA insulations such as glass in high-temperature areas.
    - 2) Splice wire rated at 180°C (356°F).
    - 3) For binding Fire and Electric Arc Proofing Tape.
  - c. Meeting and complying with:
    - 1) MIL-I-1966C.
    - 2) UL Recognized Component listing for 200°C (392°F) (Guide OANZ2, File E17385).
    - 3) CSA Accepted Component 180°C (356°F) File LR93411.
  - d. Manufactured by the following or equal.
    - 1) 3M – Scotch Number 69.
- 5. Self-fusing Silicone Rubber Tape:
  - a. 12-mil, high-temperature, track resistant, insulating tape.
  - b. Composed of fully cured inorganic silicone rubber.
  - c. Use as a protective overwrap for terminating medium voltage cables.
  - d. Manufactured by the following or equal:
    - 1) 3M – Scotch Number 70.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Load connections:
  - 1. Connect loads to the circuits as indicated. Color-code all branch circuits as per Section 26 05 53 "Electrical Identification."
- B. Zero to 600-volt systems:
  - 1. Make all connections with the proper tool and die as specified by the device manufacturer.
  - 2. Use only tooling and dies manufactured by the device manufacturer.
  - 3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
  - 4. Number all power and control wires before termination.
- C. Motor connections (600 Volts and below):
  - 1. Terminate wires with compression type ring lugs at motors.
  - 2. Connection at both the motor leads and the machine wires are to have ring type compression lugs.
  - 3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
    - a. In damp and wet locations use a complete kit containing mastic that shall seal out moisture and contamination.
    - b. Shrink cap with low heat as recommended by manufacturer.
  - 4. Wire markers shall be readable after boot installation.
  - 5. Manufactured by one of the following or equal:
    - a. Raychem MCK.

END OF SECTION

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**SECTION 26 20 00**  
**LOW-VOLTAGE AC INDUCTION MOTORS**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. General: The Contractor shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to electric motors 250 hp and less.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. American Bearing Manufacturers Association (ABMA):
  - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
  - 2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronic Engineers (IEEE):
  - 1. IEEE 43 – Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
  - 2. IEEE 112 – Standard Test procedure for Polyphase Induction Motors and Generators.
  - 3. IEEE 114 – Standard Test procedure for Single-Phase Induction Motors.
  - 4. IEEE 303 – Recommended Practice for Auxiliary Devices for Motors in Class 1, Groups A, B, C, and D, Division 2 Locations.
  - 5. IEEE 841 – Standard for Petroleum and Chemical Industry – Severe Duty totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – up to and including 500hp.
  - 6. IEEE 1349 – Guide for the Application of Electric Motors in Class I, Division 2 Hazardous (Classified) Locations.
- C. National Electrical Manufacturers' Association (NEMA):
  - 1. MG-1 – Motors and Generators.
  - 2. MG-1 – Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators.
- D. Underwriters Laboratories Inc. (UL):
  - 1. UL 674 – Electric Motors and Generators for use in Division 1 Hazardous (Classified) Locations.

**1.3 CONTRACTOR SUBMITTALS**

- A. Complete motor data shall be submitted with the driven machinery shop drawings. Motor data shall include:
  - 1. Machine name and specification number of driven machine.
  - 2. Motor manufacturer.
  - 3. Motor type or model and dimension drawing. Include motor weight.
  - 4. Nominal horsepower.
  - 5. NEMA design.

6. Enclosure.
  7. Frame size.
  8. Winding insulation class and temperature rise class.
  9. Voltage, phase and frequency ratings.
  10. Service factor.
  11. Full load current at rated horsepower for application voltage.
  12. Full load speed.
  13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at 1/2 and 3/4 load.
  14. Type of thermal protection or overtemperature protection, if included.
  15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
  16. Bearing data. Include recommended lubricants for relubricatable type bearings.
  17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
  18. Power factor at 1/2, 3/4 and full load.
  19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
- B. If water cooling is required for motor thrust bearings, the shop drawing submittals shall indicate this requirement.

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of providing full motor load, under the following conditions unless otherwise indicated:
1. See section 26 05 00 of the specifications for the project conditions.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage and handling of motors shall be in accordance with manufacturer's recommendations. Preferred storage is indoors in clean, dry space with uniform temperature to prevent condensation. Protect motors from exposure to dirt, fumes, water, corrosive substances, and physical damage.

#### 1.6 QUALITY ASSURANCE

- A. All motors shall be UL listed and labeled.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. One of the following or equal:
1. Emerson, US Motors.
  2. General Electric.
  3. Reliance.
  4. Toshiba.
  5. Or Equal.

## 2.2 GENERAL REQUIREMENTS

- A. Electric motors driving identical machines shall be identical.
- B. Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
  - 1. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads which may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the Owner. In addition, any changes caused by increase in motor horsepower shall be made by the Contractor at no additional cost to the Owner; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
  - 2. Exempt Motors: Motors which are for valve operators, submersible pumps, or motors which are an integral part of Standard Manufactured Equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

## 2.3 DESIGN REQUIREMENTS

- A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.
- B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in Equipment Specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings.
- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
  - 1. Voltage:
    - a. All motors ½ hp and larger shall be 460V, 3 phase unless otherwise indicated on the Drawings.
    - b. dual voltage motors rated 230/460V, 3 phase are acceptable provided all leads are brought to the conduit box.
  - 2. Motors driving identical machines shall be identical.
  - 3. All motors 1 hp and larger shall be "Premium Efficiency" motors as defined in NEMA MG-1.
  - 4. Horsepower as indicated on the Drawings:
    - a. Horsepower ratings shown on the drawings are based on Vendor's estimates. Provide motors sized for the load of the actual equipment furnished.
  - 5. Service Factor:
    - a. Provide motors rated at 1.15 Service Factor.

- b. Provide motors capable of operating continuously at 1.15 Service Factor at project altitude.
      - 1) Without exceeding Class B temperature rise limits where motors are provided with Class F insulation.
      - 2) Without exceeding Class F temperature rise limits where motors are provided with Class H insulation.
- 6. Torque:
  - a. Provide motors that develop sufficient torque for acceleration to full speed at voltage 10 percent less than motor nameplate rating.
  - b. When started using reduced voltage starters:
    - 1) Provide motors that develop sufficient torque for acceleration to full speed.
  - c. NEMA Design B except where driven load characteristics require other than normal starting torque.
    - 1) In No case shall starting torque or breakdown torque be less than the values specified in NEMA MG-1.
- 7. Enclosures:
  - a. As indicated in the individual equipment Specifications or as specified in this section.
  - b. Totally Enclosed Fan Cooled::
    - 1) Cast iron conduit box.
    - 2) Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger.
  - c. Explosion-Proof:
    - 1) Tapped drain holes with corrosion resistant plugs for frames 286T and smaller and automatic breather and drain devices for frames 324T and larger.
  - d. Lifting Devices: All motors weighing 265 pounds (120 kilograms) or more shall have suitable lifting devices for installation and removal.
- 8. Manufactured with cast iron frames in accordance with NEMA MG-1.
- 9. Nameplates:
  - a. Provide all motors with a permanent, stainless steel nameplate indelibly stamped or engraved with:
    - 1) NEMA Standard motor data.
    - 2) Bearing description and lubrication instructions.
- 10. Hardware:
  - a. Type 316 stainless steel.
- 11. Conduit Boxes:
  - a. Cast iron or stamped steel.
  - b. Split from top to bottom.
  - c. Provide gaskets at the following interfaces:
    - 1) Frames and conduit boxes.
    - 2) Conduit boxes and box covers.
  - d. Rotatable through 360 degrees in 90 degree increments.
  - e. Exceeding the dimensions defined in NEMA MG-1.
  - f. Provide grounding lugs inside conduit boxes for motor frame grounding.
- 12. Motor Bearings:
  - a. Antifriction.



- b. Regreasable and initially filled with grease.
  - c. Pumps Motor in excess of 100 HP shall have oil lubricated bearings.
  - d. Bearings and lubrication suitable for ambient temperature and temperature rise.
  - e. Suitable for intended application and have ABMA L-10 rating life of 60,000 hours or more.
  - f. Fit bearings with easily accessible grease/oil supply, flush, drain, and relief fittings using extension tubes where necessary.
  - g. Where specified in the equipment specifications, provide split-sleeve type hydrodynamic radial bearings. Provide a bearing isolator to protect bearings from contaminants.
13. Insulation Systems:
- a. Motors Installed in Ambient Temperatures of 40 degrees Celsius or less:
    - 1) Provide Class F insulation.
    - 2) Design temperature rise consistent with Class B insulation.
    - 3) Rated to operate at an ambient temperature of 40 degrees Celsius and at the altitude where the motor will be installed.
  - b. Motors Installed in Ambient Temperatures between 40 degrees Celsius and 65 degrees Celsius:
    - 1) Provide Class H insulation.
    - 2) Design temperature rise consistent with Class F insulation.
    - 3) Rated to operate at an ambient temperature of 65 degrees Celsius and at the altitude where the motor will be installed.
14. Motor Leads:
- a. Insulated leads with non-wicking, non-hydroscopic material. Class F insulation.
15. Noise:
- a. Maximum operating noise level of 85dB measured per IEEE 85.
- D. Submersible Motors:
- 1. Enclosures:
    - a. Totally Enclosed Non-Ventilated (TENV) watertight casing.
    - b. Smooth outer surface. Cooling fins may clog with solids and are not acceptable.
    - c. Inner and outer shaft seals separated by an oil chamber.
  - 2. Cooling:
    - a. Suitable continuous operation in totally, partially, or nonsubmerged condition without overheating.
    - b. Convection cooling only.
    - c. Water jackets and oil cooling are not acceptable.
  - 3. Electrical Cables:
    - a. Wire unit without splices. Coordinate with Contractor to ensure cables of adequate length.
    - b. Epoxy encapsulated cable entry into terminal box.
  - 4. Insulation:
    - a. Sealed moisture resistant windings.
  - 5. Motor Protection:
    - a. Provide temperature detection in motor windings.
    - b. Provide moisture detection in motor housing.

- c. Provide associated electronics and relaying in a separate enclosure to be mounted remotely.
- E. Vertical Motors:
  - 1. Enclosures:
    - a. Weather protected Type II (WP II) where installed outdoors.
    - b. Weather protected Type I (WP I) where installed indoors.
  - 2. Thrust Bearings:
    - a. Selected for combined rotor and driven equipment loads.
    - b. Coordinate with driven equipment supplier for maximum vertical thrust of driven equipment.
- F. Variable Frequency Drive Motors
  - 1. Compatible with the variable frequency drives specified.
  - 2. Inverter duty rated and labeled.
  - 3. Meet the requirements of NEMA MG-1 Part 31.
  - 4. Winding insulation meets the requirements of NEMA MG-1 Part 31.4.4.2.
  - 5. Capable of running continuously at 1/10<sup>th</sup> of full speed, with no harmful effects or overheating.
  - 6. Service factor of 1.0 when driven by VFD.
- G. Motors Installed in Corrosive Environments:
  - 1. Nameplate indicating conformance to IEEE 841.
  - 2. Stator double dipped in varnish and baked.
  - 3. Stator and rotor coated with corrosion resistant epoxy.
  - 4. Frame, brackets, fan guard and conduit box coated with minimum of two coats of epoxy paint.
  - 5. Withstand salt spray tests per ASTM B-117.
  - 6. Suitable for hose down areas.
- H. Single Phase Motors:
  - 1. Capacitor start type rated for operation at 115 volts, 60 hertz, unless otherwise specified or as indicated on the Drawings.
  - 2. Totally enclosed, fan cooled motors manufactured in accordance with NEMA MG-1.
  - 3. Ball Bearings: Sealed.
  - 4. ½ Horsepower or Less Fan Motors:
    - a. Split-phase or shaded pole type when standard for the equipment.
    - b. Open type when suitably protected from moisture, dripping water, and lint accumulation.
  - 5. Wound rotor or commutator type single-phase motors only when their specific characteristics are necessary for application and their use is acceptable to the Engineer.
  - 6. Integral overload protection.

## 2.4 ACCESSORIES

- A. Space Heaters:
  - 1. Provide all 3 phase motors with belted or cartridge space heaters mounted within the motor enclosure.

2. Space heater rating shall be 120 volts, single-phase, unless otherwise shown.
  3. Power leads for heaters wired into conduit box.
  4. Installed within motor enclosure adjacent to core iron.
- B. Winding Temperature Detectors:
1. Provide temperature switches with normally closed contacts or resistance temperature detectors, 2 per each phase, as indicated on the Drawings.
- C. Bearing Temperature Detectors:
1. Where required by the driven equipment specification or as indicated on the Drawings.
  2. RTD type and wiring matches the winding RTDs.
- D. Vibration Detectors:
1. Where required by the driven equipment specification.
  2. In accordance with the driven equipment specification.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory Testing
1. Perform factory tests in accordance with:
    - a. IEEE 112 for three phase motors.
    - b. IEEE 114 single phase motors.
  2. Furnish copies of test reports.
  3. Include testing of:
    - a. No load current.
    - b. Locked rotor current.
    - c. Winding resistance.
    - d. High potential.
  4. Tests required on motors 250 hp and larger:
    - a. Manufacturer's routine test (use polarization index voltage = 5000V for insulation resistance tests).
    - b. Efficiency and power factor versus load test performed at rated speed and 50 percent, 75 percent, 90 percent, and 100 percent of rated load. The curves from the motor tests shall be submitted for information.
    - c. The maximum allowable residual unbalance in each correction plane (journal) shall be calculated using the following equation:
      - 1)  $U = 4 W/N$
      - 2) Where:
      - 3)  $U$  = residual correction plane unbalance, in ounces-inches
      - 4)  $W$  = static correction plane journal loading, in pounds
      - 5)  $N$  = maximum specified operating speed, in revolutions per minute

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install motors in accordance with manufacturer's instructions.

- B. Electrical work involving connections, controls, switches, disconnects, etc., shall be performed as provided in the applicable sections of Division 26.

### 3.2 FIELD QUALITY CONTROL

- A. Before start-up perform insulation resistance test on each motor furnished or installed on this project.
  - 1. Windings energized to 1000 volts D.C. for one minute.
  - 2. Resistance measured at the end of the test, recorded, and submitted to the Engineer for review.
  - 3. Inform the Engineer of any unusual or unacceptable test results.

### 3.3 VISUAL AND MECHANICAL INSPECTION FOR MOTORS AND THEIR ROTATING MACHINERY:

- A. Compare equipment nameplate information with the Drawings and Specifications.
- B. Inspect physical and mechanical condition.
- C. Inspect for proper anchorage, alignment, and grounding.
- D. Inspect air baffles, filter media, cooling fans, slip rings, brushes and brush rigging.
- E. Inspected bolted electrical connections for high resistance by one of the following:
  - 1. Use of low resistance ohmmeter.
  - 2. Calibrated torque wrench.
  - 3. Thermographic survey.
- F. Verify correct application of appropriate lubrication and lubrication systems.
- G. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.
- H. Special tests as suggested by manufacturer, such as gap spacing and pedestal alignment shall be made where applicable.

### 3.4 ELECTRICAL TESTS:

- A. Perform resistance measurements through bolted connections with a low resistance ohmmeter.
- B. Perform insulation resistance test in accordance with ANSI/IEEE43. Test voltage shall be as specified by the manufacturer:
  - 1. On motors 200 HP and smaller, test duration shall be one minute. Calculate dielectric absorption ratio using resistance measurements at 20 seconds and 60 seconds.
  - 2. On motors larger than 200 HP, test duration shall be 10 minutes. Calculate polarization index using resistance measurements at one minute and 10 minutes.
    - a. Perform stator resistance test phase-to-phase.
    - b. Perform insulation power-factor or dissipation-factor tests.
    - c. Perform surge comparison tests.
    - d. Verify operation of motor space heater.

- e. Perform a rotation test to ensure correct shaft direction.
- f. Measure no load and full load running current and compare to nameplate.
- g. Observe proper operation and sequence of any reduced voltage starters.
- h. Perform vibration base line test. Amplitude to be plotted vs. frequency.
- i. Check all protective devices in accordance with other sections of these specifications.
- j. After start-up of each motor, the current on each phase shall be measured:
  - 1) At no load.
  - 2) At defined load:
  - 3) Record the voltage of each phase to round during this test.
  - 4) Inrush current.

C. Measurements shall be recorded and submitted to the Engineer.

### 3.5 TEST VALUES:

- A. Insulation resistance should be not less than 10 megohms.
- B. Dielectric absorption ratio or polarization index readings less than the manufacturer's recommended values (not less than three for polarization index or 1.4 for dielectric absorption ratio) shall be investigated.
- C. Motor measured full load current shall not exceed nameplate value.
- D. Vibration amplitudes shall not exceed values furnished by manufacturer.

END OF SECTION

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## MOTOR DATA SHEET

MOTOR NUMBER: \_\_\_\_\_ MOTOR/EQUIPMENT NAME \_\_\_\_\_

SPECIFICATION NUMBER OF DRIVEN MACHINE \_\_\_\_\_

### MOTOR NAMEPLATE DATA

MANUFACTURER \_\_\_\_\_ MODEL/SERIES \_\_\_\_\_ MODEL NO. \_\_\_\_\_

FRAME _____	ENCLOSURE _____	NEMA DESIGN _____
HP _____	SERVICE FACTOR _____	RPM _____
INSULATION CLASS _____	VOLTS _____	FULL LOAD AMPS _____
AMBIENT TEMP _____	PHASE _____	NO LOAD AMPS _____
DESIGN TEMP RISE _____	HERTZ _____	LOCK ROTOR AMPS _____
		INRUSH CODE LETTER _____

	100 PERCENT LOAD	75 PERCENT LOAD	50 PERCENT LOAD
GUARANTEED MIN EFFICIENCIES	_____	_____	_____
GUARANTEED MIN POWER FACTOR	_____	_____	_____
MAX SIZE OF POWER FACTOR CORRECTION CAPACITOR	_____	_____	KVAR

### ACCESSORIES

MOTOR WINDING HEATER	_____	VOLTS	_____	WATTS
WINDING THERMAL PROTECTION	_____			
WINDING TEMP SWITCHES (YES/NO)	_____			
RTD	TYPE _____	QUALITY PER PHASE _____	# OF WIRES _____	
	NOMINAL RESISTANCE _____	NOMINAL TEMP _____	COEFFICIENT _____	
	RECOMMENDED ALARM _____	DEGREES C _____	RECOMMENDED TRIP _____	DEGREES C _____

### SPECIAL APPLICATIONS

INVERTER DUTY* (YES/NO)	_____	PART WINDING (YES/NO)	_____	WYE-DELTA (YES/NO)	_____
2 SPEED, 1 WINDING (YES/NO)	_____	2 SPEED, 2 WINDING (YES/NO)	_____		
AREA CLASSIFICATIONS					
CLASS	_____	DIVISION	_____	GROUP	_____
				TEMP CODE	_____

\* Conforms to NEMA MG-1 Part 31.

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**SECTION 26 28 16**  
**LOW-VOLTAGE CIRCUIT BREAKERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
1. Requirements for Circuit Breakers.
    - a. Molded case circuit breakers.
    - b. Molded case switches.
    - c. Motor circuit protectors.
    - d. Low voltage metal enclosed (large air iron frame) circuit breakers.
- B. Related Sections:
1. Division 26 Section "Electrical General Provisions".
  2. Division 26 Section "Electrical Identification".
  3. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.3 REFERENCES**

- A. Molded Case Circuit Breakers
1. U.L.:
    - a. U.L. 489 - Branch Circuit and Service Circuit Breakers.
    - b. U.L. 1087 - Molded Case Switches.
  2. NEMA:
    - a. AB-1 - Standards Publication Molded Case Circuit Breakers.
  3. Federal Specifications:
    - a. WC -375A - Circuit Breaker, Molded Case, Branch Circuit and Service.
- B. ANSI Large Air Iron Frame Circuit Breakers
1. NEMA:
    - a. SG3 - Low Voltage Power Circuit Breakers.
  2. ANSI:
    - a. C37.13 - American National Standards for Low Voltage AC Power Circuit Breakers used in Enclosures (IEEE Std 20).
    - b. C37.16 - Preferred Ratings, Related Requirements and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors.
    - c. ANSI C37-50 - Test Procedures for Low-Voltage AC Power Circuit Breakers used in Enclosures

#### 1.4 DEFINITIONS

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. NEC: National Electrical Code.
  - 2. IEEE: Institute of Electrical and Electronic Engineers.
  - 3. NFPA: National Fire Protection Association.

#### 1.5 SYSTEM DESCRIPTION

- A. Furnish molded case, insulated case, power type, or motor circuit protector circuit breakers as indicated on the drawings and connect to form a completed system.
- B. Circuit breakers must be of the current and voltage ratings indicated and be capable of interrupting the available fault current.
- C. Where circuit breakers are used as disconnects for miscellaneous over-current protection, provide automatic type enclosed units with the indicated ratings and complying with applicable requirements (including manufacturer) for circuit breakers as specified.

#### 1.6 SUBMITTALS

- A. Furnish complete submittals in accordance with Sections 01 33 20 and 26 05 00.
- B. Product Data:
  - 1. Catalog Cut Sheets
  - 2. Complete data sheets indicating:
    - a. Manufacturer.
    - b. Type of enclosure.
    - c. Voltage rating.
    - d. Current rating.
    - e. Amperage rating.
    - f. Complete dimensional and weight information.
- C. Operating Manuals
  - 1. Furnish complete operating and maintenance instructions presenting full details for care and maintenance of equipment of every nature furnished and/or installed under this section.
    - a. Complete electrical ratings.
    - b. Complete renewal parts list.

#### 1.7 WARRANTY

- A. All circuit breakers shall be 100% warranted for a period of not less than two years from the date of final acceptance by the ENGINEER.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

#### **A. Acceptable Manufacturers:**

1. Eaton.
2. Square D.
3. GE.
4. Siemens.
5. ABB.
6. Cutler-Hammer.

### **2.2 EQUIPMENT**

#### **A. Breakers General**

1. All breakers shall have temperature insensitive trips.

#### **B. Molded Case Circuit Breakers**

1. Molded case circuit breakers for distribution panelboards and motor control centers.
  - a. Basic circuit breaker must be trip free with a quick-make, quick-break mechanism.
  - b. Trip indicating handle position.
  - c. Frame sizes:
    - 1) 150 Amp.
    - 2) 400 Amp.
    - 3) 600 Amp.
    - 4) 800 Amp.
    - 5) 1,200 Amp.
  - d. Trip mechanism as indicated on drawings:
    - 1) Thermal magnetic.
    - 2) Thermal high magnetic.
    - 3) Solid State.
      - a) Adjustable long time pickup-, ampere setting to determine the value of current that the breaker will carry indefinitely.
      - b) Adjustable long time delay- varies the time it will take the breakers to trip under sustained overload.
      - c) Adjustable short time pickup- controls the level of high current the breaker will carry for short periods of time.
      - d) Adjustable short time delay- controls the length of time the breaker will carry a high current without tripping.
      - e) Adjustable instantaneous pickup- controls level at which immediate tripping of breaker occurs.
        - i. Instantaneous trip function may be eliminated on main breakers, refer to drawings.
      - f) Adjustable ground fault pickup- controls the level at which the breaker will trip under a ground fault condition (where shown on the drawings).

- g) Adjustable ground fault delay- controls the time that a ground fault can exist without tripping the breaker (where ground fault feature is shown on the drawings).
    - h) Long time pickup indicator- provides a visual indication that the breaker is experiencing an overload condition.
    - i) Fault indicators shall be either mechanical or powered from a separate battery and charger that shall be an integral component of the switchboard.
      - i. Indicator for overload fault trip.
      - ii. Indicator for short circuit fault trip.
      - iii. Indicator for ground fault trip.
  - 2. Provide non-automatic trip breakers (molded case switches) only where specifically indicated on the contract drawings or in the specifications.
- C. ANSI Metal Enclosed (Large Air Iron Frame) Circuit Breakers
- 1. Shall be used exclusively in:
    - a. 600 V switchgear.
  - 2. The individually mounted low-voltage power circuit breakers shall consist of an electrically and mechanically trip-free circuit breaker element.
  - 3. The circuit breaker shall be of the draw out type capable of being racked to the disconnect position with the door closed.
    - a. Interlocks shall be provided to prevent connecting or disconnecting the circuit breaker unless the breaker is in the open position.
    - b. The breaker shall be prevented from being closed during any racking operation.
    - c. A test position shall be provided to permit operating the breaker while it is disconnected from the power circuit.
  - 4. Circuit breakers shall be manually or electrically operated as indicated on the drawings.
    - a. Control voltage for electrically operated circuit breakers shall be as indicated on the drawings.
  - 5. Overcurrent trip device shall be solid-state type with the following functions:
    - a. Adjustable long time pickup-, ampere setting to determine the value of current that the breaker will carry indefinitely.
    - b. Adjustable long time delay- varies the time it will take the breakers to trip under sustained overload.
    - c. Adjustable short time pickup- controls the level of high current the breaker will carry for short periods of time.
    - d. Adjustable short time delay- controls the length of time the breaker will carry a high current without tripping.
    - e. Adjustable instantaneous pickup- controls level at which immediate tripping of breaker occurs.
      - 1) Instantaneous trip function may be eliminated on main breakers, refer to drawings.
    - f. Adjustable ground fault pickup- controls the level at which the breaker will trip under a ground fault condition (where shown on the drawings).
    - g. Adjustable ground fault delay- controls the time that a ground fault can exist without tripping the breaker (where ground fault feature is shown on the drawings).

- h. Long time pickup indicator- provides a visual indication that the breaker is experiencing an overload condition.
  - i. Fault indicators shall be either mechanical or powered from a separate battery and charger that shall be an integral component of the switchboard.
    - 1) Indicator for overload fault trip.
    - 2) Indicator for short circuit fault trip.
    - 3) Indicator for ground fault trip.
- 6. Each circuit breaker shall be equipped with the following accessories as required for proper operation of the control system.
  - a. Shunt trip.
  - b. Overload bell alarm.
  - c. Lockout Device.
  - d. Auxiliary Switch:
    - 1) Number of contacts as required plus a minimum of one spare.
    - 2) Type "a" normally open.
    - 3) Type "b" normally closed.
- 7. Minimum insulation, dielectric withstand ratings:
  - a. Breaker - 2.2 KV.
  - b. Control wiring - 1.5 KV.
  - c. Closing motor - 0.9 KV.
- 8. Available in the following frame sizes:
  - a. 800 Amps.
  - b. 1,600 Amps.
  - c. 2,000 Amps.
  - d. 3,200 Amps.
  - e. 4,000 Amps.
  - f. 5,000 Amps.
- 9. Operating Times:
  - a. Electrically closing time from energizing closing circuit until contacts touch, 5 cycles max.
  - b. Maximum clearing time with instantaneous overcurrent trip 3 cycles.
  - c. Maximum clearing time with shunt trip 3.5 cycles.

## 2.3 COMPONENTS

### A. Enclosures

- 1. Furnish enclosures consistent with the area classification and NEMA designation as indicated on the plans and specifications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive safety switches for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Arrange all breakers to correspond exactly with the schedules.
- B. In damp or wet areas, mount the enclosures on Unistrut type mounting channels that run vertically so that water and moisture may flow freely behind enclosure.

### 3.3 FIELD QUALITY CONTROL

#### A. Low Voltage Molded Case and Insulated Case Circuit Breakers:

- 1. Visual and Mechanical Inspection:
  - a. Compare equipment nameplate data with Drawings and Specifications.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage and alignment.
  - d. Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.
  - e. Operate circuit breaker to ensure smooth operation.
  - f. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.
  - g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.
- 2. Electrical tests for breakers in excess of 200 Amp trip ratings:
  - a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.
  - b. Time-current characteristic tests shall be performed by passing 300% rated current through each pole separately. Trip time shall be determined:
    - 1) Determine long-time pickup.
    - 2) Determine short-time pickup.
  - c. Instantaneous pickup current shall be determined by run-or pulse method:
    - 1) Clearing times should be within 4 cycles or less.
  - d. Insulation resistance shall be determined pole to pole, across pole and pole to ground.
    - 1) Circuit breaker shall be closed.
    - 2) Test voltage shall be 1000 volts dc applied for one minute.
  - e. Perform adjustments for final setting in accordance with the Short Circuit and
  - f. Coordination Study.
- 3. Test values:
  - a. Contact resistance shall be compared to adjacent poles and similar breakers:
    - 1) Deviations of more than 50% shall be investigated.
  - b. Insulation resistance shall not be less than 100 MΩ.
  - c. All trip times shall fall within manufacturer's published time current curves:
    - 1) Circuit breakers exceeding maximum time shall be replaced.
  - d. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

#### B. Low Voltage Air Circuit Breaker ANSI Class Breakers:

- 1. Visual and mechanical inspection:
  - a. Compare equipment nameplate data with Drawings and Specifications.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage and alignment and grounding.

- d. Verify that all maintenance devices are available for servicing and operating the breaker.
  - e. Verify the unit is clean.
  - f. Verify the arc chutes are intact.
  - g. Perform all mechanical operator and contact alignment tests in accordance with manufacturer's instruction manual.
  - h. Check cell fit and element alignment.
  - i. Check tightness of connections using a calibrated torque wrench.
  - j. Verify racking mechanism operation.
  - k. Lubrications requirements.
    - 1) Verify appropriate lubrication on moving current-carrying parts.
    - 2) Verify appropriate lubrication on moving and sliding surfaces.
2. Electrical tests:
- a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.
  - b. An insulation resistance test shall be performed on each pole, phase-to-phase and phase to ground with the circuit breaker closed, and across each open pole:
    - 1) Test voltage shall be 1000 volts dc applied for one minute.
  - c. Perform a contact/pole-resistance test.
  - d. Make adjustments to the trip settings in accordance with the Short Circuit and coordination study.
  - e. Minimum pickup current shall be determined by primary current injection.
  - f. Long time delay shall be determined by primary injection at 300% pickup current.
  - g. Short time pickup and time delay shall be determined by primary injection of current.
  - h. Instantaneous pickup current shall be determined by primary injection.
  - i. Trip unit reset characteristics shall be verified.
  - j. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function, trip unit battery condition, and reset all trip logs and indicators.
  - k. Verify operation of charging mechanism.
3. Test Values:
- a. Contact resistance shall be determined in micro-ohms:
    - 1) Any values exceeding 200  $\mu\Omega$  or any values which deviate from adjacent poles or similar breakers by more than 50% should be investigated.
  - b. Insulation resistance shall not be less than 50 M $\Omega$ .
  - c. Pickup currents and trip times should fall within manufacturer's published time-current characteristic tolerance band.

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**SECTION 26 42 00**  
**CORROSION MONITORING SYSTEM**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED:**

- A. This section covers the work necessary to furnish and install a corrosion monitoring system, which includes test stations, electrical isolation, and pipe joint bonds for electrical continuity, complete.
- B. Contractor to have Corrosion Expert to train and/or perform required quality control testing as defined this section.

**1.2 STANDARDS**

- A. The following standards are included by:
  - 1. NACE SP-0169
  - 2. NACE SP-0177

**1.3 QUALITY CONTROL**

- A. All Contractor specified testing shall be performed by a 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 with verifiable expertise in corrosion control and cathodic protection.
- B. Contractor performed quality control testing shall include the following tests, which shall be performed as defined this section.
  - 1. Joint Bond Resistance test
  - 2. Insulating Joint Testing
- C. Connection of galvanic anodes, energizing and testing of cathodic protection system, and other tests as defined under "System Tests and Inspections" shall be performed by the Engineer unless specifically stated otherwise this section.

**1.4 DEFINITIONS**

- A. Foreign-Owned: Buried pipe or cable not specifically owned or operated by the OWNER.
- B. Electrically Continuous Pipeline: A pipeline which has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable joint bond resistance for each bonded pipe joint as specified in this section.
- C. 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. Shop Drawings: Catalog cuts and other information for products proposed for use.
- B. 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 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

2.2 SUPPLIERS:

- A. Alternate suppliers will be considered, subject to approval of the 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. Corrpro, Inc., Chicago, IL [www.corrpro.com](http://www.corrpro.com)
  - 2. Farwest Corrosion Control, Gardena, CA [www.farwestcorrosion.com](http://www.farwestcorrosion.com)
  - 3. Hoff Company, Inc., Denver, CO [www.pipelinesupplies.com](http://www.pipelinesupplies.com)
  - 4. MESA Products, Tulsa, OK [www.mesaproducts.com](http://www.mesaproducts.com)
  - 5. Northtown Products, Huntington Beach, CA [www.northtownproducts.com](http://www.northtownproducts.com)

2.3 JOINT BONDS

- A. General:
  - 1. All joint bonds provided by pipe manufacturer or Contractor shall meet the following minimum requirements:
    - a. All connections shall be welded or soldered.
    - b. Mechanical or compression type connections will not be permitted.
    - c. Bonds and welds shall exhibit sufficient strength and flexibility to allow thermal movement of the pipe after pipe backfill without cracking or breakage.
    - d. Bond connections to pipe shall be with an Engineer approved welding method.
  - 2. All installed bonds shall be insulated or coated copper with all exposed copper field coated to prevent galvanic corrosion of pipe.
- B. Ductile or Cast Iron Pipe, External Bonds:
  - 1. Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE insulation,

- 18 inches long, with formed copper sleeve on each end of the wire.
2. Quantity of joint bonds per pipe joint by pipe diameter shall be as defined below:

<b>Bond Type</b>	<b>Two Bonds</b>	<b>Three Bonds</b>	<b>Four Bonds</b>
#2 AWG Wire	16" or less	42" or less	Over 42"

3. Connection of wire joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for bond type used.
4. Bonds shall be as manufactured by Erico Products, Continental Industries, or approved equal. Third party manufactured bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
- C. Coated Steel Pipe, External Bonds:
1. Rolled joint or Carnegie joint bonds shall be one of the following types at the Contractor's option:
- Wire Bond: Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE or THWN insulation, 18 inches long, with a formed copper sleeve on each end of the wire.
  - Strap Bond:
    - Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with two punched holes for thermite welding to the pipe. Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.
    - Strap bond shall be 12-inches long with dielectric coating applied to the center 8-inches of the strap bond. Strap bonds provided without a dielectric coating shall be coated prior to installation with filler mastic as specified for heat shrink sleeves in Section 09 90 10, Pipeline Coating and Lining.
    - Strap bonds shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured strap bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
  - Use of manufactured steel bonding clips will not be permitted with heat shrink sleeve coated joints.
- D. Flange joints:
1. Flanged joint bonds shall be one of the following types at the Contractor's option:
- Steel rod, 5/8-inch diameter, length as required, arc welded to flange. Steel rod bonds will not be allowed where welding to the flange is not approved by the Engineer.
  - Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE insulation, 18 inches long, with a formed copper sleeve on each end of the wire.
2. Quantity of joint bonds per pipe joint shall be as defined below:

<b>Bond Type</b>	<b>Two Bonds</b>	<b>Three Bonds</b>	<b>Four Bonds</b>
Steel Rod	36" or less	72" or less	Over 72"
#2 AWG Wire	NA	30" or less	Under 60"

3. Connection of wire joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for bond type used.
4. Coat steel rod bonds with fast curing epoxy after welding to joint as specified in this Section, except when pipe is specified to be coated in accordance with Section 09 90 00 – Coatings and Painting.

E. Sleeve Coupling, Flanged Coupling Adapter, and Other Non-standard Joints:

1. Ductile Iron Pipe:
  - a. Bond: No. 2 AWG wires, 24 inches long, HMWPE insulation, with two 12-inch long THHN insulated No. 12 AWG wire pigtails,
  - b. Manufacturer: Erico Products Inc. (Cadweld), Cleveland, OH, Hoff Company, Denver, Colorado, or equal.
2. Steel Pipe:
  - a. Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with five punched holes for thermite welding to the coupling follower rings, middle, ring, and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.
  - b. Strap bond shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured copper strap bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
3. Bond Quantity per Joint: Provide the quantity of bonds per pipe diameter as defined below:

<b>Bond Type</b>	<b>Two Bonds</b>	<b>Three Bonds</b>	<b>Four Bonds</b>
Copper Strap	NA	54" or less	Over 54"
No. 2 Wire Bond	NA	54" or less	Over 54"

4. Connection of wire or copper strap joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for the bond type used.

F. Insulated Sleeve Coupling Joints:

1. Ductile Iron Pipe:
  - a. No. 8 AWG wire, 18-inch long, with one 12-inch long THHN insulated No. 12 AWG wire pigtail.
  - b. Manufacturer: Erico Products Inc. (Cadweld), Cleveland, OH, Hoff Company,

Denver, Colorado, or equal.

2. Steel Pipe:
  - a. Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with four punched holes for thermite welding to the coupling and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. . Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.
  - b. Strap bond shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
3. Bond Quality per Joint: Provide the quantity of bonds per pipe diameter as defined below:

Bond Type	One Bonds	Two Bonds	Three Bonds
Copper Strap	Up to 36"	36" to 60"	Over 60"
No. 2 Wire Bond	Up to 36"	36" to 60"	Over 60"

## 2.5 CATHODIC PROTECTION TEST STATIONS

- A. Flush Style, Vehicular Traffic (Type 2):
  1. Test Box: Concrete body cast with a cast iron ring, minimum weight of 55 pounds and minimum dimensions of 9-inch inside diameter and 12 inches long.
  2. Furnish extensions as required to penetrate concrete surfaces by 4 inches minimum.
  3. Furnish with a 14-pound cast iron lid with the words "CP Test" cast into the lid.
  4. Manufacturer and Products: Brooks; Models 3RT or Christy Oldcastle Model G05, or equal
- B. Flush Style Terminal Boards:
  1. Dimensions: 5-inch by 8-inch by 1/4 inch thick
  2. Material: Phenolic, micarta, or fiberglass.
  3. Terminals: Stainless steel bolts, double nuts, double flat washers, lock and shunt. Quantity and placement as shown on the Drawings.
  4. Labels: Engrave terminal board with label of each terminal as shown Drawings and with the OWNER's name and contact number.
- C. Post Style, Steel Conduit:
  1. Test Box:
    - a. Cast aluminum with thread hub suitable for mounting to a 2-inch x 3-inch reducer. Reducing bushings will not be permitted.
    - b. Manufacturer and Product:
      - (1) Type T, C, and I Stations: Gerome Manufacturing, Testox 700 series (rectangle) with 2-inch threaded hub.
      - (2) Type F and A Stations: Gerome Manufacturing, Testox 2000 series (rectangle) with 2 or 3-inch threaded hub.

2. Street Reducer:
  - a. Hot dipped galvanized 2-inch x 3-inch reducer and close nipple. Not required with 3-inch threaded hub.
3. Terminal Block:
  - a. Plastic or glass-reinforced laminated, 1/4-inch thick with seven terminals for Type T, C, and I test stations.
  - b. Plastic or glass-reinforced laminated, 1/4-inch thick with eleven terminals for Type F, and A test stations.
  - c. Terminal heads shall have special heads to keep them from turning or shall be easily accessible from both sides of the terminal block without requiring its removal.
  - d. Terminal studs, washers, and nuts shall be stainless steel.
4. Mounting Structure:
  - a. Rigid hot dipped galvanized steel conduit 3-inches diameter, threaded at one end (minimum), 5-feet long or as required for installation requirements.
  - b. PVC long radius sweep elbow, 1-inch diameter, for wire protection as shown on Drawings.

## 2.6 REFERENCE ELECTRODES:

- A. Prepackaged Copper-Copper Sulfate Reference Electrodes:
  1. Material: Permanent type, copper-copper sulfate reference electrode suitable for direct burial with a minimum design life of 25 years.
  2. Lead Wire:
    - a. As specified under wire, this section,
    - b. Length of 25 feet or as required for splice free installation.
  3. Backfill: As recommended by the reference electrode manufacturer.

## 2.7 CORROSION COUPON

- A. Application: Provide at all remote monitoring capable test stations, Type F test stations, and where shown on the Drawings.
- B. Coupon:
  1. Steel corrosion coupon with IR drop free measurement capability.
  2. Exposed steel area to be 0.01 square feet.
  3. Provide with two #12 or #14 AWG stranded copper wires leads, green insulation.
- C. Switch:
  1. Magnetic reed switch, normally closed, with connecting leads and terminals.
  2. EDI Model UI-MS, board or adjustable mount as required, with activating magnet.
- D. Manufacturers:
  1. Cott Manufacturing,
  2. M. C. Miller,
  3. Or equal.

## 2.8 WIRE:

- A. Pipe and Test Lead Wires:
  - 1. Pipe Test Wires: No. 10 AWG wire, single-conductor, stranded copper with 600-volt, TW, THWN, or HMWPE insulation. Color coded insulation as specified.
  - 2. Insulation Color: Color shall indicate the function of each test wire and shall be as follows:
    - a. Pipe: White
    - b. Reference electrodes: Yellow
    - c. Casings: Orange
    - d. Foreign Pipe: Blue (Water) or Red (Gas or Oil)
    - e. Insulating Joints: White and Green as shown on
    - f. Corrosion Coupons: Green
  - 3. Reference Electrode Wires: No. 14 or 12 AWG wire single-conductor, stranded copper with 600-volt, TW, THWN, USE2, or HMWPE insulation. Color code insulation as specified. Wire length of 25 feet or as required for splice free installation.
- B. Temporary Groundbed Header Wires:
  - 1. No. 8 AWG wire, single-conductor, stranded copper with 600-volt, TW, THWN, or HMWPE insulation. Color coded insulation as specified.

## 2.9 CONDUIT, LOCKNUTS, AND STRAPS:

- A. Outdoors, Exposed Conduit
  - 1. Rigid conduit shall be rigid galvanized steel.
  - 2. Fittings, junction boxes, pull boxes, and outlet bodies shall be hot-dipped galvanized iron.
  - 3. Locknuts, conduit clamps, and other miscellaneous hardware shall be hot dipped galvanized steel. Galvanized items shall be hot-dipped galvanized in accordance with ASTM A153.
  - 4. Conduit clamps shall be two piece, malleable iron, one hole, strap and clamp back spacer, O. Z. Gedney 14-100G and 143G or similar, for mounting to surfaces with either lag bolts or concrete wedge anchors, as shown on the Drawings.
- B. Buried Conduit:
  - 1. Conduit and fittings shall be rigid electrical grade, schedule 40 gray PVC or PVC coated rigid steel as shown on the Drawings.

## 2.10 WIRE SPLICE INSULATING KIT:

- A. Tap Splice: Tap splice insulating kit for the connection of the anode wire to the anode header wire shall be 3M Company Scotchcast 90-B1; Hexcel Kit No. 7K53; Raychem Corp. Thermofit No. ASE-4, or equal.
- B. In-Line Splice: In-line splice insulating kit for the connection of the anode wire to the anode header wire shall be 3M Company Scotchcast 82-A2; Hexcel Kit No. 7K32; Raychem Corp. Thermofit No. ASE-4, or equal.

## 2.11 THERMITE WELD MATERIALS:

- A. General:

1. Thermite weld materials consist of wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material.
  2. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers is not acceptable.
- B. Molds: Graphite, as recommended by manufacture for pipe and wire size.
- C. Adapter Sleeves:
1. For No. 12 AWG and No. 2 AWG wires.
  2. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Attach field-formed joint bonds sleeves with the appropriate size and type of hammer die furnished by the thermite weld manufacturer.
  3. Extend wire conductor 1/8 inch beyond the end of the adapter sleeve.
- D. Cartridges:
1. Steel: 32 grams, maximum.
  2. Cast and Ductile Iron: 45 grams, maximum, XF-19 Alloy
- E. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
<b>No. 6 AWG Wire &amp; Smaller</b>		
Steel	HA, VS, HC	15 gm
Ductile or Cast Iron	HB, VH, HE	25 gm
<b>No. 2 Wire Joint Bonds</b>		
Steel	FS	32 gm
Ductile or Cast Iron	FC	45 gm
<b>Copper Strap Joint Bonds</b>		
Steel	M-128	15 gm

- F. Welding Materials Manufacturers:
1. Erico Products Inc. (Cadweld), Cleveland, OH.
  2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.



## 2.12 COATING REPAIR MATERIAL FOR PIPE AND FITTINGS

### A. General:

1. Complete coating repairs in accordance with recommendations of the pipe or fitting manufacturer.

### B. Coating Requirements:

1. Steel Pipes:
  - a. Coal tar based coatings: Koppers Bitumastic 50 or Denso or Tapecoat wax tape coatings; or equal, 20 mils dry film thickness, minimum.
  - b. Polyurethane or Epoxy Coatings: Fast cure epoxy, 20 mils dry film thickness, minimum
  - c. Tape Wrap Coating: Thermite Weld Cap, Canusa CRP Patch, or Raychem PERP patch, or equal
2. Ductile iron Pipe:
  - a. Fast cure epoxy
  - b. Thermite weld cap

### C. Coating Materials:

1. Thermite Weld Caps:
  - a. Royston Laboratories Handi-Cap IP, prefabricated primerless thermite weld cap and coating system.
  - b. Provide primer unless specifically stated in product data sheet that no primer is required.
2. Fast Cure Epoxy Coating:
  - a. 100 percent solids, fast curing epoxy suitable for submerged or buried conditions.
  - b. Acceptable products or equal:
    - (1) Denso Protal 7125 (low temperature) or Protal 7300
    - (2) Tapecoat TC 7010
    - (3) 3M ScotchKote 323

## 2.13 INSULATING JOINTS

- ### A. General:
- Insulating joints shall be dielectric unions, flanges, or couplings. 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. Flange:
  - a. As specified in applicable pipe sections or in conformance with AWWA C207, whichever is more stringent.
  - b. Bolt holes may be oversized not more 1/4 inch over nominal bolt diameter where required for insulating flange assembly.
2. 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
  - d. Verify compatibility of insulating gasket and kit with valve, equipment and pipe flanges.
- 3. Insulating Sleeves: Full-length Mylar or fiberglass reinforced epoxy (NEMA G-10 grade).
- 4. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
- 5. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
- 6. Manufacturers:
  - a. GPT Industries, Houston, Texas
  - b. Advanced Products and Systems, Scott, LA
  - c. Central Plastics Co., Shawnee, OK.
- C. Insulating Couplings:
  - 1. Coupling: As specified in Section 40 05 00.
  - 2. Dielectric Boot: Rubber boot suitable for immersion service, two boots required per insulating joint.
  - 3. Manufacturers:
    - a. Style IC400, Romac Industries
    - b. Style 39, Dresser Industries
- D. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Company, Shawnee, OK; or equal.

## 2.14 CONCRETE

- A. ASTM C94-90, Option A
- B. Cement: ASTM C150-89, Type II with minimum cement content of 6.5 bags (611 pounds) per cubic yard.
- C. Coarse Aggregate Size:  $\frac{3}{4}$  inches
- D. Minimum Compressive Strength: 4,000 psi at 28 days with maximum water-cement ratio of 0.45.
- E. Air Entrainment:
  - 1. ASTM C260, nontoxic after 30 days and containing no chlorides.
  - 2. Not less than 5 nor more than 7.5 percent entrained air at the project site.

## 2.15 OTHER MISCELLANEOUS MATERIALS

- A. Test Station Wire Terminations: One-piece, tin-plated crimp-on ring tongue connector as manufactured by Burndy Co. or Thomas and Betts.
- B. Shunts: Shunts shall be 0.01-ohm Holloway Type RS.
- C. Compression Connectors:
  - 1. Compression connectors for in-line and tap splices shall be "C" taps made of

2. conductive wrought copper, sized to fit the wires being spliced.
  2. Compression connectors shall be applied with the crimp tool and die recommended by the manufacturer for the wire and tap connector size. Connectors shall be Burndy Type "YC", or equal.
- D. Electrical Tape:
1. Linerless rubber high-voltage splicing tape and vinyl electrical tape suitable for moist and wet environments.
  2. Use Scotch 130 C and Scotch 88 as manufactured by 3M Products.

### **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 during installation shall be replaced.
- C. The Contractor shall examine all Drawings and coordinate his work 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, the Engineer shall be consulted.

#### **3.2 STORAGE AND HANDLING**

- A. Store all prepackaged anodes off the ground and keep them dry until after installation. Protect against weather, condensation, and mechanical damage.
- B. Immediately remove from the project site all mechanically damaged anodes.
- C. Galvanic anodes shall not be lifted or held by the lead wire.
- D. Anode backfill material that has become wet prior to installation shall not be acceptable.

#### **3.3 PIPE JOINT BONDING, NEW PIPE**

- A. To form an electrically continuous pipeline and associated appurtenances, all metallic pipe joints shall be electrically bonded; including buried, vault, and manhole pipe, fittings, and restrained joints; except threaded, welded, or insulated joints.
- B. All buried pipe shall be electrically continuous from test station to test station and from test station to fire hydrant or blowoff. Contractor shall locate and repair any joint that is found to be discontinuous during Engineer performed electrical continuity testing.

- C. Install the quantity of joint bonds at each joint required to be bonded as specified this section or shown on the Drawings. Should the specifications and drawings conflict, the larger quantity shall apply.
- D. Electrical connection of bonds to pipe and fittings shall be by thermite or arc welding process. Bolted, compression, or mechanical connections will not be permitted.
- E. Contractor shall test each bonded joint for electrical resistance as specified under Contractor QUALITY CONTROL TESTING, this section.

### 3.4 TEST STATION INSTALLATION

#### A. General:

- 1. Test station location, type, and style shall be as shown on the Drawings.
- 2. Contractor may relocate test station up to  $\pm 25$  feet for site conditions without Engineer approval. Relocation greater than  $\pm 25$  feet must be approved by the Engineer.
- 3. Contractor shall maintain records showing actual pipeline stationing of test station wire connections to the pipe.
- 4. Records of actual pipeline stationing shall be provided to Engineer prior to electrical continuity testing by Engineer.
- 5. Test stations shall be generally located as follows:
  - a. Install Type T test stations or other type test stations as required or at 1/4 mile intervals, but not greater than 1,500 feet.
  - b. Install a Type F test station where pipe crosses a foreign-owned metallic pipeline under cathodic protection.
  - c. Install a Type C test station at both end of cased crossings, unless shown otherwise on the Drawings.
  - d. Install a Type I test station at all buried insulated joints.
- 6. Locate post-mounted test stations directly over the pipe and, where possible, at protected locations such as structures, fences, manholes, power poles, or edges of cultivated land.
- 7. Locate flush mounted test stations directly over the pipeline, except in areas of heavy traffic conditions. When heavy traffic conditions exist, offset the test stations to the side of the street.
- 8. All offset test stations shall protect the test wires with PVC coated rigid steel conduit from pipeline centerline to within 6-inches of test station as shown on the Drawings. Do not connect rigid steel conduit to test station.

#### B. Style:

- 1. Test station style shall be as shown on the Drawings and as follows:
- 2. Post mount style test stations shall be steel conduit style as shown on the Drawings.
- 3. Flush mount style test stations shall be as shown on the Drawings and used where directed by the Engineer.

#### C. Installation:

- 1. Post mounted test station:
  - a. Height shall be between 36 to 42 inches above finish grade.
  - b. Buried steel posts shall be concrete encased as shown on the Drawings.

2. Flush Mounted Test Stations
  - a. Place in concrete pad or sidewalk with cast iron cover as shown on Drawings.
  - b. Place concrete box on top of 3-inch base of compacted sand.
  - c. In unimproved areas provide blue "Carsonite" utility marker with yellow reflector on each side 1 foot from test box or as directed by the Engineer.
- D. Test Wires:
  1. Wires shall be attached to the pipe as specified under WIRE CONNECTIONS, this section.
  2. Wire connections shall be an individual connection with not less than 6-inches separation from other connections. Common connections will not be allowed. Where a steel tab is welded to pipe for test wire connections, a separate tab shall be provided for each wire connection.
  3. Wires to foreign-owned pipelines shall be connected to the pipe by the Contractor unless the foreign pipeline owner has indicated otherwise in writing. The Contractor shall coordinate this work with the owner of the foreign pipeline.
  4. Where foreign owners refuse test wire installation to their pipe, the Bidder shall obtain a written refusal from the field representative and install a Type T test station.
  5. Wires shall be buried a minimum of 24 inches below finished grade, except in undeveloped or cultivated areas where test wires shall be a minimum of 30-inches below finished grade.
  6. Wires shall be direct buried except where test station offset is required. Offset wires shall be installed in PVC coated rigid steel conduit from the centerline of the pipeline to 6-inches from test station. Rigid conduit shall not be connected to the test station.
  7. Provide 12-inch diameter loop in wires at the pipeline connection, at each end of rigid conduit when required, and below post mounted test stations to prevent wires from being stressed or broken.
  8. Maintain sufficient slack in flush mount test wires to permit extension of terminal block 18-inches above test station. Connect all wires to a terminal board as specified.
  9. Make wire connections to test station terminals with crimp-on ring tongue terminals, except where solid wire is specified.

### 3.5 REFERENCE ELECTRODE INSTALLATION

- A. Remove plastic or paper wrapper and place reference electrode within the pipeline trench excavation inches from pipe in a vertical position and activate reference electrode per manufacturer's written instructions.
- B. Install reference electrode centered between foreign pipelines and OWNER's pipeline at pipe crossing location as shown on Drawings.
- C. Backfill hole with select native material in 6-inch layers and hand tamp each layer around anode. Use only native soil for backfill; do not use sand or flowable fill. Exercise care not to strike reference cell or lead wire with tamper.
- D. Terminate reference electrode wire in test station on separate terminal.

### 3.6 CORROSION COUPON INSTALLATION

- A. Place corrosion coupons within 6-inches of pipe and reference electrode.
- B. Install reference electrode centered between foreign pipelines and OWNER's pipeline at pipe crossing locations.
- C. Terminate corrosion coupon lead wires in test station on separate terminals.
- D. Connect coupon to pipeline with magnetic switch as specified and shown on drawings.

### 3.7 THERMITE WELD WIRE CONNECTIONS:

- A. Use thermite weld method for electrical connection of copper wire to steel, ductile iron, and cast iron surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation as recommended by the material manufacturer. Assure that pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the pipe or fitting wall's integrity or damage the lining in any way.
- B. Before the connection is made, the surface shall be cleaned to bare metal by making a 2-inch by 2-inch window in the coating, and then filing or grinding the surface with a vitrified wheel to produce a bright metal finish. Wire sleeves shall be installed on the ends of the wire before welding to the metal surface.
- C. After the weld connection is cooled, remove slag, visually inspect, and physically test wire connection by hitting with a hammer. Remove and replace any defective connections.
- D. Make wire connections to concrete cylinder pipe by thermite welding to the shop welded steel plates provided on the pipe for this purpose.
- E. Coat each completed wire connection as specified, this section. If lining is damaged by welding, repaired in accordance with the lining applicator's recommendations.

### 3.8 TRENCHING AND BACKFILL

- A. General
  - 1. Complete excavations and trenching regardless of the type, nature, or condition of materials encountered, and as required to accomplish specified construction to lines and grades shown.
  - 2. Contractor shall complete all utility notifications prior to performing trenching and excavations work.
  - 3. Take care to avoid damage to existing structures and utilities during excavating and trenching process. Contractor may modify location, where approved by the Engineer, to minimize possible damage to existing structures. Trench shall be of

uniform depth and width, level, smooth, and free of sharp objects.

B. Trench Depths:

1. Trench depths vary for conditions and requirements. Trench depths provided are minimum requirements. Contractor to meet minimum requirements or that required by local utilities, ordinances, or regulations, whichever is more stringent.
2. Minimum depths for cathodic protection or corrosion monitoring work shall be as defined herein or shown on the Drawings. If in conflict, the more stringent shall apply.
  - a. Pipeline Test wires, undeveloped 24-inches (direct bury)
  - b. Pipeline Test wires, roadways 30-inches (conduit)
  - c. All other 30-inches

C. Safety

1. Slope, shore, or brace excavations and trenches in accordance with OSHA regulations as necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public.
2. Contractor shall have sole responsibility for ensuring safety of trenches and conformance to OSHA trench safety requirements.

D. Backfill and Compaction

1. Backfill trench with excavated backfill materials, unless otherwise specified.
2. Compaction requirements shall be as specified for the pipeline or 90 percent compaction, whichever is more stringent. Backfill within 5 feet of roadways, paved areas, or other traffic areas shall be compacted to 95 percent.
3. Do not use backfill material of frozen or consolidated debris. Leave the trench with the excess backfill material neatly mounded, but not more than 4 inches above the existing ground level, for the entire width of the trench in undeveloped areas.
4. Replace topsoil in developed, landscaped, or cultivated areas.

3.9 SURFACE RESTORATION:

- A. Contractor shall restore all existing surface improvements within the pipeline easement removed in the performance of this work.
- B. Contractor to complete surface restoration as specified and shown on the Drawings.

3.10 CONCRETE:

- A. Concrete used for slabs shall conform to the requirements for concrete in Section CONCRETE.
- B. Contractor shall finish all concrete work to a smooth trowel finish with radius edges.
- C. Concrete flatwork shall be sloped to drain water away from conduits and posts.
- D. All forms shall be removed from concrete work prior to final acceptance and removed from the project site.

### 3.11 WIRE INSULATION REPAIR

- A. Underground splicing of wire will not be permitted, except where specifically shown on the drawings and approved by the Engineer.
- B. Where splicing is approved by the Engineer, splices shall mechanically secure and soldered with rosin cored 50/50 solder. Compression connectors will not be permitted.
- C. Splices or insulation damage to test station wires shall be spirally wrapped with two coats of high-voltage self-vulcanizing rubber splice tape and two layers of vinyl electrical tape.

### 3.12 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. Install a Type I test station at each buried insulated joint.
- E. Provide a DC blocking device on all insulating joints, except buried joints, as specified herein and shown on the Drawings.
- F. The Contractor shall test each insulated joint for electrical insulation as specified this section. Defective insulating joints shall be repaired by the Contractor at his sole expense. All damaged or defective insulation parts shall be replaced.

### 3.13 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 the Contractor.
- B. Joint Bond Resistance Test:
  - 1. General
    - a. The Contractor shall test completed joint bonds for electrical continuity using a digital low resistance ohmmeter.
    - b. Joint bond quality control test shall be performed on all bonded joints after the bonds are installed but before backfilling of the pipe.
    - c. Furnish all equipment and materials as required for test.
  - 2. Digital Low Resistance Ohmmeter Test Method:



- a. Required Equipment and Materials:
    - (1) One AVO Model DLRO10, digital low resistance ohmmeter or equivalent instrument.
    - (2) Two duplex, helical spring point leads with current and potential points, AVO Model No. 242011-7, or equivalent wire lead set.
  - b. Test Procedure:
    - (1) Measure the resistance of joint bonds with the low resistance ohmmeter in accordance with the manufacturer's written instructions.
    - (2) Use the helical handspikes to contact the pipe on each side of the joint, without touching the thermite weld or the bond. The contact area shall be cleaned to bright metal by filing or grinding and without any surface rusting or oxidation.
    - (3) Record the measured joint bond resistance on the test form described herein.
    - (4) Repair any damaged pipe coating in accordance with WIRE CONNECTIONS, this section.
3. Joint Bond Acceptance:
- a. Joint bond resistance shall be less than or equal to the maximum allowable bond resistance values shown below.

Joint Type	Max. Allowable Resistance (micro-ohms)		
	Two Bonds/Joint	Three Bonds/Joint	Four Bonds/Joint
No. 2 AWG wire (Steel)	162	108	81
No. 2 AWG wire (DIP)	185	123	93
Copper Strap (12-inch)	64	43	32
Copper Strap (9-inch)	48	32	24
Coupling, 24" No. 2 AWG	212	142	106
Coupling, 24" Copper Strap	128	85	64

- b. For bond quantities greater than shown above. Obtain maximum allowable bond resistance from the Engineer.
  - c. The Contractor shall remove and replace all joint bonds on a joint that exceeds the maximum allowable resistance. Replacement joint bonds shall be retested for compliance with the specified bond resistance.
  - d. Any defective joint bond discovered during SYSTEM TESTS AND INSPECTION shall be located, excavated, repaired, and backfilled by the Contractor.
4. Test Records: Records shall be made of each bonded pipeline during the test and submitted to the Engineer. These records shall include:
- a. Description and location of the pipeline tested.
  - b. Starting location and direction of test.
  - c. Date of test.

- d. Joint type.
  - e. Measured joint bond resistance
- 5. Report: Contractor shall submit a QC report upon completion of joint bond resistance testing which includes the information listed above.
- C. Insulated Joint Isolation Test:
  - 1. Contractor shall provide a Corrosion Expert to test each insulating joint after assembly with a GAS Electronics Model 601 insulator tester or equivalent instrument in accordance with the manufacturer's written instructions.
  - 2. The Corrosion Expert 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.
  - 3. Conduct test before burial and coating of buried insulating flanges.
  - 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 Corrosion Expert certifying insulating joint testing isolation, test method(s), test data, and any corrective action required.
- D. Casing Isolation Testing:
  - 1. Contractor to test each casing and carrier pipe after assembly for electrical isolation before and after filling of casing with the specified fill material.
  - 2. An electrical isolation test method and evaluation criterion to be utilized by Corrosion Expert is to be submitted in writing for approval by Engineer prior to beginning field testing.
  - 3. 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.
  - 4. Contractor to conduct any and all remedial actions necessary to clear all electrical contacts between the carrier pipe and casing before filling of the casing shall be permitted.
  - 5. Contractor shall submit a written report prepared by the Corrosion Expert certifying casing isolation, testing method(s), test data, and any corrective action required.

### 3.14 SYSTEM TESTS AND INSPECTION

- A. General
  - 1. All testing specified herein shall be performed by the Engineer and shall include:
    - a. Preliminary electrical continuity testing of the full pipeline.
    - b. Other tests as specified in Section 13115, Cathodic Protection.

2. Contractor shall correct all construction defects identified during testing.
  3. Provide Engineer with one week advance notice of completion of corrosion monitoring system work.
- B. Electrical Continuity Testing:
1. Preliminary Continuity Test by Engineer
    - a. After the pipeline construction is completed and all test stations have been installed, the Engineer shall test all pipelines with joint bonds for electrical continuity using the four-wire lineal pipe resistance test method.
    - b. Test will be conducted with a minimum test current of 15 amperes using a portable rectifier or dc welder.
    - c. An electrically continuous pipeline will be defined as a pipe or section of pipe that has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable joint bond resistance for each joint as specified in this section.
    - d. The Contractor shall locate electrically discontinuous joints at his sole expense as specified herein.
    - e. Each discontinuous section of pipe shall be retested by the Engineer after all continuity repairs are completed to demonstrate that the pipeline is electrically continuous. Engineer retesting costs shall be at the Contractor's expense.
    - f. Electrical continuity testing requires two electrically continuous wires connected to pipeline at each test station. Any pipe section with one or more broken test wire(s) cannot be tested for continuity and will be classified as electrically discontinuous.
  2. Electrical Discontinuity Location:
    - a. Contractor shall be solely responsible for location and repair of all discontinuous or high resistance joints bonds using a test method determined by the Contractor. Regardless of test method used to locate discontinuous joints, final acceptance of discontinuous sections shall be determined by the lineal pipe resistance method.
    - b. After all discontinuous or high resistance joint bonds are repaired, the repaired section shall have a resistance less than or equal to the calculated allowable lineal pipe resistance as determined by the initial final continuity testing.
    - c. Existing joint bonds damaged during excavation of the pipe for repairs or temporary wire connections shall be repaired by the Contractor.
    - d. Existing test stations shall be protected from damage. When damage occurs Contractor shall complete repairs while the excavation is open. Undisclosed test station damage that requires repairs to be made after backfilling the excavation will be repaired at the Contractor sole expense.
    - e. Upon completion of continuity repairs, the Engineer shall retest the continuity of repaired sections at the Contractor's expense in accordance with the General Conditions.

END OF SECTION

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**SECTION 26 50 00  
LIGHTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes
  - 1. The general requirements for luminaries and light poles.
- B. Related Sections
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.2 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. National Electrical Code.
  - 2. Institute of Electrical and Electronic Engineers.
  - 3. National Fire Protection Association.
  - 4. Illuminating Engineering Society.

**1.3 SYSTEM DESCRIPTION**

- A. The Contractor shall furnish and install luminaries, and accessories for all lighting systems, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. Individual luminaire types etc. are identified in the plans and on the luminaire schedule.

**1.4 SUBMITTALS**

- A. Furnish complete submittals in accordance with Section 26 05 00.
- B. Product Data
  - 1. Catalog literature for each luminaire specified cross referenced to the luminaire type found on the Luminaire Schedule in the plans.
    - a. Each such submittal shall clearly describe:
      - 1) Materials.
      - 2) Type of diffuser.
      - 3) Hardware.
      - 4) Gasketing.
      - 5) Reflector.
      - 6) Chassis.
      - 7) Finish.
      - 8) Ballast.
  - 2. Complete literature for each luminaire substitutions.
    - a. Submittals for luminaries shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire.

- 1) Photometric data shall include coefficients of utilization, average brightness, candle power distribution curves, and lumen output chart.
    - b. Substitutions for specified luminaires shall be based upon quality of construction, light distribution, appearance, and maintenance.
  3. Support method shall be submitted for interior fixtures weighing more than 50 pounds.
  4. Ballast catalog data indicating lamp wattage, input watts, sound rating, power factor, and type of ballast.
    - a. Data for outdoor ballast shall be include low temperature starting characteristics.
  5. Photocell data submittal shall indicate switching capacity, the means of adjusting the lighting pickup level, and enclosure.
  6. Pole-mounted luminaries, including complete data on the pole material, finish, handholes, anchoring, and fixture attachment.
  7. Pole height, dimensions, bolt hole circle layout, light supporting rating, and wind withstand rating based on effective area of luminaries, and hardware.
- C. Calculations
1. Provide mounting details for indoor lights with calculations showing that the installation meets the seismic requirements of the site.
  2. Calculations and design must be made by and stamped by a registered professional engineer registered in the state where the project is being constructed. In light of the fact that this design is being provided by a professional engineer the submittal will be reviewed for form and content but not reviewed for technical completeness, methods, or calculations.
- D. Record Drawings
1. The luminaire schedule in the plans must be updated to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

## 1.5 QUALITY ASSURANCE

- A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
1. National Electric Code.
  2. Underwriters Laboratories.
  3. ANSI C82.1 Specifications for Fluorescent Lamp Ballasts.
  4. ANSI C84.4 Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type).
  5. Standards of the Certified Ballast Manufacturer's Association.
  6. Illuminating Engineering Society (IES).

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Luminaries shall be stored in their original cartons from the manufacturers until the time of installation.

- B. Luminaire poles shall be stored on blocks above grade until the time of installation.

#### 1.7 PROJECT/SITE CONDITIONS

- A. Seismic and wind withstand ratings in accordance with Section 26 05 00.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Exterior lighting system operation shall be demonstrated during the hours of darkness.
- B. Lighting demonstration shall occur within 2 weeks prior to project acceptance.

#### 1.9 WARRANTY

- A. The Contractor shall warrant all luminaries, ballasts, and lamps for a minimum period of one (1) year from Substantial Completion unless otherwise specified by the General Conditions.
  - 1. Furnish, and replace any defective equipment during that period at no charge to the Owner.
  - 2. Said warranty shall be independent of any manufacturer infant mortality or normal failure statistics.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Pre-approved manufacturers are indicated on the Luminaire Schedule, and in notes on the drawings.
  - 1. This selection of manufacturer's is not intended to be overly restrictive and the Contractor may make substitutions from the manufacturers listed in the Luminaire Schedule in order to offer a more advantageous luminaire package.
  - 2. The lighting design and luminaire selection has been based upon the photometrics of the identified luminaries. It is the Contractor's responsibility to insure and prove to the Engineer at time of submittal that any substitutions meet the quality and photometric requirements of the original design.
  - 3. The Engineer shall make final determination if proposed substitutes are acceptable.
    - a. The Contractor shall furnish the identified luminaries at no additional cost to the Owner for any luminaire substitutions that in the sole opinion of the Engineer, are not acceptable.

#### 2.2 EQUIPMENT

- A. Luminaries – General
  - 1. All luminaries shall be pre-wired with leads of 18-AWG, minimum, for connection to building circuits.
  - 2. In general the luminaries furnished shall be as per the Luminaire Schedule. The specifications apply to those luminaries not described or as an addition or supplement to the luminaire schedule.
- B. Exterior Luminaries

1. Exterior luminaries in combination with their mounting pole and bracket shall be capable of withstanding winds of levels consistent with the levels identified in Section 26 05 00 without damage.
  2. Exterior luminaries shall have corrosion-resistant hardware and hinged doors or lens retainer.
  3. Luminaries specified to be furnished with integral photo-electrical control shall be of the luminaire manufacturer's standard design.
- C. Interior Luminaries
1. Interior luminaries without diffusers shall be furnished with end plates.
  2. Where diffusers are required, they shall be of high molecular strength acrylic.
    - a. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.
- D. Photo-Electric Cells
1. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type and shall be provided with time-delay features.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Special Techniques
1. Luminaries shall be installed plumb and square with building and wall intersections.
    - a. Pendant-mounted luminaries which are mounted from sloping ceilings shall be suspended by ball hangers, unless otherwise indicated on the Drawings.
    - b. Luminaries installed in machinery rooms shall be located after machines have been installed.
  2. In all cases, luminaire locations shall be coordinated with work of other trades to prevent obstruction of light from the fixtures.
  3. Unless otherwise indicated, luminaries shall be centered on ceiling tiles.
  4. Luminaries weighing more than 25 pounds shall be supported independently of the outlet box.
  5. Recessed luminaries shall be installed light-tight to the ceiling and shall be provided with auxiliary safety supports attached directly to the building structure.
    - a. Said safety supports shall consist of #12 AWG soft drawn galvanized wire.
  6. Luminaries installed in suspended grid ceilings shall be supported independently of the grid.
  7. All luminaries installed in suspended grid ceilings shall be held in place with seismic restraint clips.
- B. Lighting Poles
1. Poles shall be set on anchor bolts and secured with double nuts on each bolt.
  2. After luminaire has been leveled and plumbed, the pole base shall be dry-packed.
  3. Poles that are specified as hinged shall have one pole lowering winch furnished for all of the poles.



### 3.2 ADJUSTING

- A. All outdoor luminaires shall be aimed after installation during dark evening hours as directed by the Engineer.

### 3.3 CLEANING

- A. Lenses, diffusers, and reflectors shall be cleaned just prior to the time specified for the system demonstrations.
- B. Luminaire trim, poles and support brackets, where finish has been damaged, shall be refinished.
- C. All luminaires used during construction for construction lighting shall be cleaned, the lamps shall be replaced, and the used lamps returned to the Owner.

### 3.4 DEMONSTRATION

- A. Exterior lighting system operation shall be observed to indicate that fixtures are properly focused, photo-cell operation is correct, and that switching functions as intended in accordance with the drawings.
- B. Similar requirements shall apply to interior lighting.
- C. Through demonstration, the Contractor shall also verify that panel schedules properly indicate the lighting outlets connected to each circuit.

### 3.5 SCHEDULES

- A. Refer to the Luminaire Schedules as found in the plans.

END OF SECTION

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**DIVISION 31**  
**EARTHWORK**

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**SECTION 31 10 00  
SITE PREPARATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Work of this Section includes all those measures required during the Contractor's initial move onto the site to protect existing fences, structures and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process: clearing, grubbing and stripping; and regrading of areas to receive embankment fill.
- B. The Contractor is required to protect and preserve all things designated to remain. Where Contractor's operation causes damage or injury to trees and plants designated to remain, an arborist or other qualified professional shall be employed by the Contractor, at no additional cost to the Owner, to repair the damage or provide adequate replacement to the Owner's satisfaction where damage is beyond repair.

**1.2 SITE INSPECTION**

- A. Prior to moving onto the Project site, the Contractor shall inspect the site conditions and review maps of the existing plant site and off-site pipeline routes and facilities delineating the Owner's property and right-of-way lines.
- B. Contractor shall submit photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site preparation.
- C. The Contractor shall identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions. Existing conditions shall be incorporated into the record drawings for the project.

**1.3 DEFINITIONS**

- A. The following definitions apply to the Work of this Section:
  - 1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
  - 2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.
  - 3. Stripping is defined as removing a surface layer of soil and organic material, sod, topsoil, and other unsuitable material as defined in Section 31 23 00 – Earthwork, to a depth that earthwork can proceed.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### **3.2 TREE PROTECTION**

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
  - 2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.

### **3.3 UTILITIES**

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Engineer's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

### **3.4 PRIMARY SITE ACCESS**

- A. Develop any necessary access to the site, including barrier facilities to be installed at the beginning of construction in order to prohibit entry of unauthorized persons.
- B. Utility Interference: Where existing utilities interfere with the Work of this Section, notify the Engineer and work around the interferences until a directive is issued.

### 3.5 CLEARING, GRUBBING, AND STRIPPING

- A. All construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the Engineer.
- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Debris or waste shall be totally removed if they are found on the site. All objectionable material from the clearing and grubbing process shall be removed from the site and wasted in approved safe locations in compliance with state and federal regulations.
- C. The area to be affected by construction that have not been pre-excavated to the subgrade elevation shall be removed and placed in the designated stockpile areas, and/or incorporated into landscaped areas or other nonstructural embankments.
- D. For all areas that have not been previously disturbed, including staging areas and temporary construction easements, topsoil-salvaging operation shall immediately follow clearing operations. The area shall be stripped of topsoil to a depth of 8 inches. Unsuitable materials, specified in Section 31 23 00, shall not be considered topsoil. The Contractor shall strip to the depth indicated regardless of the material encountered. All stripped topsoil shall be stockpiled within stripped areas in stockpiles not to exceed 15 feet in height. Vegetation shall be ground or chipped to a mulching consistency and mixed with the stripped soil. Stockpiles shall be placed away from high construction traffic areas and shall be fenced and signed to prevent accidental use as fill prior to topsoil replacement.
- E. Upon completion of Work within the construction areas stripped of topsoil, the stored topsoil shall be respread over the disturbed areas. Topsoil shall be spread in about a 6-inch layer. Respread topsoil shall match the existing terrain as much as possible. Interfaces between restored disturbed areas and undisturbed areas shall be chain dragged to eliminate obvious edges. All tracks and equipment marks shall be chain dragged or hand raked away. Replaced topsoil shall be thoroughly watered for dust control upon completion of the resspreading operations. Once topsoil replacement has been completed, no vehicles or other motorized equipment shall be allowed to travel on the finished surface.
- F. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the Engineer's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if not necessary for the Contractor's choice of means and methods, shall be arranged with the property owner and be removed and replaced at no increased cost to the Owner.
- G. Except in areas to be excavated, holes and other holes resulting from Work of this section shall be backfilled with suitable material in accordance with Section 31 23 00 – Earthwork.

3.6 SITE SPECIFIC IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction. Remove surficial soil and vegetation.
- B. Excavate to subgrade elevation shown in the drawings.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION



**SECTION 31 23 00  
EARTHWORK**

**PART 1 - GENERAL**

1.1 THE REQUIREMENT

- A. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

29 CFR 1926	OSHA Safety and Health Regulations for Construction
ASTM C150	Portland Cement
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft <sup>3</sup> ) (2,700 kN-m/m <sup>3</sup> )
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2901	Test Method for Cement Content of Freshly Mixed Soil Cement
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density of Soils using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4832	Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D 5971	Practice for Sampling Freshly Mixed Controlled Low Strength Material (CLSM)
ASTM D 6023	Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM D 6024	Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
ASTM D 6103	Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

### 1.3 CONTRACTOR SUBMITTALS

- A. The Contractor's attention is directed to the provisions of Subpart P, 29 CFR 1926 of the OSHA Safety and Health Standards for Construction, which relate to protection of employees in excavations. The Contractor shall submit, for information to the Engineer, the project excavation plan and the name of the Contractor's competent person, prior to commencing any excavation.
- B. Submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01 33 20 – Submittal Procedures. Sample sizes shall be as determined by the testing laboratory.
- C. Submit dewatering and water removal plan prior to performing any dewatering or water removal.

## PART 2 - PRODUCTS

### 2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. General: Fill, backfill, and embankment materials shall be suitable material.
- B. Suitable Materials: Suitable material is defined as selected or processed clean, well graded earth material, sands and gravels free of excessive fines, less than 20 percent rock and boulders larger than 4 inches, grass, roots, brush, vegetation, or other deleterious materials.
- C. Fill and backfill materials within 6 inches of any structure or pipe shall be smaller than 1 inch in any dimension.
- D. Suitable materials may be obtained from onsite excavations, may be processed onsite materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule. Onsite materials shall be stockpiled and segregated prior to use.

E. It is expected that the Project will require a significant volume of exported materials. Contractor is responsible for identifying suitable export and disposal locations offsite. Contractor is responsible for all costs associated with furnishing materials qualification testing for suitability, for processing, hauling, storing and placing suitable fill materials, and for export and disposal of excess materials.

F. The following types of suitable materials are defined:

1. Type A (Granular Backfill): Crushed rock or gravel, and sand well graded and readily compacted, non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
No. 40	30 - 50
No. 200	0 - 12

2. Type B (Crushed Rock): Manufactured angular, crushed rock, non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (Sand Backfill): Sand non-plastic, meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4-inch	100
No. 4	80 - 100
No. 10	30-50
No. 40	10-30
No. 200	7 - 15

Squeegee is not acceptable as sand backfill.

4. Type D (Select Backfill): Suitable material that can be readily compacted and meets the requirements of AASHTO M 145 classification A-1-a, non-plastic, well graded with a maximum particle size of 2 inches.

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-inch	100
No. 10	30-50
No. 40	15-30
No. 200	0 - 15

5. Type E (Pea Gravel Backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

6. Type F: (Coarse Drainrock): Crushed rock or gravel conforming to one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

Sieve Size	Percentage Passing		
	3 inch Max.	2 inch Max.	3/4 inch Max.
3 inch	100		
2 inch	90-100	100	
1 1/2 inch	70-100	95-100	
3/4 inch	0-50	50-100	100
1/2 inch			95-100
3/8 inch	0-10	0-55	70-100
No. 4		0-25	0-70
No. 8	0-5	0-15	
No. 200	0-3	0-3	0-3

7. Type G (Type II Aggregate Base): Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, or crushed gravel, free of organic matter and contamination from chemical or petroleum products meeting State specification requirements and conforming to the following Table and gradations:

Aggregate Properties			
	Aggregate Class		
	A	B	
Dry Rodded Unit Weight	Not less than 75 lb/ft <sup>3</sup>		AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	PI ≤ 6	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent		AASHTO T 96
Gradation	Table below		AASHTO T 11 AASHTO T 27
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	N/A	AASHTO T 193
Two Fractured Faces	50% Min	N/A	AASHTO T 335

Sieve Size	Percentage Passing
1 - 1/2-inch	100
3/4-inch	81 - 91
1/2-inch	67 - 77
No. 4	43 - 53
No. 16	23 - 29
No. 200	6 - 10

8. Type H (Graded Drainrock): Graded drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting and drying. The material shall be uniformly graded and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1 inch	100
3/4 inch	90-100
3/8-inch	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

9. Type I: Not used
10. Type J (Cement-Treated Backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.
11. Type K (Topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth as defined in Section 31 10 00 - Site Preparation. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris. Stockpiled topsoil and imported topsoil must meet the requirements of Section 32 90 00 - Planting.
12. Type M (Aggregate Subbase): Crushed rock aggregate subbase material non-plastic that can be compacted readily by watering and rolling to form a stable base. The sand equivalent value shall not be less than 18 and shall meet one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

<u>Sieve Size</u>	<u>Percentage Passing</u>	
	<u>3-inch Max.</u>	<u>2-inch Max.</u>
3-inch	100	-
2-inch	90-100	100
1-1/2 inch	-	95 - 100
1-inch	70 - 90	-
No. 4	30 - 65	30 - 65
No. 16	15 - 40	15 - 40
No. 200	2 - 12	2 - 12

13. Type N (trench plug): Low permeable fill material, a nondispersable clay material having a minimum plasticity index of 10.
14. Type O (Controlled Low Strength Material (CLSM)): CLSM material shall be in accordance with Section 31 23 26 - Flowable Fill.
15. Type P (Suitable Trench Backfill): Suitable material that can be readily compacted, with less than 35 percent passing the No. 200 sieve and a plasticity index of 10 or less. Maximum particle size shall be restricted to two inches.

16. Type Q (Embankment Fill): Embankment fills for general backfill around the tank and access road may be obtained from processed on-site materials, subject to approval by the Engineer, provided processed materials meet one of the specifications for Type A through H, maximum particle size is restricted to 3 inches, and compaction density of the materials can be demonstrated and verified.

## 2.2 UNSUITABLE MATERIAL

- A. Unsuitable materials include but are not limited to the materials listed below.
  1. Soils which, when classified under ASTM D 2487 - Classification of Soils for Engineering Purposes, fall in the classifications of Pt, OH, CH, MH, or OL.
  2. Soils which cannot be compacted sufficiently to achieve the density indicated for the intended use.
  3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, slag, and any material which may be classified as hazardous or toxic according to applicable regulations.
  4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing onsite soils.
  5. Topsoil, except as allowed below.
- B. All unsuitable excavated material shall be disposed off site.

## 2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. Use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, notify the Engineer immediately. In case of conflict between types of pipe embedment backfills, use the agency-specified backfill material if that material provides a greater degree of support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, use the agency-specified backfill material if that material provides the greater in-place density after compaction.
- C. Fill and backfill types shall be used in accordance with the following provisions:
  1. Embankment fills shall be constructed of Type Q material, as defined herein, or any mixture of Type Q and Type A through Type H materials.
  2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
    - a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided with Type C material in the pipe zone. Large diameter pipe (30-inch diameter and greater) shall be backfilled to the springline with CLSM, and the remainder of the pipe zone backfilled with Type C material.
    - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other nonmortar coated pipe shall be backfilled with Type C material in the pipe zone.
    - c. Plastic pipe and vitrified clay pipe shall be backfilled with Type C material in the pipe zone.

- d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of Type J or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.
  - e. Type O material shall be used in the pipe zone where shown on plans, specified, or required by the Engineer for special crossings or other locations, or where otherwise approved.
  - f. Type E material will not be allowed for backfill within the pipe zone.
- 3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type D backfill material or processed native material under unimproved surfaces.
- 4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill.
- 5. Trench backfill and final backfill for pipelines under structures shall be Type A or B, except where concrete encasement is required by the Contract Documents.
- 6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
- 7. Backfill around structures shall be Type P material, or Types A through Type G materials, or any mixture thereof, except as shown.
- 8. Backfill materials beneath structures shall be as follows:
  - a. Graded drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.
  - b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types G or H materials shall be used.
  - c. Under structures where groundwater must be removed to allow placement of concrete, Type H material shall be used. Before the Type H material is placed, filter type geotextile fabric shall be placed over the exposed foundation.
  - d. Under all other structures, Type G material shall be used.
- 9. Backfill used to replace pipeline trench overexcavation shall be a layer of Type F material with a filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.
- 10. Backfill used to replace overexcavation beneath structures shall be Type G or H.

## 2.4 PIPELINE MARKING TAPE

- A. **Metallic Tape:** Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be a minimum of 6 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, as indicated. Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.
- B. **Plastic Tape:** Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalais acids, and chemicals and solvents which are likely in the soil. Tape shall be a minimum of 6 inches wide and lettering shall be 1-inch tall permanent black on a colored background. Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.

- C. Warning Tape: Warning tape manufactured for marking and identifying underground utilities continuously inscribed with a description of utility, colored as follows:
1. Red; Electric.
  2. Yellow; Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water Systems.
  5. Green: Sewer Systems.

## 2.5 MATERIALS TESTING

- A. All soils testing of samples submitted by the Contractor will be done by a testing laboratory of the Owner's choice and at the Owner's expense. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the work.
- B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Method for Particle-Size Analysis of Soils.
- C. Determination of sand equivalent value will be performed using ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- D. Unified Soil Classification System: References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.
- E. The testing for chloride, sulfate, resistivity, and pH will be done by a testing laboratory of the Owner's choice and at the Owner's expense.

## PART 3 - EXECUTION

### 3.1 EXCAVATION – GENERAL

- A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including rock and all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with safety requirements of the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).
- B. Maximum Length of Open Trench: The maximum length of open trench in urban and rural areas shall not exceed 500-feet at each pipe installation heading beyond the end of the installed pipeline, or the requirements of the agency with jurisdiction, whichever is lesser.
- C. Construction Delays: In the case of any construction delay in excess of five calendar days, whether Contractor or Owner caused, the Contractor shall backfill the excavation, install



temporary paving including temporary traffic markings, and restore traffic to pre-construction condition to minimize disruption to traffic and the community at no additional cost to the Owner.

- D. Removal and Exclusion of Water: Remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, well points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

### 3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. Overexcavation: Except as noted otherwise, excavation beneath the reservoir shall be carried to the depth shown in Drawings C-02 and C-04 to allow for approximately 2 feet of structural fill below the underdrain and liner. Overexcavated areas below the tank shall be backfilled and compacted using Type G material. Install 2-inch layer of Type C material to the grade of the bottom of the liner. Install EPDM liner and underdrain system, including 8-inches of compacted Type H material. All backfill of overexcavation and structural fill beneath structures shall be compacted to obtain 95-percent of maximum relative density. Excavation beneath vaults shall be carried to a depth of 1 foot below the bottom of slab, and backfilled and compacted using Type G material.
- B. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be overexcavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such overexcavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed. When such overexcavation is not indicated but is ordered by the Engineer, such overexcavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or overexcavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.
- C. Excavation Beneath Concrete Reservoirs: Excavation under reservoirs shall extend to the subgrade elevations shown on Drawings C-02 and C-04. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95-percent of maximum density and graded to provide a horizontal and reasonably smooth surface for placement of the structural fill.
- D. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the bottom of the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the

finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

- E. Notification of Engineer: Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least 1 day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

### 3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.
- B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe zone. Excavations for pipe bells and welding shall be made as required.
- C. Open Trench: The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be protected in accordance with Section 01 71 50 – Protection and Restoration of Existing Facilities. The Contractor shall provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches, and shall remain in place during all non-working hours.
- D. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.
- E. Overexcavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be overexcavated beyond the depth and/or width shown. Such overexcavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Overexcavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the Owner. When the overexcavation ordered by the Engineer is 6 inches or greater below the limits shown, or wider, additional payment will be made. Said additional payment will be made under separate unit price bid items for overexcavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.
- F. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
- G. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench

shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

#### 3.4 OVEREXCAVATION NOT ORDERED OR INDICATED

- A. Any overexcavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed at no additional cost to the Owner.

#### 3.5 EXCAVATION IN VICINITY OF TREES

- A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed by the Engineer.

#### 3.6 BACKFILL – GENERAL

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed. Structures shall not be constructed on CLSM backfill until the CLSM has obtained a 7-day minimum cure.
- B. Except for Type F drainrock materials being placed in overexcavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.
- C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. Do not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.
- D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. All materials disturbed from their intact condition that are 4 inches or larger in least dimension or aggregates of soil material thicker than 4 inches shall be removed from the excavation walls and base prior to placing pipe or any backfill material. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

#### 3.7 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness.
- B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the

pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

- C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the indicated degree of compaction the material shall be dried or mixed with drier material until the moisture content is satisfactory.
- E. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs.

### 3.8 COMPACTION OF EARTH FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Each layer of Types A, B, C, D, G, H, I, K, M, P and Q backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type E and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.
- C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.
- D. Pipe zone backfill materials that are granular, shall be compacted by using vibratory compactors.
- E. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.
- F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.
- G. Compaction Requirements: The following compaction test requirements shall be in accordance with ASTM D 1557, method C. Compaction shall be obtained with the moisture content within plus or minus 2 percent of the optimum moisture content. Where agency or utility company requirements govern, the highest compaction standards shall apply.

<b>Location or Use of Fill</b>	<b>Percentage of Maximum Density</b>
Pipe embedment backfill for flexible pipe	90
Pipe bedding and overexcavated zones under bedding for flexible pipe, including trench plugs	90
Pipe embedment backfill for steel yard piping	---
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe	90
Pipe bedding and overexcavated zones under bedding for rigid pipe	90
Final backfill, beneath paved areas or structures	95
Final backfill, not beneath paved areas or structures	85
Trench zone backfill, beneath paved areas and structures, including trench plugs	95
Trench zone backfill, not beneath paved areas or structures, including trench plugs	90
Embankments and fills	90
Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill and fill around structures on reservoir or structure roof	90
Topsoil (Type K material)	80
Aggregate base or subbase (Type G or M material)	95

### 3.9 PLACEMENT OF CLSM

- A. Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench, which might fall into the trench during placement of the CLSM.
- B. Deliver the CLSM to the trench in ready mix trucks and utilize pump or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 1.5 feet above the pipe bottom. Use at least two hand-held vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture

to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.

- C. Maintain stability of pipe throughout CLSM placement. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the Owner. Remove all sloughed material or other debris from top of previously placed CLSM.

### 3.10 PIPE AND UTILITY TRENCH BACKFILL

#### A. Pipe Zone

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe and a plane at a point 12 inches above the top surface of the pipe. The bedding is defined as that portion of pipe zone backfill material between the bottom of the trench and the bottom of the pipe. The embedment is defined as that portion of the pipe zone material between the bedding and a plane at a point 6 inches above the top surface of the pipe.
2. After compacting the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.
3. The pipe zone shall be backfilled with the indicated backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. Do not displace the pipe or backfill while the shield is being moved.

- B. Trench Zone: After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

#### C. Marking Tape Installation

1. Continuously install metallic marking tape along the pipe at a depth of 3 feet below finish grade.
2. Continuously install plastic marking tape along the pipe at the elevation indicated on the Drawings.

- D. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

### 3.11 FILL AND EMBANKMENT CONSTRUCTION

- A. Embankment Fill Beneath Tank: The area where a fill or embankment is to be constructed shall be cleared in accordance with Section 31 10 00 – Site Preparation. Excavation under reservoirs shall extend to the subgrade elevations shown on Drawings C-02 and C-05. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95-percent of maximum density and graded to provide a horizontal, benched and reasonably smooth surface for placement of the structural fill. Embankment and fill material shall be placed and spread evenly in horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness. The embankment structural fill shall be compacted to 95 percent of maximum density.
- B. General Embankment and Fill: The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be scarified to a depth of 6 inches, moisture conditioned, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere. See
- C. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 5H:1V, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and recompacted as the embankment or fill is brought up in layers. Material thus cut shall be recompacted along with the new material at no additional cost to the Owner. Hillside or fill slopes 5H:1V or flatter shall be prepared in accordance with Paragraph A, above.
- D. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.
- E. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs.

### 3.12 FIELD TESTING

- A. General: All field soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.
- B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Field density in-place tests will be performed in accordance with ASTM D 1556 or by such other means acceptable to the Engineer.

- C. In case the test of the fill or backfill show noncompliance with the required density, perform remedies as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner, paid by the Contractor, at no additional cost to the Owner.
- D. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the Owner's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the Owner. All Work for test trenches and excavations shall be provided at no additional cost to the Owner.
- E. Frequency of Testing
  - 1. Backfill around and below structures and in embankments shall be tested every 300 square ft of each lift of placement.
  - 2. CLSM shall be tested each batch being placed or every 100 cubic yards that is placed.
  - 3. Pipe backfill shall have one test every 80 feet (2 joints) of backfill placed.

END OF SECTION



**SECTION 31 23 26**  
**CONTROLLED LOW STRENGTH MATERIAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install flowable fill, complete and in place, in accordance with the Contract Documents.
- B. Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.
- C. Place flowable fill where indicated on the Drawings. With approval of the Engineer, normal flowable fill with high slump, non-segregating consistency that readily flows and fills voids and difficult-to-reach places may also be used for the following purposes:
  - 1. Pipe zone fill.
  - 2. Trench zone fill.
  - 3. Pipe abandonment.
  - 4. Structure backfill.
  - 5. Structure cavity fill.

**1.2 REFERENCES**

- A. ASTM International (ASTM) standards, most recent editions:

ASTM C33	Standard Specifications for Concrete Aggregates
ASTM C94	Standard Specifications for Ready-Mixed Concrete
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C150	Standard Specifications for Portland Cement
ASTM C260	Specification for Air-Entraining Admixtures for Concrete Compounds for Curing Concrete
ASTM C403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

### 1.3 DEFINITIONS

- A. Flowable fill: A mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C94.

### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product data.
1. Flowable fill mix designs which show the proportions and gradations of materials proposed for each type of flowable fill indicated. Provide independent laboratory test results for each mix design verifying indicated properties.
- C. Test and Evaluation Reports
1. If Contractor proposes to provide lower strength flowable fill with aggregates that do not conform to ASTM C33, provide written testing program that will be used to control the variability of the aggregates. Testing program must be acceptable to Engineer.
- D. Correlation Test Reports

### 1.5 QUALITY ASSURANCE

- A. Testing will be performed by a testing laboratory selected by the Owner at the Owner's expense, except when otherwise specified herein or on the Drawings. Preconstruction qualification testing to verify compliance of materials with specifications shall be done by the Contractor and supplier at their expense.
- B. If tests of the flowable fill indicate non-compliance with these Specifications, make changes as may be required to achieve compliance. Perform and pay for subsequent testing to show compliance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE / DESIGN CRITERIA

- A. Prepare flowable fill mixes within the following limits and as necessary to produce the indicated compressive strengths:
1. Density: Between 120 pcf minimum and 145 pcf maximum.
  2. Slump: As required by for placement methods, which do not promote segregation; maximum of 10 inches.
  3. Compressive Strength: 28-day compressive strength to be between 100 psi minimum and 300 psi maximum per ASTM D4832.
  4. Entrained Air: Between 20 percent minimum and 30 percent maximum.
  5. Water reducing agent: Provide at Contractor's option as necessary.

## 2.2 MATERIALS

- A. Cement: Provide per ASTM C150, Type I or Type II.
- B. Pozzolan: Provide fly ash conforming to ASTM C618, Type C or Type F. Pozzolan content, by weight, is limited to the weight of cement in the mixture.
- C. Aggregate:
  - 1. Provide aggregates free from organic matter and containing no more alkali, sulfates, or salts than the native materials at the Site.
  - 2. Provide aggregate consisting of a well-graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8 inch and conforming to the following sieve limits:

Sieve Size	Percent Passing
1/2-inch	100
3/8-inch	>70
No. 200	<12 <sup>1</sup>

<sup>1</sup> If more than 5 percent of the aggregate passes the No. 200 sieve, the plasticity index must be less than 0.73 (liquid limit – 20), when tested in accordance with ASTM D4318.

- D. Admixtures
  - 1. Air entraining admixture: ASTM C260.
  - 2. Water reducing admixture: ASTM C494
- E. Water: Provide potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Batch, mix, and deliver flowable fill per ASTM C94. Produce at a batch plant acceptable to the Engineer and delivered in transit mix trucks.

### 3.2 PLACEMENT

- A. Place flowable fill by tailgate discharge, conveyor belts, pumps, or other appropriate means. Direct flowable fill in place by vibrator, shovel, or rod to fill crevices and pockets. Avoid over-consolidation that causes segregation of aggregates.
- B. Temperature Limits:
  - 1. Flowable fill temperature at placement: 50 degrees F to 90 degrees F.
  - 2. Air temperature at placement: Above 40 degrees F and rising.

3. Do not place flowable fill against frozen subgrade or other materials having a temperature less than 32 degrees F.
- C. Place flowable fill continuously against fresh material unless otherwise approved by the Engineer. When new material is approved to be placed against existing flowable fill, conform to the following:
  1. Clear the area of all loose and foreign material.
  2. Soak the surface of the existing material a minimum of 1 hour before placement of fresh material but do not create standing water.
- D. Flowable fill Placement for Piping:
  1. Place pipe on soil pads.
  2. Place bedding under the pipe from one side and vibrate as necessary, so that the flowable fill flows to the opposite side.
  3. Add flowable fill to both sides of the pipe and vibrate until it fills the space between the pipe and the excavated trench bottom.
  4. Deposit flowable fill in such a manner as to avoid uplift. Deposit in final position to avoid disturbing the pipe trench or causing foreign material to mix with the cement slurry.
  5. Do not place pipe zone backfill until the flowable fill has reached initial set.
  6. Pipes placed on steep slopes may require a stiffer mix to prevent flowable fill from flowing down the trench.
  7. Vibrate as necessary to ensure that the flowable fill fills all voids.

### 3.3 FINISHING

- A. Finish flowable fill smooth and to the grade indicated on the Drawings or as directed by the Engineer. Finish free from fins, bulges, ridges, offsets, and honeycombing.
  1. Finishing by wood float, steel trowel, or similar methods is not required.

### 3.4 CURING

- A. Maintain flowable fill damp for a minimum of 7 days or until final backfill is placed.

### 3.5 PROTECTION

- A. Protect flowable fill from temperatures below 40 degrees F for a minimum of 72 hours after placement.
- B. Protect flowable fill from running water, rain, or other damage until the material has been accepted and final fill completed.

### 3.6 FIELD QUALITY CONTROL

- A. Correlation Testing:
  1. Perform a field correlation test for each mix of flowable fill used in pipe zones, trench zones, or backfill used in amounts greater than 100 cu yd, or when flowable fill is required to support traffic or other live loads on the fill less than 7 days after placing the flowable fill.

2. Perform field correlation tests in a test pit similar in cross section to the Work and at least 10 feet long at a location near the Work, acceptable to the Engineer. Test under the following standards:
  - a. Compression Testing: ASTM D4832.
  - b. Setting Test: ASTM C403.
  - c. Density Test: ASTM C138
3. Perform all laboratory and field tests on samples taken from the same flowable fill batch mix at Contractor's expense and in accordance with the following schedule:
  - a. Perform tests once each 2 hours during the first 8 hours.
  - b. Perform tests once each 8 hours during the first week (after the first 8 hours).
  - c. Perform tests once each 24 hours (after the first week) until the flowable fill reaches its design strength.

END OF SECTION

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**SECTION 31 32 19**  
**GEOTEXTILES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Furnish and install geotextiles, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCES

- A. ASTM International (ASTM) standards, most recent editions:

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4884	Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles
ASTM D6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.3 DEFINITIONS.

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.
- C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.
- D. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

- G. Woven geotextile: A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.
- H. Nonwoven geotextile: A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data.
  - 1. Manufacturer’s material specifications and product literature.
  - 2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
  - 3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.
- C. Samples.
  - 1. Geotextile: One-piece, minimum 18-inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.
  - 2. Field Sewn Seam: 5-foot length of seam, 12-inches wide with seam along center, for each type and weight of geotextile.
  - 3. Securing Pin and Washer: 1 each.
- D. Certificates.
  - 1. Certification from geotextile manufacturer that products satisfy the indicated requirements.
  - 2. Field seam efficiency test results.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.
- C. Handle products in manner that maintains undamaged condition.
- D. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Nonwoven geotextile
    - a. Propex Geosolutions; Geotex 801.
    - b. SKAPS Industries, GT-180.
    - c. TenCate Geosynthetics; Mirafi 180N.
    - d. US Fabrics; US 205NW
    - e. Engineer approved equal.

### 2.2 NONWOVEN GEOTEXTILE

- A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.
- B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.
- C. Geotextile Edges: Selvaged or finished to prevent outer material from separating from sheet.
- D. Unseamed Sheet Width: Minimum 6 feet.
- E. Nominal Weight Per Square Yard: 8 ounces.
- F. Physical Properties: Conform to physical property requirements below:

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Apparent Opening Size (AOS)	Max No. 80 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	1.4 sec. <sup>-1</sup> , MinARV	ASTM D4491
Vertical Water Flow Rate	95 gpm/sq ft, Min ARV	ASTM D4491
Grab Tensile Strength	205 Min ARV	ASTM D4595
Grab Tensile Elongation	≥50 percent, MaxARV	ASTM D4595
Trapezoidal Tear Strength	80 lb, Min ARV	ASTM D4533
CBR Puncture Strength	500 lb, Min ARV	ASTM D6241
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

## 2.3 SEWING THREAD

- A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

## 2.4 SECURING PINS

- A. Securing pins shall be steel rods or bars conforming to the following:
  - 1. 3/16-inch diameter.
  - 2. Pointed at one end; head on other end, sufficiently large to retain washer.
  - 3. Minimum Length: 12-inches.
- B. Steel Washers for Securing Pins:
  - 1. Outside Diameter: Not less than 1-1/2 inches.
  - 2. Inside Diameter: 1/4-inch.
  - 3. Thickness: 1/8-inch.
- C. Steel Wire Staples:
  - 1. U-shaped.
  - 2. 10-gauge.
  - 3. Minimum 6-inches long.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Laying Geotextile
  - 1. Notify the Engineer whenever geotextiles are to be placed. Do not place geotextile prior to obtaining Engineer's approval of underlying materials.
  - 2. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.
- B. Orientation on Slopes
  - 1. Orient geotextile with long dimension of each sheet parallel to direction of slope.
  - 2. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18-inches beyond toe of slope.
- C. Joints.
  - 1. Unseamed Joints.
    - a. Overlap unseamed joints to the following dimensions unless otherwise indicated:
    - b. Foundation/Subgrade Stabilization: Minimum 18-inches.
    - c. Riprap: Minimum 18-inches.
    - d. Drain Trenches: Minimum 18-inches, except overlap shall equal trench width if trench width is less than 18-inches.
    - e. Other Applications: Minimum 12-inches.
  - 2. Sewn Seams.

- a. Use sewn seams wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.
- b. Seam efficiency shall be minimum 70 percent.
- c. Type: "J" type seams are preferred, but flat or butterfly seams are acceptable.
- d. Stitch Count: Minimum 3 to maximum 7 stitches per inch.
- e. Stitch Type: Double-thread chain stitch, Type 401, Federal Standard No. 751a.
- f. Stitch Location: 2-inches from geotextile sheet edges, or more if necessary to develop required seam strength.
- g. Sewing Machines: Capable of penetrating 4 layers of geotextile.

D. Securing Geotextile.

- 1. Secure geotextile during installation as necessary with sand bags or other means approved by Engineer.
- 2. Securing Pins
  - a. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6-inches from free edges.
  - b. Spacing:

Slope	Maximum Pin Spacing (Feet)
Steeper than 3:1	2
3:1 to 4:1	3
Flatter than 4:1	5

- c. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.
  - d. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.
- 3. For underdrain applications (geotextile cushion over PVC or rubber waterproof membrane liner) do not use pins, staples or other securing methods that would damage waterproof membrane liner.

E. Placing Products over Geotextile.

- 1. Notify Engineer before placing material over geotextile. Do not cover installed geotextile prior to receiving authorization from the Engineer to proceed.
- 2. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

F. Installing Geotextile in Trenches.

- 1. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.
- 2. After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

- G. Riprap Applications.
  - 1. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet. Sew joints where wave run-up may occur.
- H. Geotextile-Reinforced Earth Wall Applications.
  - 1. Sew exposed joints; extend sewn seams minimum 3-feet behind face of wall.
  - 2. Protect exposed geotextile from damage and deterioration until permanent facing is applied.
- I. Silt Fence Applications.
  - 1. Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.
  - 2. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.
  - 3. Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.
  - 4. Promptly repair or replace silt fence that becomes damaged.

### 3.2 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18-inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by Engineer.

### 3.3 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Test seam efficiency by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided for the Work. Test according to ASTM D4884 and submit written results to Engineer.

END OF SECTION

**SECTION 31 37 00  
RIPRAP**

**PART 1 - GENERAL**

**1.1 GENERAL**

- A. This section covers furnishing and placing compacted rock (riprap) materials in accordance with these specifications and in conformity with the lines, grades, and dimension shown on the drawings or as directed by the Engineer.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Commercial Standards:

ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	Specific Gravity and Absorption of Coarse Aggregate.
ASTM C 535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM D 5519	Standard Test Method for Particle Size Analysis of Natural and Man-Made Riprap Materials.
AASHTO T 85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 210	Method of Test for Aggregate Durability Index.

**1.3 CONTRACTOR SUBMITTAL**

- A. At least 30 days before rock is delivered from any source, the contractor shall designate in writing the source from which rock material will be obtained and provide information satisfactory to the Engineer that the material meets contract requirements. Contractor shall provide Engineer free access to the source for the purpose of obtaining samples for testing.
- B. Rock riprap source locations, processing, haul routes, storage and placement plan.
- C. Certification from a certified independent laboratory that the riprap meets the material properties of this specification, if riprap is provided from a source other than noted on the drawings.
- D. Furnish submittals in accordance with Section 01 33 20 – Contractor Submittals.

#### 1.4 STORAGE OF MATERIALS

- A. Materials shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials.

### PART 2 - PRODUCTS

#### 2.1 GEOTEXTILE FABRIC

1. Materials shall meet the following requirements.
  - a. Geotextile fabric shall meet all requirement specified in Section 31 32 19.

#### 2.2 RIPRAP

1. Rock materials shall meet the following requirements:
  - a. Individual rock fragments shall be fresh, dense, sound, sub-angular to angular and resistant to abrasion, and durable against disintegration under conditions to be met in handling and placing.
  - b. Individual rock fragments shall be free from cracks, seams, and other defects that would tend to increase their susceptibility to destruction by water, frost actions, and accelerated weathering.
  - c. Riprap sources shall be approved by the Engineer prior to use. Concrete masonry or concrete debris may not be used for riprap. Rock shall meet the following gradation limits after it has been placed within the matrix of the compacted rock riprap (dimensions apply to minimum section), in accordance with ASTM D 5519:

COMPACTED ROCK RIPRAP GRADATIONS			
Riprap Designation	%Smaller Than Given Size By Weight	(Inches)	D <sub>50</sub> ** (Inches)
Class I	70-100	12	6
	50-70	9	
	35-50	6	
	2-10	3	
Class II	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	
Class III	70-100	20	12
	50-70	16	
	35-50	12	
	2-10	4	
Class IV	70-100	25	15
	50-70	20	
	35-50	15	
	2-10	5	

Class V	70-100	30	18
	50-70	24	
	35-50	18	
	2-10	6	
Class VI	70-100	35	21
	50-70	28	
	35-50	21	
	2-10	7	
Class VII	70-100	40	24
	50-70	32	
	35-50	24	
	2-10	8	
Class VIII	85-100	42	30
	50-80	30	
	30-50	24	
	15-30	18	
	2-15	6	

s\*\* D<sub>50</sub> = Nominal particle size

- d. Maximum rock size shall not exceed 2.0 time the D<sub>50</sub>. Minimum rock size shall be no less than 6-inches.
- e. Sand and rock dust shall be less than 3 percent, by weight, of total riprap materials.
- f. Neither the breadth nor thickness of any piece of rock shall be less than one-third its length.
- g. Rock shall be sub-angular to angular. Rounded boulders and cobbles shall not be used. The greatest dimension of each rock shall not be greater than three times its least dimension.
- h. Specific Gravity: not less than 2.5 when tested in accordance with ASTM C127 (Bulk SSD).
- i. Abrasion Resistance:
  - 1) 10 percent maximum loss of weight at 100 revolutions when tested in accordance with ASTM C131.
  - 2) 40 percent maximum loss of weight at 500 revolutions when tested in accordance with ASTM C131.
  - 3) 40 percent maximum loss of weight at 1000 revolutions when tested in accordance with ASTM C535.
- j. Soundness: 15 percent maximum weighted average loss by weight after five cycles when tested in accordance with ASTM C88.
- k. Absorption: Not more than 2 percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.
- l. Weight: Minimum weight of stone shall be 156 lb/ft<sup>3</sup> as tested by AASHTO Test T 85.
- m. Contractor shall submit documented laboratory test results to verify that proposed riprap materials meet all specifications.
- n. Contractor must receive, in writing, approval of proposed off-site riprap source from Engineer, prior to placing any materials.
- o. Contractor shall be responsible to process material that will meet these specifications.

## **PART 3 - EXECUTION**

### **3.1 COMPACTED ROCK (RIPRAP)**

- A. Contractor shall haul a test pile of riprap to the site for inspection and comparison to the gradation required for the project. Test pile results that do not meet the specifications shall be cause for the rock to be rejected. The test pile that meets specification requirements shall be left on the job site as a sample for visual comparison. The test pile rock shall be utilized as part of the last rock riprap to be placed.
- B. Prior to placement of filter material, remove brush, trees, round rocks, and other objectionable materials in area where riprap is to be placed. All objectionable material shall be disposed of at a location to be determined by the OWNER. All soft or spongy material shall be removed to the depth as directed by the engineer and replaced with native material. Care shall be taken to preserve and protect utilities which are to remain in service in the location where riprap is to be placed.
- C. The subgrade surface on which the geotextile filter fabric will be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved material and shall conform to the requirements of the specified class of earthfill. Geotextile filter fabric shall not be placed until the foundation preparation is complete and the subgrade surface has been approved by the Engineer.
- D. Riprap shall generally be placed starting at the lowest elevations and working upward, taking care not to damage the geotextile filter fabric. Rock shall not be dropped more than 2 feet onto the installed geotextile filter fabric. Riprap shall be placed to the minimum thickness designated on the drawings and shall be positioned in such a manner that will provide uniform distribution of the various sizes of stone and produce a well-keyed, compacted mass of rock with the least practical amount of void space. Riprap shall be placed and compacted with the bucket of a backhoe to the lines and grades shown on the drawings. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation, will not be permitted. The surface shall be worked as necessary, to produce a reasonably uniform appearance and the required thickness. Some hand placing may be required to provide a neat and uniform surface.
- E. Rock riprap shall be placed in a manner that will prevent damage to structures.
- F. Unless otherwise authorized by the engineer, the riprap protection shall be placed in conjunction with the construction of the embankment with only sufficient lag in construction of the riprap protection as may be necessary to prevent mixture of embankment and riprap. The contractor shall maintain the riprap protection until accepted, and any material displaced by any cause shall be replaced to the lines and grades shown on the drawings at no additional cost to the OWNER.
- G. Hand placed riprap. Rock riprap shall be placed in a manner to prevent damage to structures, pipe or other improvements. Hand placing may be required to prevent damage to facilities.
- H. Contractor shall leave riprap storage/borrow sites in a neat and clean condition, free from rock chips, spalls, and debris from riprap sizing process.



- I. Contractor shall implement good housekeeping measures and best management practices to prevent mud and other material from being tracked or deposited on City and County streets.

END OF SECTION

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**SECTION 31 50 00**  
**EXCAVATION SUPPORT AND PROTECTION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide excavations with ground supports conforming with 29CFR1926, Subpart P-Excavations, OSHA requirements, and the General Conditions.
- B. The Contractor shall prepare and follow in his work the following plans for worker and property protection:
  - 1. Plan for trench and structure excavations
  - 2. Plan for supporting trenches and structure excavations
  - 3. Plan for movement monitoring.
- C. These plans shall be prepared, signed and properly sealed by a Professional Engineer registered in the State of Utah with suitable license and experience to prepare said plans. Submit such plans to Engineer. No excavation or blasting shall take place until these plans have been prepared, signed, sealed and reviewed by all pertinent members of Contractor's staff.
- D. These plans shall address temporary excavations for tank structure, vault structures, pipeline trenches, temporary stockpile slopes, and other temporary excavations and stockpiles.
- E. Excavation and support plans shall address the following topics:
  - 1. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.
  - 2. Design assumptions and calculations.
  - 3. Methods and sequencing of installing excavation support.
  - 4. Proposed locations of stockpiled excavated material.
  - 5. Minimum lateral distance from the crest of slopes for construction vehicles, stockpiled excavated materials, and other construction loadings
  - 6. Anticipated difficulties and proposed resolutions.
- F. Movement monitoring plan shall address the following topics:
  - 1. Survey control

2. Location of monitoring points
3. Plots of data trends
4. Interval between surveys

## 1.2 SUBMITTALS

- A. Submit excavation plans for worker protection in pipe trenches and other excavations. Submittal of excavation plans shall be for records only. Submittals will not be reviewed as they are the sole responsibility of the Contractor and the registered engineer who signs and seals said plans.

## 1.3 QUALITY ASSURANCE

- A. Provide surveys and competent persons to monitor movements of critical facilities and areas of anticipated difficulties.

## **PART 2 - MATERIALS (NOT USED)**

## **PART 3 - EXECUTION**

### 3.1 EXCAVATION SUPPORT

- A. Provide, and maintain shoring, sheeting, and sloping as necessary to support the sides of excavations, to protect workers and other people on the site, and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.
- B. Take necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from high groundwater table, surcharge, or other problems associated with the soil excavated.
- C. Install shoring, sheeting, and sloping for trench and structure excavation progressively with the removal of excavated material. Erect sheeting or lagging to exclude groundwater and prevent fines from migrating into the excavation. In soft, wet ground, drive sheeting to a lower elevation level as excavation progresses so that sheeting is embedded in undisturbed earth. Bracing or sheet piling may be permitted to penetrate structural concrete only as approved in advance by the Engineer.
- D. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting, and bracing shall be carefully removed so no voids shall be created and no caving, lateral movement, or flowing of the subsoils shall occur.
- E. Withdraw the shoring and sheeting members as the backfill is raised, maintaining sufficient support to protect the work and workers. Remove bracing completely. Where unstable conditions may occur in the underlying strata, and withdrawal of the excavation support system may endanger the work, portions of the sheeting and bracing, including pressure

treated lagging, may be left in place with approval of the Engineer. Remove all wood within a zone extending 5 feet below finished grade.

- F. Any damage resulting from improper installation or inadequate maintenance shall be the responsibility of the Contractor.
- G. Nothing contained in this specification shall be construed as relieving the Contractor of the full responsibility for providing shoring, bracing, sloping, or other provisions which are adequate for the protection of people and property.

### 3.2 MOVEMENT MONITORING

- A. This sub-section does not limit the Contractor's choice of construction methods based on the site conditions. It establishes minimum requirements for the Contractor to monitor the effects of construction on existing site features and to demonstrate a reasonable preparedness to meet potential contingencies and protect existing site features.
- B. Where trenching or excavating are required within 50 feet of existing structures and aqueducts, the Contractor shall implement and maintain monitoring and contingency plans during the open excavation until completion of excavation operations.
- C. Prepare a movement monitoring and contingency program for any permanent structure and any buried utilities larger than 12 inches in diameter, all natural gas pipelines, and any additional structures indicated which are within a horizontal distance of 50 feet from any excavation.
- D. Perform a photographic survey of all structures that may be affected in the presence of the Engineer. Provide written monitoring and contingency program and site photos to Engineer prior to commencing excavation.
- E. Where excavations are required within 50 feet of existing structures, aqueducts, and other pipelines, the Contractor shall implement and maintain monitoring and contingency plans until completion of excavation operations.
- F. Establish a horizontal and vertical movement monitoring program and perform all survey and inspections necessary for monitoring existing site features. All surveys shall be performed under the direction of a licensed land surveyor. Set control for movement monitoring in a location that will not be subject to ground movement or construction disturbance.
- G. Set at least two survey monuments on each existing structure, a minimum of one survey monument within 10 feet of the excavation in the immediate vicinity of existing buried utilities, and a minimum of one survey target on existing structures, utilities or gas lines. The survey monuments and targets shall be spaced at least 50 feet apart on structures and 100 feet apart for all other conditions, when excavations parallel structures, utilities, or gas pipes.
- H. The survey monuments shall consist of permanently installed metal plates scribed with an identification number, elevation and coordinate location. The method of installing survey monuments shall be as approved by the Engineer. The survey monuments shall consist of

permanently scribed elevation and coordinate location securely fastened to the structure. The Engineer shall be notified a minimum of one day prior to setting a survey monument and be given free access to confirm any survey information immediately after the Contractor has set the elevation and location.

- I. Perform surveys of each monument at least once during every five vertical feet of excavation or prior to and after each blasting event. Surveys shall be performed more often during excavation if deemed necessary by the Engineer for any reason. Upon completion of the excavation, surveys shall be performed at least once a week, or more often if deemed necessary by the Engineer, until the Engineer determines that there is no risk of significant additional ground movement. If pumping or dewatering of excavations is interrupted or cannot be adequately maintained, the survey monuments shall be checked a minimum of once every 6 hours for as long as the conditions exist or as necessary for the protection of the site and worker's safety.
- J. Immediately notify the Engineer of any cumulative change in elevation or location of any monument in excess of 1/4 inch.
- K. Maintain the survey data taken on a daily basis for each monument or target in a log. A copy of the log shall be sent to the Engineer on a daily basis.
- L. Perform, at a minimum, daily visual inspections of the perimeter of the excavation to identify any signs of excessive settlement or movement. The results from visual inspections shall be recorded with the daily survey log. Any area which appears to be excessively deformed or damaged shall immediately be brought to the attention of the Engineer and be corrected.

END OF SECTION

**DIVISION 32**  
**EXTERIOR IMPROVEMENTS**

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**SECTION 32 12 16**  
**A.C. PAVEMENT AND BASE**

**PART 1 - GENERAL**

1.1 THE REQUIREMENT

- A. The Contractor shall perform all work associated with asphalt concrete (A.C.) Pavement and Base, as shown and specified herein including all labor, materials, equipment supplies and facilities associated with providing of finished product satisfying all the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AASHTO M 82	Cut-Back Asphalt (Medium Curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO M 226	Viscosity Graded Asphalt Cement
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1557	Moisture-Density Relations of Soils and Soil - Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (45-mm) Drop <sup>7</sup>
ASTM D 2027	Cutback Asphalt (Medium Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2726	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens.
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

### 1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 20 – Submittal Procedures. Include materials testing reports, job-mix formulas, and other pertinent information satisfactory to the Engineer.
- B. Prior to Delivery to Site:
  - 1. Mix Design: Submit current mix design dated within one year of submittal listing:
    - a. Date of mix design
    - b. Asphalt cement source, type and chemical composition.
    - c. Aggregate gradation target.
    - d. Asphalt cement target percentage, dust to asphalt ratio, moisture sensitivity (tensile strength ratio), stability, flow and voids in the bituminous mix.
  - 2. Before changing mix design, submit new design to Engineer 10-days prior to placing pavement for review and evaluation of changes.
  - 3. Type and number of compaction and finish rollers.
- C. At Delivery: Supply a batch ticket identifying:
  - 1. Serial Number of ticket.
  - 2. Date and truck number.
  - 3. Job name, location and mix identification.
  - 4. Type, grade and weight of asphalt.
  - 5. Type, grade and weight of aggregate.
  - 6. Mix design method.
- D. Trial Batch: Before placing any paving material, a testing laboratory acceptable to the Engineer shall prepare a trial batch of asphalt concrete for each job-mix formula to be used by the Contractor for the work. The trial batch shall be prepared using the aggregates and asphalt cement proposed by the Contractor, and approved by the Engineer. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than two laboratory trial batch tests will be paid by the Owner but the Contractor shall furnish the materials at no cost to the Owner. Any additional trial batch testing required shall be performed at the expense of the Contractor.

### 1.4 QUALITY ASSURANCE

- A. Use a laboratory that follows and complies with ASTM D 3666.
- B. Do not change aggregate source, asphalt source or mix design without Engineer's prior written approval.
- C. Reject product and work that does not meet the requirements of this Section.
- D. Remove product that is found to be defective after installation and install acceptable product at no additional cost to the Owner.
- E. Foreman of paving crew shall have completed at least five projects of similar size and nature.

## 1.5 WEATHER

- A. Do not pave until air temperature is 50 degrees F and rising.
- B. Cease paving if air temperature falls below 50 degrees F.
- C. Do not pave if surface is wet or if rain, snow or other precipitation is expected.
- D. Do not pave if wind or ground cools the mix material before compaction.

## 1.6 ACCEPTANCE

- A. General: Acceptance is by lot.

- B. Materials:

- 1. Lot is one day's production.
- 2. At the source:
  - a. Aggregate: Verify gradation. Collect sample from the conveyor belt or stockpile if belt is not accessible.
  - b. Paving Asphalt: Asphalt shall meet the requirements of this section and shall satisfy the limits identified in the Utah Department of Transportation's "Manual of Instructions – Part 8 Materials"
  - c. Mix Temperature shall not exceed 325 degrees F in the transport vehicle.
- 3. At the Site:
  - a. A sub-lot is 500 tons.
  - b. Obtain one random sample per sub-lot behind the paver before compaction or at locations exhibiting non-uniform appearance.
- 4. At the Laboratory:
  - a. Air voids shall be evaluated on the basis of laboratory compacted samples.
  - b. Dust to asphalt ratio.
  - c. Asphalt content and aggregate gradation.
- 5. If material does not meet any requirement of the specification, the Engineer may direct that the sub-lot be removed and replaced with a material meeting the specification requirements at no additional cost to the Owner.

- C. Installation:

- 1. Observation of Contractor's field quality control testing does not constitute acceptance.
- 2. Opening a paved surface to traffic does not constitute acceptance:
- 3. Reject any mixes exceeding 325 degree F in transport vehicle.
  - a. Dispose of cold mix in paver hopper as thin spread underlay.
- 4. Grade, Cross Slope: Verify that tolerance is not exceeded.
- 5. Compaction:
  - a. For compaction a lot is 1,000 square yards or any part thereof.
  - b. Core Density: A lot is acceptable if the average core density does relative to ASTM D 2041 is 93 percent, with no individual test less than 89 percent.
  - c. At least two test locations shall be sampled per ASTM D 3665 and three core samples shall be collected per each test location per ASTM D 5361. Core samples shall be full depth.
  - d. Cores shall be tested per ASTM D 2725 for core density and ASTM D 2041 (Rice) for maximum theoretical density.

- e. Other non-destructive testing methods may be used during placement to aid in establishing a rolling pattern and determining the required compaction effort. However, density acceptance will be by core densities.
- 6. Thickness:
  - a. For thickness a lot is 1,000 square yards or any part thereof.
  - b. Core Thickness: A lot is acceptable if the average core thickness is not less than 0.25 inches less than the specified thickness.
  - c. At least two test locations shall be sampled per ASTM D 3665 and three core samples shall be collected per each test location per ASTM D 5361. Core samples shall be full depth.
  - d. Cores shall be tested per ASTM D 3549 for thickness.
- 7. Lots that are not acceptable may be rejected and the Engineer may direct that the lot be removed and replaced at no additional cost to the Owner.

## **PART 2 - PART 2 - PRODUCTS**

### **2.1 UNTREATED BASE COURSE**

- A. The untreated base course shall consist of select material, either natural or crushed and shall be graded as follows:

<u>Sieve Size</u>	<u>Gradation Ideal Gradation</u>
1-1/2 inch	100
3/4 inch	81 - 91
1/2-inch	67 - 77
No. 4 sieve	43 - 53
No. 16 sieve	23 - 29
No. 200 sieve	6 - 10

### **2.2 TACK COAT**

- A. Tack coat shall be emulsified asphalt Grade SS-1 or SS-1h, CSS-1 or CSS-1h diluted with one part water to one part emulsified asphalt, undiluted asphalt Grade RS-1 or CRS-1, or paving asphalt Grade AR-1000. Emulsified asphalt shall comply with the requirements of AASHTO M 140 (ASTM D 977) or M 208 (ASTM D 2397); paving asphalt shall comply with the requirements of AASHTO M 226 (ASTM D 3381).

### **2.3 ASPHALT CEMENT (AC)**

- A. Performance Graded Asphalt Binder (PGAB)
  - 1. PGAB asphalt meeting the requirements of ASTM D 6373 as follows:
    - a. PGAB 58-28

### **2.4 AGGREGATE**

- A. Aggregate shall be clean, hard, durable, angular and sound consisting of crushed stone, crushed slag, crushed gravel, sand, or a combination of two or more of these materials.
- B. Source Suitability: Use the following requirements to determine the suitability of the aggregate source and not for project control.

1. Coarse Aggregates:
  - a. Angularity (fractured faces), ASTM D 5281: 50 percent maximum by weight of particles with at least 2 fractured faces.
  - b. Hardness (toughness), ASTM C 131: 40 percent minimum wear of aggregate retained above the No. 4 sieve unless specific aggregates having higher values are known to be satisfactory.
  - c. Flat or elongated particles, ASTM D 4791: 20 percent maximum retained above the 3/8 inch sieve has a 3:1 length to width ratio.
2. Fine Aggregates:
  - a. Friable Particles, ASTM C 142: 2 percent maximum passing the No. 4 sieve.
  - b. Plasticity, ASTM D 4318: Aggregate passing the no. 40 sieve shall be non-plastic even when filler material is added to the aggregate.
    - 1) Liquid Limit: Less than 25
    - 2) Plastic Limit: Less than 6
- C. Combinations of aggregates having a history of polishing shall not be used in surface courses.

## 2.5 ADMIXTURES

- A. Mineral filler shall comply with ASTM D 242.
- B. Antistrip shall be heat stable cement slurry of lime slurry.

## 2.6 MIX DESIGN

- A. Material Designation:
  1. Asphalt Cement shall be PGAB 58-28.
  2. Aggregate gradation shall be DM-1/2.
  3. Traffic Classification shall be medium.
- B. Design Aggregate Gradation: The job-mix formula for the asphalt-aggregate surface course mixture shall be within the following gradation limits as percent passing by weight, ASTM C 136:

Aggregate Gradations				
Sieve Size	DM-1	DM-3/4N	DM-3/4	DM-1/2
1 inch	100			
3/4 inch		100	100	
1/2 inch	75-91	74-99		100
3/8 inch		69-91	75-91	
No. 4	47-61	49-65	46-62	60-80
No. 8		33-47		
No. 16	23-33	21-35	22-34	28-42
No. 50	12-22	6-18	11-23	11-23
No. 200	3-7	2-6	3-7	3-7

1. Dry-rodded Unit weight per ASTM C 29 shall be a minimum of 75 pounds per cubic foot.
2. Weight Loss or soundness per ASTM C 88 shall be a maximum of 16 percent using sodium sulfate.

3. Clay Content or cleanliness per ASTM D 2419 shall be determined by the sand equivalent value after passing through the dryer or prior to the drum mixer at the following levels:
  - a. 45 percent minimum for Medium Traffic Classification
  - b. 60 percent minimum for Heavy Traffic Classification.

- C. Design Mixture Test Criteria: Use the Marshall volumetric mix design, AI MS-2: price and payment procedures

Mix Design Criteria			
Criteria	Traffic Classification		
	Light	Medium	Heavy
Number of Compaction Blows	35	50	75
Stability, lbs. (minimum), ASTM D 5581	750	1200	1800
Flow, in 0.01 inch units, ASTM D 5581	10-18		
Voids in Mineral Aggregate (VMA), percent min., ASTM D 3203			
Nominal Maximum Particle Size			
1"			
3/4"			
1/2"			
3/8"			
Voids in Bituminous Mix (percent)	3-5		
Dust to Asphalt Ratio	0.8 – 1.6		
Moisture Sensitivity, ASTM D 4867	>0.8 with freeze thaw conditioning and test specimen compacted at 6-8 percent air voids		

Notes and Traffic Classifications:

Light – Parking lots, driveways, light traffic residential streets, light traffic farm roads. (ESAL <10<sup>4</sup> per year)

Medium – Residential streets, rural farm and residential roads (Class II); Urban minor collector streets, rural minor collector roads (Class III). (10<sup>4</sup><ESAL<10<sup>6</sup> per year)

Heavy – Urban Minor arterial and light industrial streets, rural major collector and minor arterial highways (Class IV); Urban major arterial and heavy industrial streets, freeways, expressways, arterial highways, rural interstate, and other principal arterial highways (Class V). (ESAL > 10<sup>6</sup> per year)

## 2.7 SOURCE QUALITY CONTROL

- A. General: Supplier shall randomly collect samples per ASTM D 3665. The same sample point shall be used for all samples of a particular material.
  1. Aggregate sampling shall be per ASTM D 75.
  2. Asphalt Cement sampling shall be per ASTM D 140.
- B. Asphalt-aggregate mix shall be sampled per ASTM D 979 and test for:
  1. Air Voids per ASTM D 3203.
  2. Paving Asphalt Content per ASTM D 6307.
  3. Aggregate Gradation per ASTM D 5444
  4. Tensile strength of bitumen-aggregate mixtures per ASTM D 4867.

- C. Mixing plant shall meet the requirements of ASTM D 3515.

## 2.8 PAVEMENT MARKING PAINT

- A. Pavement marking paint shall be a product specifically formulated for use on asphalt concrete pavement and shall have a proven record of performance and durability. The paint striping materials shall conform with the State of Utah Standard Specifications for Road and Bridge Construction and its addenda.

## PART 3 - EXECUTION

### 3.1 SUBGRADE PREPARATION

- A. The subgrade shall be prepared in accordance with Section 31 23 00 – Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02-foot from the indicated grade and cross section. Subgrade for base material shall not vary more than 0.04-foot from the specified grade and cross section.

### 3.2 UNTREATED BASE COURSE

- A. Untreated base course shall be provided where shown and to the thickness indicated. Imported untreated base course shall be delivered to the job site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6 inches or less, the base materials may be spread and compacted in one layer. Where the required thickness is more than 6 inches; the base material shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 6 inches. The relative compaction of each layer of aggregate base shall be not less than 96 percent of maximum density when measured in accordance with ASTM D 1557 with no test below 92 percent of maximum density. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 foot from the specified grade or cross-section.

### 3.3 TACK COAT

- A. A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like immediately before the adjoining asphalt pavement is placed. Care shall be taken to prevent the application of tack coat material to surfaces that will not be in contact with the new asphalt concrete pavement. Diluted emulsified asphalt shall be applied at the rate of 0.05 to 0.15 gal/sq yd. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sq yd. Paving asphalt shall be applied at the rate of approximately 0.05 gal/sq yd.

### 3.4 CONSTRUCTION EQUIPMENT

- A. Lay Down Machine shall have tracks when operating on fabrics, geogrids or pavement mats hotter than 180 degrees F.

- B. Compactors shall be static or vibratory, steel wheel rollers. Pneumatic tire rollers may be used for intermediate rolling only.

### 3.5 ASPHALT CONCRETE

- A. At the time of delivery to the work site, the temperature of mixture shall not be higher than 320 degrees F, and shall not be less than indicated below:

Minimum Asphalt Concrete Temperature, degrees F						
Air Temperature	Compacted Mat Thickness					
	3/4 inch	1 inch	1-1/2 inch	2 inch	3 inch	4 inch +
45-50	-	-	-	-	280	265
50-59	-	-	-	280	270	255
60-69	-	-	285	275	265	250
70-79	285	285	280	270	265	250
80-89	280	275	270	265	260	250
90+	275	270	265	260	250	250

- B. The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that, after rolling, it will be of the required cross section and grade of the course being constructed.
- C. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed especially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical, the Engineer may waive the self-propelled requirement.
- D. Spreading, once commenced, shall be continued without interruption.
- E. The mix shall be compacted immediately after placing. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
- F. Compaction shall be completed before temperature drop to 180 degrees F.
- G. Do not leave unsafe butt joints if paving operations stop.
- H. Barricade or eliminate fall off edges.
- I. Joints
1. Construct joints to have the same texture, density and smoothness as other section of the new pavement course.
  2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new pavement or between successive day's work.
  3. Offset longitudinally joints a minimum of 12 inches in succeeding courses and offset transverse joints a minimum of 6 feet to avoid a vertical joint through more than one course. In the top course restrict longitudinal joints to either side of the lane lines.



4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges prior to making another pass with the paver if the mix has cooled to 90 degrees F.

### 3.6 TOLERANCES

- A. Lift thickness shall not be less than 2 times the maximum aggregate size nor more than 3 inches (compacted thickness) or the limits established by the pneumatic or vibratory compactor equipment manufacturer, whichever is less.
- B. Upon completion the pavement shall be true to grade and cross-section. When a 10-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8-in except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-in.

### 3.7 BITUMINOUS SURFACE PATCHING

- A. Where pits are excavated through bituminous surfaced roads, driveways, parking areas, etc., the surface shall be restored and maintained as follows:
  1. A temporary gravel surface shall be placed and maintained after the required backfill and compaction of the trench has been accomplished.
  2. The gravel shall be placed to such depth as to provide six inches below the pavement and shall be brought flush with the paved surface.
  3. The area over trenches to be resurfaced shall be graded and rolled with a roller weighing not less than twelve tons, or with the rear wheels of a five-yard truck loaded to capacity, until the subgrade is firm and unyielding. Mud or other soft or spongy material shall be removed and the void filled with gravel and rolled and tamped thoroughly in layers not exceeding six inches in thickness. The edges of trenches which are broken down during the making of subgrade shall be removed and trimmed neatly before resurfacing.
  4. Before any permanent resurfacing is placed, the Contractor shall trim the existing paving to clean, straight lines as nearly parallel to the centerline of the trench as practicable.
  5. Existing bituminous paving shall be cut back a minimum of six inches beyond the limits of any excavation of cave-in along the trench so that the edges of the new paving will rest on at least six inches of undisturbed soil.
  6. As soon as is practical, weather permitting, the bituminous surface shall be restored by standard paving practices to the thickness specified herein.
  7. Pavement restoration shall include tacking of pavement of edges and subbase with MC 70-250 bituminous material and placing rolling plant hot mix bituminous material to the level of the adjacent pavement surfaces.

### 3.8 PROTECTION AND REPAIR

- A. General: All work is at no additional expense to the Owner.
- B. Protection:
  1. Protect all structures, including curb, gutter, sidewalks, street fixtures, delineators, signs, guard rails and guide posts.

2. Remove all spatter, over-coat or mar.
  3. Do not discharge bituminous materials into borrow pits, roadside ditches, gutters or other areas.
  4. Protect hot pavement from traffic until mixture has cooled enough not to become marked.
  5. Protect neighborhood, storm drains and downstream wetland and fish habitats.
- C. Repair
1. When thickness is deficient, place additional material over deficient areas. Do not skin patch. If necessary, mill for inlay.
  2. Repair defective seams, edges and joints.
  3. Remove and replace unacceptable paving.

### 3.9 PAVEMENT MARKING

- A. Pavement marking paint shall be applied where indicated only when the pavement surface is dry and clean, and when the air temperature is above 40 degrees F. Pavement marking shall commence no sooner than 21 days after completion of pavement installation. All equipment used in the application of pavement marking shall produce stripes and markings of uniform quality with clean and well-defined edges that conform to the details and dimensions shown. Drips, overspray, improper markings, and paint material tracked by traffic shall be immediately removed from the pavement surface by methods previously reviewed by the Engineer.

END OF SECTION

**SECTION 32 90 00  
LANDSCAPE RESTORATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall provide landscaping and appurtenant work, complete and in place, in accordance with the Contract Documents.
- B. Landscaping as referred to herein shall include supplying and placing topsoil, soil preparation, installation of headers, weed control, finish grading, furnishing and installing plant materials, seeding, erosion control, cleanup, and maintenance guarantee.

**1.2 DEFINITIONS**

- A. The terms "plant material" or "plants" refer to all vegetation, including but not limited to seed and seeded areas, etc.
- B. "Quality" refers to general development without consideration of size or condition. "Standard quality" indicates the least acceptable quality. "Standard quality" seeded and germinated plants shall be typical of the species and variety of good average uniform growth, shall be well formed.
- C. "Condition" is the factor controlled by vitality and ability to survive and thrive and be comparable with normal plants of the same species and variety in the vicinity at the same season of the year. Plants shall be free from physical damage or adverse conditions that would prevent thriving. "Condition" also sometimes refers to state of growth, i.e., whether "dormant condition" or "growing condition" and this state shall be comparable to plants of similar species in the vicinity for leaves, formation of buds, and the like.

**1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Commercial Standards:

ASTM D 422                      Method for Particle-Size Analysis of Soils

ANSI Z60.1                      Nursery Stock

American Association of Rules and Grading Provisions Nurserymen, Inc.

**1.4 CONTRACTOR SUBMITTALS**

- A. General: Submittals shall be furnished in accordance with Section 01 33 20 - Contractor Submittals.
- B. Product Information
  - 1. Manufacturer's product information on slow release fertilizer, fertilizer tablets, seed, and erosion control materials.

2. **Topsoil Analysis Report:** A report certified by an analytical laboratory which shows results of analyzing representative samples of topsoil proposed for use. Approval of the report does not constitute final acceptance of the topsoil.
  3. Supplier's information and testing information on compost for soil amendment.
- C. Certificate
1. Certificates shall accompany each product delivery stating source, quantity, and type of material. All certificates shall be submitted to the Landscape Architect at the time of delivery.
  2. Certificates of inspection of plant material, as may be required by Federal, State, or other authorities having jurisdiction, which accompany the shipment, shall be submitted to the Landscape Architect at the time of delivery.
  3. Landscaping Subcontractor guarantee to perform seed maintenance and weeding services during the one-year correction of defects period.

#### 1.5 QUALITY ASSURANCE

- A. General: All plants shall be true to type or name as indicated in the Contract Documents and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of Utah however, determination of plant species or variety will be made by the Landscape Architect.
- B. All plants shall comply with Federal and Utah State laws requiring inspection for plant diseases and infestations.
- C. The Contractor shall obtain clearance from the County Agricultural Commissioner, as required by law, before planting plants delivered from outside the County in which they are to be planted. Evidence that such clearance has been obtained shall be filed with the Engineer or Landscape Architect.
- D. Inspections will be made by the Engineer or Landscape Architect. The Contractor shall request inspection at least 24 hours in advance of the time inspection is required. Inspection is required on the following stages of the Work:
1. During preliminary grading, soil preparation, and initial weeding.
  2. When approved, amended topsoil is placed.
  3. When finish grading has been completed.
  4. When seed is to be applied.
  5. Once seed application has been complete and erosion control is in place.
  6. When all Work except the maintenance period has been completed.
  7. Final inspection before acceptance of the project.

#### 1.6 CLEANUP

- A. Upon completion of all planting operations, the portion of the Site used for a work or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the Site in accordance with Section 01 70 10 – Project Closeout.
- B. All walks or pavement shall be swept or washed clean upon completion of the Work of this Section.

C. During the entire Contract period, plant containers that have been cut or removed from plant materials shall be removed from the site daily.

D. All fertilizer packaging shall be cleared from the site at the end of every day.

#### 1.7 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The Contractor shall be responsible for protecting and maintaining all seeded areas until final acceptance of all Work under the Contract.

B. Protection: The Contractor shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the correction of defects period.

C. The Contractor shall replace any materials or equipment that its employees or Subcontractors have damaged.

D. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

E. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, fertilizing, spraying, and other operations necessary.

F. Maintenance shall include, in addition to the foregoing, cleaning, the repair of erosion, reseed bare areas, and all other necessary maintenance work. Sidewalks, retaining walls and paved areas shall be kept clean while seeding and maintenance are in progress.

#### 1.8 FINAL INSPECTION AND GUARANTEE

A. Inspection of all planted areas will be part of final inspection under the Contract.

B. Written notice requesting inspection shall be submitted to the Landscape Architect at least 10 days prior to the anticipated inspection date.

C. Final acceptance prior to start of the guarantee period of the Contract will be on written approval by the Engineer or Landscape Architect, on the satisfactory completion of all Work, including maintenance, but exclusive of the replacement of plant material or reseed areas that have less than 60% coverage.

D. Any delay in the completion of any item of work in the planting operation which extends the seeding into more than one season shall extend the correction period in accordance with the date of completion given above.

E. The Contractor shall reseed, as soon as weather conditions permit, all bare areas or areas that show less than 60% seed germination which are noted at the end of the one-year correction period.

F. All Work under this Section shall be left in good order to the satisfaction of the Owner and the Landscape Architect, and the Contractor shall, without additional expense to the Owner.

## 1.9 MAINTENANCE AND GUARANTEE FOLLOWING ACCEPTANCE OF PROJECT

- A. General: The Contractor shall be responsible for a period of one year after date of acceptance of the Work of this Section, for maintaining all seeded areas, including fertilizing, controlling insects and diseases and weeding. The Contractor shall obtain a written guarantee from the landscaping Subcontractor embodying the provisions of this paragraph.
- B. The Work covered by the maintenance and guarantee portions of this paragraph includes providing all reseeding of seeding areas for the one year maintenance period or for 2 full growing seasons if the maintenance periods starts in the fall or winter, labor, materials, chemicals, equipment, and supplies and in performing all operations in connection with maintenance and guarantees.
- C. The Contractor shall clean-up and remove unused or waste materials from the Site and leave the area in a neat condition satisfactory to the Owner whenever it performs work during the maintenance period.
- D. Final Inspection: The Owner and Contractor shall make a final inspection at the end of the one-year maintenance and correction period. Any bare seed areas or less than 60% coverage at time of final inspection shall be reseeded within a time agreed upon by both parties. If it is outside of the seeding window for seeding, seeding shall take place within the next seeding window even though reseeding may run beyond the maintenance and correction period.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All landscaping materials including but not limited to, soil amendments, fertilizer, herbicides, pesticides, seed mixtures and erosion control materials shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or furnished with each delivery. Delivery certificates shall be given to the Landscape Architect as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the Landscape Architect prior to final acceptance.

### 2.2 TOPSOIL

- A. Imported topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval by the Landscape Architect at the source of supply and upon delivery to the site. All laboratory soil testing shall be ordered and paid by the Contractor.
- B. Onsite or imported topsoil shall be of uniform quality, free from toxic substances, subsoil, stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. **Topsoil shall contain no noxious weeds or noxious weed seeds.**
- C. Topsoil used for this Work shall meet the following requirements.
  - 1. Soluable salts (EJe) Less than 4 dS/m or mmho/cm

2. ph Between 5.0 and 7.5
3. Sand, silt, clay content Less than 30% clay
  - a. Less than 70% sand and
  - b. Less than 70% silt.
4. Soil texture Sand clay loam (SLC)
  - a. sandy loam (SL)
  - b. clay loam (CL)
5. Organic matter content (by weight) Minimum 0.5 Percent
6. SAR (sodium absorption ratio) Less than 7
7. Percent coarse fragments (rocks > 2mm) Less than 5 percent
8. Nitrate Nitrogen (ppm) Greater than 20
9. Phosphorus (ppm) Greater than 15
10. Potassium (ppm) Greater than 150
11. Iron (ppm) Greater than 10

## 2.3 FERTILIZER AND AMENDMENTS

- A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.
- B. Chemical fertilizers shall be a mixed commercial fertilizer with percentages of nitrogen, phosphoric acid, and potash at 16-16-8 slow release formula. Fertilizers shall be uniform in composition, dry, and free flowing.
- C. Fertilizer tablets shall be 12 grams each 20-10-5 "Agriform," "Lesslie", or equal.
- D. Compost: Onsite topsoil shall be amended with one part compost to 5 parts topsoil. Compost shall consist of composed leaves and yard grass. Compost shall meet the following requirements:
  1. Compost shall be dark brown to black in color,
  2. Compost shall have no objectionable odor,
  3. Compost shall have a particle size of ½ inch or less,
  4. Compost shall have a pH of 5.0 to 7.8,
  5. Compost shall have a soluble salt concentration (mmhos/cm or dS/m) of less than 5 and
  6. Compost shall have a carbon-to-nitrogen ration of less than 25:1.

## 2.4 MULCH & COMPOST

- A. Organic Compost material as outlined in "Compost Quality Guidelines for Landscaping" by Isaman, Koenig, Cerny, USU Extension, 3 March 2003.

## 2.5 PLANT MATERIALS

- A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. They shall be true to name, genera, species, and variety in accordance with reference publications.

- B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.
- C. Plants shall be marked for identification. Each bundle of plants and at least 25 percent of each species and variety of separate plants in any one shipment shall have legible labels securely attached before delivery to the site.
- D. All trees and shrubs shall be measured while their branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees will be accepted with their leaders cut, or so damaged that cutting is necessary.
- E. All plants shall be symmetrical and shall conform to the size, age, and condition as specified on the plant list shown in the Contract Documents. Exceptions are as follows:
  - 1. Plants larger than specified in the plant list may be used if approved by the L.A., but use of such plants shall not increase the contract price. If the use of larger plants is approved, the spread of roots or ball earth shall be increased in proportion to the size of the plant. Bare root plants furnished in size greater than specified shall be balled and burlaped when required by the L.A.
  - 2. Where caliper or other dimensions of any plant materials are omitted from the Plant List, it shall be understood that such plant materials shall be normal stock for type.
- F. Plants shall be of sound health, vigorous, and free from plant disease and shall be well-branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system. Cold storage plants will not be accepted. Plants that are sensitive to shock from elevation change shall be grown at elevations close enough to site to alleviate any plant damage due to such change for at least 2 years.
- G. Roots or balls of all plants shall be adequately protected at all times from sun and drying winds.
- H. Plants (indicated to be in marked cans, pots, or other containers on the plant list) shall have been grown in the containers for a minimum of 6 months and a maximum of 2 years. Roots shall fill the containers but show no evidence of being or having been root bound.
- I. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over. In no case shall trees be topped before delivery.
- J. Plants shall have been transplanted or root-pruned at least once in the 2 years. Plants shall not be pruned prior to delivery except as authorized by the L.A.

## 2.6 STAKING MATERIALS

- A. Stakes for supporting trees to be metal "T" fence posts.
- B. Guying kits for trees will be "Cable Guy" (Alpine Nursery 1-800-356-6633) #CG-4000 and CG-6800-T. Add extra hose where guy cable comes in contact with tree.



- C. Hose for covering wire shall be new or used black or green 2-ply fiber-bearing garden hose, not less than ½-inch inside diameter.
- D. Wire for tree bracing and guying shall be double strand pliable No. 10-gage galvanized steel wire or vinyl-coated steel wire.

## 2.7 NATIVE SEED

- A. Seed shall conform with applicable City, County, State, Federal regulations and meet Utah Seed Law. Seed shall be mixed by dealer. The Contractor shall furnish dealer's guaranteed germination figure for each variety. Grass seed shall not be delivered until samples have been approved in writing by the Engineer, Landscape Architect or its authorized landscape representative. Approval of samples, however, shall not affect the right of the Engineer, Landscape Architect or the authorized landscape representative to reject seed upon or after delivery. Seed that has become wet, moldy, or otherwise damaged prior to use will not be accepted.
- B. Grass seed shall be fresh, clean, new-crop seed, composed of the following varieties mixed in the proportions by weight. Purity and germination percentage shall be the results of testing.
- C. Weather Conditions: Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 5 miles per hour or when the ground is frozen, unduly wet, or otherwise not in a tillable conditions. Seeding shall not be conducted when temperatures exceed 80°F.
- D. Topsoil: Four inches of approved, onsite or imported, amended topsoil shall be placed in all areas delineated to be seeded. Imported, amended topsoil shall be placed and raked smooth prior to seeding or sodding
- E. Soil Preparation: The ground to be seeded shall be graded in conformance with the Drawings and shall be loose and reasonably free of large rocks, roots, and other material which will interfere with the work.
- F. Supply seed on a pure live seed (PLS) basis.
- G. Obtain seed from lots that have been tested by a state certified seed testing laboratory. (Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST)). Seed germination tests older than 18 months for grass seed, and 9 months for shrub or tree seed are not acceptable.
- H. Do not use wet, moldy or otherwise damaged seed.
- I. See plans for seed mix.
- J. In disturbed areas, complete all weed removal, final grading, trench settling, surface preparation and irrigation work (if applicable) before seeding begins.
- K. Roughen soil receiving seed.
- L. Do not install when seed or soil is saturated or frozen.

M. MAINTENANCE

1. During the maintenance period the contractor shall be responsible for removing weeds and maintaining the site to provide as good of conditions as possible for seed to grow.
2. Contractor shall plan on one re-seeding if the native stand has not established at the end of the warranty period.

2.8 DRILL SEEDING

- A. Drill seeding of the native seed may occur between October 30 and February 28. The actual seeding period must be approved by the Engineer or Landscape Architect because weather conditions vary from year to year. No seed shall be conducted until approved.
- B. All areas that are designated for seeding with the native seed mixture in the Contract Documents shall be seeded by drilling unless otherwise approved in writing by the Engineer or Landscape Architect. Only those areas that are too steep to drill may be hydroseeded.
- C. Seeding: Seed shall be uniformly drilled to an average depth of 1/4 to 1/2 inch at the rate specified using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder. Drill seeding shall take place 3 days after application of herbicide.
- D. Rolling: Immediately after seeding, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with drills equipped with rollers shall not be rolled.
- E. Hydromulch: Apply hydromulch over the entire seeded area at a rate of 2000 pounds per acre. Hydromulching operation shall be conducted as described in Section 3.13 Hydroseeding.

2.9 HYDROSEEDING

- A. Hydroseeding shall only be used in areas that are too steep for drill seeding.
- B. Hydroseeding of the native seed mix may occur between October 30 and February 28. The actual seeding period must be approved by the Engineer or Landscape Architect because weather conditions vary from year to year. No seed shall be conducted until approved.
- C. Hydromulch or slurry shall conform to the following:
  1. Echofiber or Conwed or approved equal wood fiber mulch, applied at a rate of 2000 pounds per acre.
  2. M-binder or Plantego tackifier, applied at a rate of 100 pounds per acre.
  3. 16-16-8 slow release fertilizer, applied at a rate of 150 pounds per acre
  4. Water at a rate of 4000 gallons per acre.
- D. Hydromulch shall be applied using a hydro-seeding equipment manufactured by Finn or Bowie or approved equal. Machines shall be equipped with heavy duty cast iron pumps and agitators capable of thoroughly mixing the slurry.

- E. Spray of hydromulch shall begin immediately after the tank is full and the slurry components are mixed.
- F. Apply hydromulch in a downward drilling motion using a fan stream nozzle. It is important to ensure that all of the components enter and mix with the topsoil.
- G. Only qualified and trained personnel shall perform hydroseeding to insure the uniformity of the hydroseeding application.

#### 2.10 EROSION CONTROL BLANKET

- A. Erosion Control Blanket shall be AEC Premier Coconut or approved equivalent and placed on slopes 3:1 or greater.
- B. Erosion control blanket shall be keyed in at the top of the slope as per manufacturer specifications.
- C. Anchorage devices shall be 9-inch, two-legged staples furnished by the manufacturer, or staples of the proper length as recommended by the manufacturer for specific soil conditions.

### **PART 3 - EXECUTION**

#### 3.1 GENERAL

- A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.
- B. The Contractor shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shall be coordinated with Engineer or Landscape Architect and final location shall be Site-oriented by the planter and Engineer or Landscape Architect. Any discrepancies or inconsistencies shall be brought to the attention of the Engineer.
- C. In case of conflict between the Plant List totals and total plant count of the Contract Documents, the Contractor shall provide the higher number of plants.
- D. Delivery of materials may begin only after samples and tests have been approved by the Engineer or Landscape Architect. Materials provided shall be not less quality than the approved sample.
- E. Substitutions for the indicated plant materials may be considered pursuant to the Contract Documents.
- F. The Contractor shall provide temporary fencing, barricades, covering, or other protections to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the landscape work.
- G. Waste materials shall be removed and disposed of off the Site, unless otherwise indicated.

- H. It shall be the responsibility of the Contractor to obtain information regarding utilities in the area of work and to prevent damage to the same. The Contractor shall protect the utilities as necessary.
- I. Burning of combustible materials on the Site shall not be permitted.
- J. The Contractor shall protect structures, sidewalks, pavements, existing irrigation system, and other facilities that are subject to damage during landscape work. Open excavations shall be provided with barricades and warning lights which conform to the requirements of governing authorities and the State's OSHA safety requirements from dusk to dawn each day and when needed for safety.
- K. Planting areas include all areas to be landscaped unless indicated otherwise.

### 3.2 SOIL PREPARATION

- A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompacted, and refinished to finish grades. The Engineer or Landscape Architect shall be notified of all areas that prevent the landscape work from being executed.
- B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.
- C. The landscape work shall not proceed until after walks, roads, vaults, trenching, and reservoir construction is in place. Work under the Contract shall be completed to a point where the landscape areas will not be disturbed. The subgrade shall be free of waste materials of all kinds.
- D. During grading, waste materials in the planting areas such as weeds, rocks 3-inches and larger, building materials, concrete rubble, wires, cans, glass, lumber, masonry, sticks, etc., shall be removed from the Site. All weeds shall be dug out by the roots.
- E. Fertilizers, soil additives, seed, etc. subject to moisture damage shall be kept dry in a weatherproof storage place.
- F. After removal of waste materials, the planting and sod area subgrade shall be scarified and pulverized to a depth of not less than 6 inches, and all surface irregularities below the cover of topsoil shall be removed.
- G. Finish grading shall consist of:
  - 1. Final contouring of the planting areas.
  - 2. Removal of 6 inches of hardpan material and placement of four inches of imported, amended topsoil over all areas to be planted, deeded or sodded unless indicated otherwise.
  - 3. Placing all soil additives and fertilizers.
  - 4. Tilling of planting areas.
  - 5. After tilling, bringing areas to uniform grades by floating and/or hand raking.

6. Making minor adjustment of finish grades as directed by the Engineer or Landscape Architect.
  7. Removing waste materials such as stones, roots, weeds or other undesirable foreign material and raking, disking, dragging, and smoothing soil ready for planting.
  8. Finished grades shall be one inch below the top of curbs, sills and walkways in all areas for seed, one and a half inches for sod and three inches for areas with mulch or groundcover.
  9. Finished grades shall be smoothed to eliminate puddling or standing water.
- H. Any unusual subsoil condition that will require special treatment shall be reported to the Engineer or Landscape Architect.
- I. **Unless otherwise specified, seeding areas shall receive a minimum of 4 inches of topsoil.**
- J. Surface drainage shall be provided as indicated by shaping the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.
- K. Finish grade of all planting areas shall be 1-1/2 inches below finish grade of adjacent pavement of any kind.

### 3.3 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

- A. No plants other than the required samples shall be dug or delivered to the site until the required inspections have been made and the plant samples are approved
- B. Plants shall not be pruned prior to delivery except upon approval by the L.A.
- C. Plant material shall be planted on the day of delivery if possible. The CONTRACTOR shall protect the stock in a temporary nursery at the project site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other acceptable material. Plants shall be planted within 2 days after delivery.
- D. All balled and burlapped plants which cannot be planted immediately in delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be planted on heeled-in trenches immediately upon delivery. No material heeled-in more than one week may be used. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots.
- E. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.
- F. Plants shall not be picked up or moved by stem or branches, but shall be lifted the ball or container.

- C. Plants shall be lifted and handled from the bottom of the ball or container. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the site.

#### 3.4 TREE AND PLANT LOCATIONS

- A. The CONTRACTOR shall locate and stake all tree and shrub locations and have the locations approved by the L.A. before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by L.A. before final approval.
- B. No trees shall be located closer than 72 inches to structures unless otherwise shown. Ground covers and shrubs may be planted up to structures or curbs.

#### 3.5 PLANT PITS

- A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes unless shown
  - 1. Tree pits shall be at least 3 feet greater in diameter than the specific diameter of ball or spread of roots, and at depth of ball or roots.
  - 2. Shrubs shall be planted in pits or holes of soil the depth of ball below finished grade, or as much deeper as necessary to properly set the plant at finished grade. Shrubs with balls shall be planted in pits that are at least 12 inches greater in diameter than the bottom of ball.

#### 3.6 PREPARED BACKFILL

- A. Tree and shrub pit backfilling soil shall consist of ½ existing soil from plant pit and ½ topsoil mixed.
- B. Tree and shrub pits shall be provided with fertilizer tablets as follows:
  - 1 per one-gallon can plant
  - 2 per 5-gallon can plant
  - 3 per 1.5" cal. tree

#### 3.7 ROCKS OR UNDERGROUND OBSTRUCTIONS

- A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations shall be selected by the L.A. Moving of trees to alternative locations shall not entail additional costs to the OWNER.

#### 3.8 SETTING PLANT MATERIALS

- A. The soil shall not be worked when the moisture content is so great that excessive compaction will occur, nor when it is so dry that a dust will form in the air or that

clods will not break readily. Water shall be applied if necessary to provide ideal moisture for filling and for planting as herein specified.

- B. Plants shall be set in center of pits as shown in the Contract Documents. They shall be set plumb and straight, and at such a level that after settlement that the crown of the plant will be 2 inches above the finished grade.
- C. Balled and burlapped trees shall have planting soil placed and compacted around base of ball to fill all voids. All burlap ropes or wires shall be removed from the sides and tops of balls.
- D. All ground cover plants shall be evenly spaced, staggered in rows, and set at intervals specified, so as to produce a uniform effect. Plants shall be watered immediately after Planting operations have been completed.
- E. All shrubs and vines shall be pruned to remove damaged branches. All bare root shrubs shall be pruned and shaped to compensate for transplant root loss.
- F. Planting soil around roots or balls shall be thoroughly compacted and watered. After planting, the soil in the shrub beds shall be cultivated between shrubs, raked smooth, and neatly outlined. Muddy soil shall not be used for backfilling. All broken or frayed roots shall be properly cut off.
- G. Trees and shrubs on slopes steeper than 6 to 1 shall be provided with watering dams or berms at least 6 inches high and 8 inches wider than planting pit (hole) unless specified or shown otherwise.
- H. All trees shall be thoroughly watered immediately after planting.
- I. Remove all tags and labels when directed by L.A.

### 3.9 STAKING AND TREE WRAPPING

- A. Staking of trees shall be done immediately after they are planted. Plants shall stand plumb after staking. Staking shall be as specified unless shown or indicated otherwise.
- B. Trees 2-inch caliper and less shall be supported by 2 stakes placed diametrically opposite at perimeter line of ball and to sufficient depth to hold tree rigid. Stakes shall be driven vertically and not twisted or pulled. Trees shall be wired to each stake as indicated on staking details. Trees shall be protected with rubber hose over wires at points of contact.
- C. Trees (deciduous) 3-inch caliper and evergreen trees over 6 feet tall to be guyed at points of branching with 3 wire guys spaced equally around and outside the perimeter of the ball with "Cable Guy" product model #CG-4000. Trees over 3-inch caliper to be guyed with "Cable Guy" product CG-6800-T. Each guy shall be positioned below crotches. Provide extra hose cushion where cable comes in contact with tree.

- D. Tree wrap all trees that may be susceptible to winter sun damage as follows:
1. Starting as low as possible, wrap Treesaver in a smooth spiral to assure overlapping each previous wrap by 1/4 inch.
  2. Continue wrapping up the trunk to just below the second scaffold branches.
  3. Tie of Treesaver with a half hitch knot.
  4. Cover the base of tree and the first wrap of Treesaver with soil.

### 3.10 PRUNING AND MULCHING

- A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the L.A.
- B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.
- C. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials, as hereinbefore specified, shall be spread on finished landscaping grade within all planting areas to a depth of 4 inches. The mulch around isolated trees shall follow the tree planting details shown on plans. All shrub and ground cover beds shall be completely covered with the mulch.

### 3.11 MISCELLANEOUS ITEMS

- A. Gravel mulch shall be placed in the landscape areas as noted on plans, spread carefully and evenly to a minimum depth as noted on plans. Contractor to provide **Dewitt Pro 5 weed barrier fabric below gravel mulch areas. Contractor to submit a sample of the gravels to L.A. for approval prior to installation.**
- C. Spray all gravel and cobble beds with a weed pre-emergent before placing weed barrier fabric.

### 3.12 CONCRETE LANDSCAPE CURBING

- A. Contractor to install in areas as shown on plans, separating the varying surface areas.

END OF SECTION



**DIVISION 33**  
**UTILITIES**

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**SECTION 33 05 16**  
**PRECAST CONCRETE MANHOLES AND VAULTS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide precast concrete manholes, catch basins, drop inlets, potable water vaults; meter vaults, and other pre-cast concrete structures complete and in place, in accordance with the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-place Concrete
- B. Section 31 23 00 – Earthwork

1.3 SPECIFICATIONS, CODES AND STANDARDS

- A. Commercial Standards

ASTM A 48	Gray Iron Castings
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 877	Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
ASTM C 990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

1.4 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings:
1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
  2. Structural design calculations for vaults and boxes shall be stamped and signed by a structural engineer registered in the state of Utah.

C. Manufacturer's Certification for Manholes and Vaults: Written certification that the structure complies with the requirements of this Section.

D. Manufacturer's Test Results: Pull out force for manhole steps.

#### 1.5 QUALITY ASSURANCE

A. Inspection: After installation, the Contractor shall demonstrate that manholes and vaults have been properly installed, level, with water-tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

B. Any precast concrete which arrives on site with voids, cracked, or damaged, or is cracked or damaged during installation shall be cause for rejection. Contractor shall remove precast section(s) from the project site and replace with new undamaged sections at no additional cost to OWNER.

#### 1.6 DELIVERY, STORAGE AND HANDLING

A. Handle precast units in positions consistent with their shape and design. Lift and support only from the support points indicated on the shop drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacturing, storage, transportation and installation.

C. Block and brace units during storage. Provide lateral bracing which is sufficient to prevent bowing and/or warping and will not inhibit curing of the exposed surfaces.

### **PART 2 - PRODUCTS**

#### 2.1 MANHOLES

A. The Contractor shall provide precast manhole sections and conical sections conforming to ASTM C 478 and the requirements of this Section. Cement used in manufacturing the manholes shall be Type II modified portland cement in accordance with ASTM C 150

B. Adjusting rings shall be standard items from the manufacturer of the manhole sections. Minimum wall thickness of rings shall be 4-inches if steel reinforced and 6-inches if not reinforced.

C. Axial length of sections shall be selected to provide the correct total height with the fewest joints. Joints shall be minimized and shall be located as close as possible to the top of the structure to help minimize opportunity for groundwater infiltration.

D. Conical sections shall have an eccentric shape and shall be designed to support cast iron frames and covers under an H-20 loading, unless indicated otherwise.

E. Design Criteria: Manhole walls, transitions, conical sections, and base shall be designed per ASTM C 478 for the depths indicated and the following:

1. AASHTO H-20 loading applied to the cover.
  2. Unit weight of soil of 120 pcf located above all portions of the manhole.
  3. Lateral soil pressure based on saturated soil producing 100 pcf acting on an empty manhole.
  4. Internal fluid pressure based on unit weight of 63 pcf with manhole filled from invert to cover with no balancing external soil pressure.
  5. External pressures and uplift forces due to groundwater elevations 2 feet below finish grade.
  6. Dead load of manhole sections fully supported by the base and transition.
  7. Additional reinforcing steel in walls to transfer stresses at openings.
  8. The minimum clear distance between the edges of any 2 wall penetrations shall be 12-inches or one-half of the diameter of the smaller penetration, whichever is greater.
- F. Joints shall have lipped male/female ends which shall provide uniform and continuous interior wall surfaces and shall be watertight. All joints (including joints between adjusting rings and manhole structure, other adjusting rings and frame and cover) shall be sealed with a preformed flexible sealant conforming to ASTM C 990.
- G. Manhole steps shall be comprised of 1/2-inch grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have tread width of 14-inches. Furnish test results demonstrating step capability to resist a pull out force of 2200 pounds.
- H. Manhole riser sections shall be greater than 12 inches in height.
- I. Manhole Manufacturers, or Equal
1. AMCOR Precast, Ogden, Ut
  2. Geneva Pipe, Orem, Ut

## 2.2 FRAMES AND COVERS

- A. Castings: Castings for manhole frames, covers, and grates shall be non-rocking with machined flat bearing surfaces, and shall conform to the requirements of ASTM A 48, Class 30. Unless otherwise indicated, cast iron covers and frames shall be heavy traffic type, 30 inches in diameter. Covers shall have cleated surfaces with pick holes and shall be ventilated in improved areas and have a solid lid design in landscape or native areas.
- B. Manhole covers shall be with embossed with lettering saying "Sewer", "Storm Drain", or "Water".
- C. All frames and covers shall be designed for H-20 traffic loading. Grates and curb inlets in traffic areas shall be designed for H-20 traffic loading.
- D. Castings Manufacturers, or Equal
1. D & L Supply
  2. Neenah Foundry Co.
  3. Olympic Foundry

## 2.3 VAULTS

- A. The Contractor shall provide precast vaults designed for the indicated applications and of the sizes indicated.
- B. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V or Type II modified portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
- C. Design Loading: Vaults in areas subject to vehicular traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf. Lateral loads on vaults in all areas shall be calculated from:
  - 1.  $L = 90 h$ , plus surcharge of 240 psf in areas of vehicular traffic
  - 2. Where  $L =$  loading in psf
  - 3.  $h =$  depth of fill in feet.
- D. Design loading shall also take into account the lateral and uplift pressure resulting from a groundwater elevation 2 feet below existing grade.
- E. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint. All openings through the precast structure shall be reinforced to transfer loads.
  - 1. Joints shall be sealed watertight. All joints (including joints between adjusting rings and manhole structure, other adjusting rings and frame and cover) shall be sealed with a preformed flexible sealant conforming to ASTM C 990. In addition, all joints shall be wrapped with an external joint sealant meeting ASTM C 877.
- F. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.
- G. Covers for access openings shall be provided. Frames for covers shall be fabricated from aluminum, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch between edges will be accepted. All covers, except round, heavy-weight, cast iron manhole covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.
- H. Where penetrations of the pre-cast concrete vaults are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or wall sleeves, as indicated. Storm drain structures may also use thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel

reinforcing. With the exception of vaults on pressurized water system, vaults need not be designed to resist thrust from piping passing through the vault.

I. Lifting holes shall be plugged with a precast concrete plug sealed with a non-shrink grout.

J. Vault Manufacturers, or Equal  
1. AMCOR Precast, Ogden, Ut  
2. Geneva Pipe, Orem, Ut

## 2.4 FABRICATION

A. Maintain plant records and quality control program during fabrication of structural precast concrete sections. Make all quality control records available to ENGINEER upon request.

B. Use molds that are rigid, and constructed of material that will result in uniform finished surfaces.

C. If self consolidating concrete is not used, thoroughly vibrate concrete to ensure proper consolidation, elimination of cold joints, and to minimize trapped air on at the concrete surface.

D. Fabricate and provide the required lifting devices which are compatible with embedded components.

E. Ensure reinforcing steel, anchors, inserts, plates, angle and other cast-in items are sufficiently embedded, properly secured, and correctly located. Ensure the reinforcing steel is properly supported to prevent movement or shifting during fabrication. Inadequate concrete cover over reinforcing shall be cause for rejection.

F. Cure precast concrete sections under identical conditions to develop specified concrete quality.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Prior to accepting manholes on site, ensure that manhole meet the requirements of these specifications, are constructed of the correct materials, and are not cracked or damaged in any other way.

B. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

C. Buried pre-cast concrete vaults and manholes shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults and manholes

shall be set to grade, plumb and level, and oriented to provide the required dimensions and clearances from pipes and other structures.

- D. Prior to backfilling vaults, pipe and conduit penetrations and other, openings shall be sealed with polyurethane sealant or as indicated in the drawings. With the authorization of the Engineer, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

### 3.2 MANHOLES

- A. Connect pipe to manhole with flexible connection, as recommended by connection manufacturer. Provide a pipe joint or additional flexible connection 18 inches from the outside of the manhole. Grout around pipe after installation is complete, unless otherwise indicated. All connections shall be watertight.
- B. Place top section, cone section or flat slab on top riser section, with the opening positioned over the steps. Top of cone section or flat slab shall be from 10 to 18 inches below finished grade.
- C. Install grade rings as required to adjust top of lid and frame to match finish grade elevation. Maximum height of grade rings shall be 12 inches. Maximum number of grade rings shall be two.
- D. In paved areas and as indicated in the plans, concrete collars shall be constructed around manhole covers as indicated. Collars shall be of 4000 psi concrete. Collars shall be constructed after pavement has been placed.
- E. Steps shall be cast-in-place or vibrated into green concrete.
- F. Steps shall be installed 12-inches on centers vertically, not more than 1/2 inch out of plumb. The top step shall be no more than 12-inches below the manhole cover.
- G. After manhole base has been completed, furnish and install temporary pipe plugs to seal all interior pipe opening. Plugs shall remain in place until final review and acceptance of completed pipeline. Plugs shall then be removed and shall be property of Contractor.

### 3.3 QUALITY CONTROL

- A. Manholes shall be tested and accepted per the requirements of Section 33 08 00 – Gravity Piping Testing and Inspection.
- B. Do not install precast concrete units until concrete has attained its design compressive strength.

END OF SECTION



**SECTION 33 08 00**  
**GRAVITY PIPING TESTING AND INSPECTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall perform all pipeline flushing and testing, complete, for gravity piping systems or other yard piping systems as required in the Contract Drawings, and as specified herein; in accordance with the requirements of the Contract Documents.
- B. The Contractor shall be responsible for providing and conveying flushing water to the point of usage and also for disposal, as required, of water used in the flushing operations.
- C. For the purpose of this specification, gravity piping, sewer or gravity sewer piping refers to all pipes with flows that are driven by gravity in an open channel flow condition and convey liquids associated with the treatment plant processes and byproducts (e.g. plant drain, raw sewage, etc).

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

A. Commercial Standards:

ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
ASTM C924	Standard Practice for Testing Concrete Pipe Sewer Line by Low-Pressure Air Test Method
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

**1.3 CONTRACTOR SUBMITTALS**

- A. The Contractor's proposed plans for testing, and for water conveyance, control, and disposal, shall be submitted in writing. The Contractor shall also submit minimum 48-hour advance written notice of its proposed testing schedule for review and concurrence of the Engineer.

**PART 2 - PRODUCTS**

**2.1 MATERIALS REQUIREMENTS**

- A. Temporary valves, plugs, bulkheads, and other air pressure testing and water control equipment and materials shall be provided by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to pipeline structure and future

function. Air test gages shall be laboratory-calibrated test gages and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test, if required by the Engineer.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. All testing operations shall be performed in the presence of the Engineer.
- B. All water required for cleaning and testing of the sewer pipes shall be furnished by the Contractor.

#### **3.2 CLEANING**

- A. Do not allow dirt, grease, mud, groundwater, tools, equipment and all other foreign matter to enter the pipe at any point during construction.
- B. All pipes shall be completely flushed at a rate with water velocities no less than 4.0 feet per second for pipes up to 12 inches in diameter and 3.0 feet per second for all other pipes. For large diameter pipes, alternate methods, including pigging, or cleaning the pipe may be proposed by the Contractor, subject to the approval of the Engineer, provided proposed method will provide a clean pipe equivalent to flushing as determined by the Engineer.
- C. No debris, rubbish, dirt, rocks, or other foreign material shall be permitted to enter downstream sections of the pipeline or system.
- D. Furnish, install and permanently remove all cross-connections, piping, valving, ports, etc required to complete the cleaning process. Obtain approval of the Engineer prior to adding any components to the pipeline.

#### **3.3 TESTING OF PIPING**

- A. General: All gravity sewer pipes and service laterals shall be air tested and mainlines shall be checked for deflection, as specified. All manholes, vaults and boxes directly conveying flows shall be tested for leakage, as specified. Manholes and piping shall be tested following backfill placement. All leakage tests shall be completed and approved prior to the placement of permanent surfacing. When leakage exceeds the amount allowed by the Specifications, the Contractor shall locate the leaks and make the necessary repairs or replacements required to eliminate the leakage. Any individually detectable leaks shall be repaired, regardless of the results of the tests.
- B. Leakage Tests: Gravity sewer systems shall be tested for leakage as follows:
  - 1. Air Pressure Test - Gravity sewers shall be air pressure tested in accordance with UNI-B 6 and/or ASTM F1417 as outlined below.
    - a. The Contractor shall furnish all materials, equipment and labor for making an air test. Air test equipment shall be approved by the Engineer.
    - b. The Contractor may conduct an initial air test of the sewer main line after densification of the backfill but prior to installation of lateral connection

sewers. Such tests will be considered to be for the Contractor's convenience and need not be performed in the presence of the Engineer.

- c. Each section of sewer shall be tested between successive manholes by plugging and bracing all openings in the main sewer line and the upper ends of all lateral connection sewers. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released, the leaks eliminated, and the test procedure started over again.
- d. Test pressure shall be 4.0 psig, unless groundwater elevation exceeds the invert elevation of the pipe. Where the normal groundwater elevation exceeds the invert elevation of the new pipe, the test pressure shall be adjusted for back pressure created by the groundwater. The new test pressure shall be determined by:
$$P_t = 4.0 + \frac{H}{2.35} \leq 9.0 \text{ psig}$$
- e. Where  $P_t$  is the new test pressure and H is the difference in feet between the groundwater elevation and the lowest invert elevation of the pipe being tested. In no case shall the test pressure exceed 9.0 psig or the maximum pressure allowed by the pipe manufacturer.
- f. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked, the plugs shall be placed in the line at each manhole and inflated to manufacturer's recommended inflation pressure. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches test pressure. At least two minutes shall be allowed for the air pressure to stabilize. After the stabilization period minimum pressure (at the beginning of test time shall be test pressure minus 0.5 psig), the air hose from the control panel to the air supply shall be disconnected.
- g. For pipe diameters 4"-36", the portion of line being tested shall be termed "Acceptable" if the allocated line pressure decreases less than 1.0 psi in the time shown for the given diameters and lengths in Table 1.
- h. For pipe diameters greater than 36", the portion of line being tested shall be termed "Acceptable", if the allocation line pressure decreases less than 0.5 psi in the time shown for the given diameters and lengths in Table 2.
- i. Required test times for lines consisting of multiple pipe diameters shall be determined in accordance with UNI-B-6 and or ASTM F1417.
- j. If the installation fails to meet these requirements, the Contractor shall determine the source of leakage. He shall perform a leak location test and then repair or replace all defective materials and/or workmanship. This work shall be completed at no additional cost to the Owner.

Table 1  
Low Pressure Air Test Times for 1.0 PSig Pressure Drop

Pipe Diameter (in.)	Minimum Time for 1.0 PSig Pressure Drop (min:sec)	Pipe Length for Minimum Time (ft.)	Test Time for Pipe Length in Excess of Minimum (sec.)
4	03:47	597	.380 L
6	05:40	398	.854 L
8	07:33	298	1.520 L
10	09:27	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L
27	25:30	88	17.306 L
30	28:20	80	21.366 L
33	31:10	72	25.852 L
36	34:00	66	30.768 L

Table 2  
Low Pressure Air Test Times for 0.5 PSig Pressure Drop

Pipe Diameter (in.)	Minimum Time for 0.5 PSig Pressure Drop (min:sec)	Pipe Length for Minimum Time (ft.)	Test Time for Pipe Length in Excess of Minimum (sec.)
42	19:50	57	20.939 L
48	22:40	50	27.349 L
54	25:30	44	34.614 L
60	28:30	40	42.733 L
66	31:10	36	51.707 L
72	34:00	33	61.535 L
78	36:50	31	72.219 L
84	39:40	28	83.756 L
90	42:30	27	96.149 L
96	45:20	25	

- C. Deflection Test: All flexible and semi-rigid main line pipe shall be tested for deflection, joint displacement, or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent surfacing. The mandrel shall be a full circle, solid cylinder, or a rigid, non-adjustable, odd-numbered leg (9 leg minimum) steel cylinder, approved by the Engineer as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside pipe diameter of the pipe and the minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. Obstructions encountered by the mandrel shall be corrected by the Contractor.

- D. Video Inspection: After the sewer pipe has been installed and cleaned; and the trench has been backfilled, the sewer pipe shall be visually inspected by video camera to locate defects in the sewer pipe. Video Inspection shall be performed by an independent testing agency acceptable to the Owner. All sewer pipes shall be video inspected.
1. Notify the Engineer, 48 hours prior to any televised inspections.
  2. The inspection shall be in digital video format, saved to a DVD or CD (enclosed within a protective case) and shall be given to the Engineer for review and final records
  3. The Contractor shall ensure safe access to each manhole as required by the testing agency.
  4. Video equipment shall include a pipe inspection video camera with the following capabilities: panorama tilt, radial viewing, pans plus and minus 75 degrees, rotates 360 degrees, and has optical zoom from 6 or less inches to infinity. Equipment shall produce a high quality, full color video image.
  5. Video equipment shall be equipped with a device that can accurately measure the depth of any ponding encountered in the pipe. Measuring device shall be clearly visible in the video image.
  6. The video equipment shall have an accurate footage counter accurate to within 1 foot per 500 foot of pipe. Footage shall be continuously displayed on the video at all times.
  7. Pipelines shall be cleaned and flushed immediately prior to video inspection. Pipelines that were cleaned and flushed more than 24 hours prior to video inspection shall be cleaned and flushed again. All dirt/debris, including pipe grease, in the line which could cover a defect shall be removed.
  8. Jetting of the lines in conjunction with the video inspection is prohibited.
  9. If during the video inspection foreign material which prohibits an acceptable video inspection is discovered the line shall be cleaned and video inspected again.
  10. The video camera shall travel through the pipe at a maximum rate of travel of 30 feet per minute. Video shall be continuous for each pipe segment between manholes or other access points.
  11. The video camera shall pause at each tee, lateral or other connection and the camera shall be rotated and tilted to provide an image of the branch for inspection. The image shall remain clear and in focus at all times while zooming to the full extent of the camera. The camera operator shall stop at each fitting and change in pipe type and complete a 360 degree view of the fitting at a rate slow enough to identify any defects.
  12. Glare shall be avoided and shall not interfere with viewing the pipe segment.
  13. Provide DVDs or CDs with labels indicating project number, segment number, date televised, date submitted, starting manhole number, ending manhole number, pipe diameter, pipe length and street name.
  14. Lines to be video inspected shall be flushed within 24 hours prior to beginning of inspection.
  15. The video inspection shall be used to identify defective construction such as sags, debris, separated joints, etc. Any Work not conforming to the Specifications or Drawings shall be promptly removed, replaced and retested at no cost to the Owner. The Engineer shall make all final determinations if the severity of the defect constitutes failure and requires subsequent removal or repair of the segment in question.
    - a. Conditions identified by the video inspection that require removal and replacement or, but are not limited to:
      - 1) Alignment (Vertical or Horizontal) is outside the specified limits.

- 2) Water ponds in any section with depths equal to or greater than 2 times the grade tolerance specified in the Contract Documents.
- 3) Pipe section with visible defects, such as: open joints, pinched gaskets, cracked barrels or bells, leaks, or other defects as determined by the Engineer.

### 3.4 TESTING OF MANHOLES AND OTHER APPURTENANT STRUCTURES

#### A. Manholes and other structures

1. Vacuum tests shall be conducted on the newly constructed manholes. Preliminary manhole testing may take place following construction after all connections are made, and before backfilling. Test results derived from this test will allow time for necessary repairs to be completed before further construction proceeds and hinders such repairs. Final tests must be performed after the manhole has been backfilled.

#### B. Procedures

1. Plug all manhole entrances and exits other than the manhole top access using suitably sized pneumatic or mechanical pipeline plugs and follow all manufacturer's recommendations and warnings for proper and safe installation of such plugs. Plugs should be inserted a minimum of 6 inches beyond manhole wall. Make sure such plugs are properly rated for the pressures required for the test. The standard test of 10 inches Hg. (mercury) is equivalent to approximately 5 PSIG (.3 bar) backpressure. Unless such plugs are mechanically restrained, it is recommended that the plugs are used with a minimum two times (2x) safety factor or a minimum of 10 PSIG (0.7 bar) backpressure usage rating.
2. Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.

Minimum Test Times for Various Manhole Diameters													
Depth, Feet	Diameter, Inches												
	48	54	60	66	72	78	84	90	96	102	108	114	120
	Time, Seconds												
8	20	23	26	29	33	35	38	41	45	48	51	54	57
10	25	29	33	36	41	44	48	52	56	60	63	67	71
12	30	35	39	43	49	53	57	62	67	71	76	81	85
14	35	41	46	51	57	62	67	72	78	83	89	94	100
16	40	46	52	58	67	70	76	83	89	95	101	108	114
18	45	52	59	65	73	79	86	93	100	107	114	121	128
20	50	53	65	72	81	88	95	103	111	119	126	135	142
22	55	64	72	79	89	97	105	114	122	131	139	148	156
24	59	64	78	87	97	106	114	124	133	143	152	161	170
26	64	75	84	94	105	114	124	134	144	155	164	175	185
28	69	81	91	101	113	123	133	145	155	167	177	188	199
30	74	87	98	108	121	132	143	155	166	178	189	202	213

(The values listed above are taken from ASTM Specification C1244-93 "Standard Test Method for Concrete Manholes by the Negative Air Pressure (Vacuum) Test.")

3. Repeat the above test procedure after backfilling manhole for final acceptance test.
4. Manholes shall be watertight. All joints, penetrations, etc., shall be sealed watertight prior to acceptance of manhole.

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**SECTION 33 11 11**  
**STEEL PIPE (AWWA C200, MODIFIED)**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide mortar-lined steel pipe coated as specified herein, complete, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards: The following standards are listed for convenience only. All specified standards, whether listed or not, shall apply to the Work.

ANSI/ASTM A 20	General Requirements for Steel Plates for Pressure Vessels
ASTM E 165	Practice for Liquid Penetrant Examination
ASTM A 370	Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 516	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ANSI/AWWA C200	Steel Water Pipe 6 In and Larger
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In and Larger - Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service 4 in to 144 in
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
ANSI/AWWA C214	Tape Coating Systems for the Exterior of the Steel Water Pipelines
ANSI/AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
ANSI/AWWA C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

ANSI/AWWA C218	Coating the Exterior of Above Ground Steel Water Pipelines and Fittings
ANSI/AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines 4-In (100 mm) and Larger - In Place
ANSI/ASTM A 36	Carbon Structural Steel
ANSI/ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 570	Steel Sheet and Strip, Carbon, Hot-Rolled Structural Quality
ASTM A 572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM C 150	Portland Cement
ANSI/AWS D1.1	Structural Welding Code – Steel
API Standard 1104	Welding Pipelines and Related Structures
AWWA M-11	Steel Water Pipe - A Guide for Design and Installation
ASME	Boiler and Pressure Vessel Code

### 1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in Section 01 33 20 – Submittal Procedures, and the following supplemental requirements as applicable. Fittings and specials shall conform to Section 33 11 12 - Steel Pipe Fabricated Specials. Contractor's submittals for steel pipe and specials shall be coordinated between the sections.
- B. Fabrication Information
  - a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.
  - b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.
  - c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.
  - d. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. 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 in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project. [To demonstrate ability to meet the schedule requirements of this project, submit project descriptions and manufacturing/fabrication schedules for other currently contracted pipe projects at the Fabricator's plant. The manufacturing / fabrication schedule for the pipe in this project shall be identified on schedule submittals under Section 01 32 21 - CPM Construction Schedule.

- e. Manufacturer's Written Quality Assurance/Control Program.
- 2. Materials: Material lists and steel reinforcement schedules which include and describe all materials to be utilized. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Project Specifications.
- 3. Line Layout Information
  - a. Line layout and marking diagrams compatible with the requirements of AWWA Manual 11 (M-11) and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.
  - b. Dimensional drawings of all valves, fittings, and appurtenances as specified in Section 40 05 00 – Piping, General.
  - c. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.
  - d. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.
- 4. Welding Information
  - a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications (WPS) numbers shall be shown on the shop drawings. The shop drawings shall 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. Written welding procedures for shop and field welds, including Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQR's).
  - c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.

- d. Current welder performance qualifications (WPQ's) shall be submitted for each welder used prior to its performing any Work either in the shop or field. Qualification testing shall be as specified in Article 1.4 - Quality Assurance, Paragraph F, in this Section.
  - e. Submit the credentials of the 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 QC-1 Certification.
  - f. Submit all nondestructive testing (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, magnetic particle, dye penetrant examination, ultrasonic, or air test examination methods specified. Test data shall be reviewed and signed by the welding inspector(s).
  - g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.
  - h. Submit a welding map showing the sequence of welds for all field welds.
  - i. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the Project.
  - j. Submit a written rod control procedure for shop and field operations demonstrating how the Contractor intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the Contractor intends to ensure that the proper rods are used for each weld.
- 5. Handling and Support Information: Detail drawings indicating the type, number and other pertinent details of the slings, strutting and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Calculations supporting the handling and support system design shall be submitted. Drawings and calculations shall be sealed by a registered professional engineer.
- 6. Control of Temperature Stresses
  - a. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation prior to starting of any field welding.
  - b. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures.
  - c. Submit plan for monitoring pipeline temperatures.
- 7. Field Lining
  - a. Submit field lining contractor's credentials.
  - b. Submit a description of lining equipment and personnel to be used.
  - c. Submit written procedures for pipe surface preparation, lining application, and curing.
  - d. Submit cement mortar mix design.
- C. Certifications: Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C602, and C206, respectively, and the following supplemental requirements:
  - 1. Compliance with the additional requirements included in these Contract Documents.
  - 2. Physical and chemical properties of all steel.
  - 3. Hydrostatic test reports.
  - 4. Results of production weld tests.
  - 5. Sand, cement, and mortar tests.
  - 6. Rubber gasket tests.

7. All materials are NSF approved for use with potable water.
  8. Pipe temperature complies with Specifications prior to pouring pipe zone material, during and between periods of CLSM placement, and prior to and during welding temperature control joints (including supporting data).
  9. All welds were performed in conformance with these documents.
- D. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the Contractor at no increased cost to the Owner.

#### 1.4 QUALITY ASSURANCE

- A. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, C602, C209, C214, C215, and C222 as applicable, as supplemented by the requirements herein. Notify the Engineer in writing not less than 14 calendar days prior to the start of any phase of the pipe manufacture, welding, lining, coating, testing, or field operations.
- B. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.
1. After the joint configuration is completed and prior to lining with cement-mortar, if applicable, 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 minimum yield strength of the pipe steel. Test pressure shall be maintained for a sufficient time to observe the weld seams. There shall be no leaks. Any leaks shall be repaired and the pipe retested.
  2. Production weld tests as required in ANSI/AWWA C200, except weld tests shall be conducted on each 5,000 feet of production welds at a minimum, and at least one set of tests per operator per work shift shall be performed.
- C. Perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.
- D. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.
- E. Welding Procedure Specifications: All 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 all welds, both shop and field. Welds qualified per the ASME BPVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.
- F. Welder Performance Qualifications: All 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 by the Contractor under the provisions of ASME BPVC for

shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

- G. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as specified below. Testing shall include submitting written documentation of procedures per Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Engineer, the butt joint welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
  2. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
  3. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
  4. All Welds: Certified welding inspector shall 100 percent visually examine all welds as a minimum.
  5. In addition to weld tests hereinbefore specified, doubler pads shall be air tested as stated in AWWA C206.
  6. Refer to Section 33 13 00 – Water Pipeline Testing and Disinfection for field non destructive testing.
- H. Onsite Observation: The pipe fabricator shall provide an experienced staff member to train the contractor's installation crews regarding pipe handling, jointing, and backfilling. Training shall be provided for a minimum of two weeks at the beginning of the project, and as needed during construction. 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 the Engineer's onsite observer.
  3. Answer questions and provide assistance to the Engineer and the Contractor.
- I. Certified Welding Inspector (CWI): Furnish the services of a certified welding inspector(s) for all shop and field welding as specified in AWWA C200 and C206. The certified welding inspector(s) shall 100 percent visually inspect all welds, verify proper procedures are being followed using qualified welders, supervise Contractor's non-destructive testing, and witness Engineer's non-destructive testing. The welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. All shop weld tests shall be reviewed and signed by the inspector(s).
- J. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for this Work and shall have the manufacturing capability to meet the schedule requirements of this project. Experience shall include successful fabrication to AWWA C200 standards 72-inch and larger pipe with wall thicknesses 0.375- inch or larger within the 4-year period preceding the bid date. This experience requirement shall apply to the fabrication plant facility and responsible personnel, not to the firm which owns the facility or employs the personnel.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Unless otherwise indicated, steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, C602, C209, C214, C215, C216, and C222, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded or gasket joints, as indicated in the Contract Documents, and all specials shall be provided as required in Section 33 11 12 - Steel Pipe Fabricated Specials. For pipe larger than 24 inches in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24 inches in diameter and smaller may be provided in standard outside diameters.
- B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings 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.
- C. Handling and Storage: The pipe 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 which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The ends of all pipe shall be securely bulkheaded or otherwise sealed during transport to the jobsite. All pipe handling equipment and methods shall be acceptable to the Engineer.
- D. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the Owner.
- E. Strutting: Adequate strutting (stulling) shall be provided on all specials, fittings, and straight pipe so as to avoid damage or distortion to the pipe and fittings during handling, storage, hauling, and installation. The following requirements shall apply:
  - 1. The strutting shall be placed as soon as practicable after the pipe is fabricated or the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.
  - 2. The strutting materials, size and spacing shall be the responsibility of the Contractor and shall be adequate to prevent deflection and support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment. One strut shall be placed vertical oriented with the top of pipe. One set of struts shall be set 2 feet from each end of each pipe section and at a maximum interval of 15 feet in-between
  - 3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

- F. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. Contractor shall select lengths to accommodate the Contractor's operation.
- G. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- H. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines as shown on the Drawings. Refer to Section 13 47 13 - Cathodic Protection System. Provide cathodic protection appurtenances, including insulating flanges and DC blockers as shown in the Drawings. Maintain electrical continuity except where isolation is indicated in the Drawings.
- 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 correction pieces and closure assemblies shall be shown on the pipe layout diagrams and shall be subject to the Engineer's review. Any change in location or number of said items shall be approved by the Engineer.
- J. Shop-Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape or plural component epoxy coating in accordance with Section 09 97 01 - Pipeline Coatings. Seams shall be ground such that the maximum weld bead height will not exceed 1/32 inch. All ground weld seams shall be smooth and free of all burrs. Do not grind into, or gouge, the adjacent pipe wall material.

## 2.2 MATERIALS

- A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C 150. Fly ash or pozzolan shall not be used as a cement replacement.
- B. Steel: Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:
  - 1. Yield Strength: 40,000 psi minimum. Measured yield strength shall not exceed 85% of measured tensile strength.
  - 2. Minimum Tensile Strength: 60,000 psi
  - 3. Coils: Steel coils shall be made from the continuous cast process or continuous cast slabs, fully killed, fine-grain practice conforming to the physical and chemical characteristics of ASTM A1018/A1018M, SS Grade 40 Type 2. For sheet steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.
  - 4. Plate: Steel plate shall be fully killed, conform to ASTM A20, and be manufactured to fine-grain practice conforming to the physical and chemical characteristics of ASTM A572/A572M, Grade 50. For plate steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.



- 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 spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than two longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.
  2. Pipe sections may be rolled or pressed from no more than three sheets the full length of the pipe and welded with no more than three longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.
- D. Charpy Tests
1. General. Steel used in production manufacturing of pipe and specials shall be tested for notch toughness using Charpy V-Notch tests per ASTM A 370. The test acceptance shall be 25 foot-pounds at a test temperature of 30 degrees F.
  2. Charpy V-Notch tests shall be conducted on all steel used in fabricating pipe and reinforcement materials 0.5-inch or greater in thickness. Test outside diameter wrap of two coils minimum per heat lot.
  3. The Owner may elect to increase the Charpy testing to include more steel than indicated above at a negotiated price.

## 2.3 SPECIALS AND FITTINGS

- A. Unless otherwise required, all specials and fittings shall be in accordance with Section 33 11 12 - Steel Pipe Fabricated Specials and shall conform to the dimensions of ANSI/AWWA C208.

## 2.4 DESIGN OF PIPE

- A. General: The pipe shall be steel pipe, mortar-lined and flexible or mortar-coated as shown on the Drawings, with field welded joints or gasket as indicated. The pipe shall consist of a steel cylinder, lined with portland cement-mortar as indicated, with an exterior coating as indicated in Section 09 97 01 – Pipeline Coatings. Field lining will only be allowed where specifically indicated on the Drawings.
- B. The pipe shall be manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.
- C. Pipe Dimensions: The pipe shall be of the diameter and wall thickness shown on the Drawings. The minimum steel cylinder thickness for each pipe size shall be as indicated.
- D. Specials Dimensions: The specials shall be of the diameter and wall thickness indicated on the Drawings, or as specified in Section 33 11 12 - Steel Pipe Fabricated Specials.
- E. Joint Design: Unless otherwise shown, the standard field joint for steel pipe shall be [butt-welded or a double-welded (fully circumferential)] [single-welded (fully circumferential)] lap joint. Mechanically coupled, or flanged joints shall be required where indicated on the

Drawings. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same or higher pressure rating as the abutting pipe. Provide air test tapped holes for each double welded lap joint as defined in Section 33 13 00 - Water Pipeline Testing and Disinfection.

- F. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the Engineer, bell ends shall be formed by an expanding press or by the pipe 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. The ends shall not be rolled. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.
- G. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels and maximum joint deflections are not exceeded. 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 75 percent of the manufacturer's recommendations or the angle which results from a ¾-inch pull out from normal joint closure, whichever is less. In no case shall pulled joints result in a gap between the bell and spigot at the weld location that exceeds 1/8 inch. All horizontal deflections or fabricated angles shall fall on the alignment, as shown.
- H. All vertical deflections shall fall on the alignment within laying tolerance as described in Section 3.1.
- I. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the Engineer. Holdback areas shall be coated as hereinafter specified.
- J. Temperature Control Lap Joint: A special longer bell end (temperature control lap joint) shall be provided at a maximum spacing of [400] feet to account for movement of the installed pipe due to temperature changes. The pipe manufacturer shall determine the length required for the longer bell as defined by the Contractor's pipe laying procedures and the location of the special bell. Minimum temperature control lap joint length shall be as shown on the Drawings.
- K. Joint Shop Coating: All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints 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 90 00 - Painting, and Section 09 97 01 - Pipeline Coatings, as applicable.
- L. Shop Fit Test
  - 1. To ensure that joints may be fully assembled and that excessive annular space between spigots and bells does not exist, and that the pipe meets the requirements of AWWA C200, the pipe fabricator shall perform a shop fit test on a minimum of

- five joints. The joints to be tested shall be selected by the Engineer based on pipe measurements.
2. The shop fit test shall join the pipe ends in the shop with the proposed adjacent pipe end.
  3. Record the actual annular space, with the data to include as a minimum:
    - a. Maximum space at any point.
    - b. Minimum space at any point.
    - c. Space at 90-degree intervals--top, bottom, and spring line on both sides.
  4. The pipe ends shall be match marked after shop assembly.

## 2.5 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Where indicated on the Drawings, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe 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 and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the Owner.
- B. The minimum lining thickness shall be as follows, with a tolerance of plus 1/8-inch or minus 1/16-inch:
- |    |                               |                          |
|----|-------------------------------|--------------------------|
| 1. | Nominal Pipe<br>Diameter (in) | Lining Thickness<br>(in) |
|    | 4 - 10                        | 1/4                      |
|    | 11 - 23                       | 5/16                     |
|    | 24 - 36                       | 3/8                      |
|    | over 36                       | 1/2                      |
- C. The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defective linings, as determined by the Engineer, 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 rejected or repaired per C205 at the discretion of the Engineer.
- E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for shop or 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. Cement-Mortar Lining: Unless otherwise indicated, all steel pipe shall be mortar-lined. The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:
1. Pozzolan 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 rejected or repaired at the discretion of the Engineer.
  5. Field applied mortar lining shall meet the requirements of this Subparagraph F.
  6. Grout mixture for field applied joint lining shall include two parts sand to one part Type II Portland Cement by volume and potable water. NSF approved acrylic latex admixture (Flex-Con, or equal) shall be added to mortar as needed to make dough like consistency for hand packing into joint area.
- G. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All 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 Steel Pipe: The exterior coating of all steel pipe shall be in accordance with Section 09 97 01 – Pipeline Coating.

## 2.7 PIPE APPURTENANCES

- A. Pipe appurtenances shall be in accordance with the requirements of Section 40 05 00 - Piping, General.

## 2.8 PIPELINE MARKING TAPE

- A. Metallic Tape: Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be 12 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, and shall read "WEST JORDAN CITY - WATER LINE BURIED BELOW". Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.
- B. Plastic Tape: Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis acids, and chemicals and solvents which are likely in the soil. Tape shall be 12 inches wide and lettering shall be 1-inch tall permanent black on a blue background. Lettering shall read: "WEST JORDAN CITY - WATER LINE BURIED BELOW." Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.

## 2.9 MARKERS

- A. Provide pipeline markers at the locations indicated. Markers in open areas shall be High Visibility Tri-View Utility Marking Posts as manufactured by Rhino Marking and Protection Systems ([www.rhinomarkers.com](http://www.rhinomarkers.com))). Coordinate color and lettering with Owner prior to

installation. Markers shall be provided at maximum intervals of 250-feet, or as otherwise indicated on the plans.

- B. Brass Caps: Caps shall be 2-1/2-inch diameter brass caps with posts set by epoxy into holes drilled into the curb adjacent to the pipeline. Brass caps and monuments shall be provided in locations as described in the plans. Caps shall be LIETZ 8/34-06 or equal, stamped with the following information:
1. "WEST JORDAN CITY".
  2. Lateral name, e.g. "FWR Inlet".
  3. Appurtenance designation, ["Drainvalve"] ["Buried Manhole"] ["Bifurcation, FB"] ["Air Valve, AV"] ["Lateral Centerline, C/L"].
  4. Station number.
  5. Distance and direction to appurtenance or lateral centerline.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF PIPE**

- A. Handling and Storage: All pipe, fittings, and specials shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated below. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks or other damage that may be harmful as determined by the Engineer. Such damaged lining and coating/interior and exterior surfaces, shall be repaired to the satisfaction of the Engineer, or a new undamaged pipe shall be furnished.
- B. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor at no additional cost to the Owner.
- C. Inspect each pipe and fitting to insure that there are no damaged portions of the pipe. Remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.
- D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.
- E. Lifting points shall be no closer than the 1/3 and 2/3 points along the length of the Section. Contractor shall be responsible for selecting lifting points that when used, do not result in damage to the pipe.
- F. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

- G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, short lengths of pipe, by the use of beveled joint rings, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer or the amount that results in more than a 1/8-inch gap at the weld location, whichever is less. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.
- H. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which 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. All bends shall be properly installed as shown.
- I. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42 inches in diameter and larger. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed to a minimum of 3-feet, the struts shall be removed by the Contractor and shall remain the property of the Contractor. Struts shall not be removed with a torch or any other method that may damage the pipe lining or coating. The parent pipe material shall not be nicked, gouged, or damaged during strut removal. All repairs of gouges or nicks in the parent material shall be made using 3/32-inch maximum diameter E-6010 welding electrodes with a maximum heat input of 5.6 kj per inch. Tack welds, stull metal, weld splatter, slag, and burrs that remain attached to the parent metal surface after cutting shall be ground to within 1/32 inch of the parent metal. Grinding shall not penetrate the parent metal. The Contractor shall notify the Engineer prior to grinding. Following grinding, all pipe surfaces at the tack weld shall be visually inspected for defects. All defects deeper than 1/16 inch shall be repaired by welding in accordance with ANSI/AWSD.1.1 and AWWA/ANSI C206. All inspection work shall be performed by a certified welding inspector.
- J. For pipe backfilled with CLSM, the pipe shall be laid directly on moist sandbags or other suitable supports approved by the Engineer in preparation for 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. The Contractor shall provide additional sandbags as needed to support the pipe on line and grade. For pipe bedded in granular material, no blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- K. At all times, means shall be provided to prevent the pipe from floating. Take all necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The 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 foreign materials and in a clean and sanitary condition until its acceptance by the Owner.

L. Bulkheads

1. Prior to shipment of pipe with cement mortar lining the lining shall be wetted then a suitable bulkhead shall be attached to each end of the pipe section. This bulkhead shall remain in place and in good condition through transit to the Project.
2. During construction the openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop 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. Introduce water into the pipe as needed to keep the mortar moist where moisture has been lost due to damaged bulkheads.

M. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

N. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and the following requirements:

1. Each section of pipe 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 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. Pipe deflection, after backfill but prior to installation of field-applied cement mortar lining, if applied, shall not exceed 2.25 percent for flexible coated pipe and 1.5 percent for cement mortar coated pipe. Deflection shall be measured by the difference in vertical inside diameter in the installed pipe and the manufactured pipe.
5. Pipe not conforming to these criteria or which otherwise impact the ability to complete the Work shall be removed and reinstalled in full conformance with the Contract Documents at no additional cost to the Owner.
6. For each section of pipe, record the invert elevation at the lower end and incorporate the data on the Record Drawings.

O. Protection of Pipe: At locations where the Contractor proposes to cross the installed pipeline with heavy equipment, precautions as approved by the Engineer shall be taken to protect the pipe from damage. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Any damage to the pipe caused by the Contractor's operation or his equipment shall be repaired at no additional cost to the Owner.

3.2 WELDED JOINTS

A. 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. All 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. The Contractor shall obtain the services of an independent testing laboratory to perform the welder qualification onsite. Copies of all test data and certifications shall be provided to the Engineer. All costs for welder qualification testing shall be at no increased cost to the Owner.
  3. Upon completion of each field-welded joint, the welding operator shall mark his regularly assigned identification number and the last two numbers of the year in which the Work was completed, or the Contractor may have a records system that traces a welder's work completion to a specific joint. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round nose types, are used.
  4. All single welded lap joints will be inspected by the Contractor in the presence of the Engineer using magnetic particle or dye penetration methods. Field butt welds will be inspected by the Contractor 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. All double welded lap joints and butt strap joints shall be air tested by the Contractor in the presence of the Engineer in accordance with Section 33 13 00 - Water Pipeline Testing and Disinfection. Repairs and retesting shall be required if any loss of pressure occurs.
  6. The Contractor shall inform the Engineer before completed weld joints are to be backfilled so that the joint may be inspected. The Contractor shall assume all costs of exposing backfilled joints for inspection when backfilling preceded the inspection.
  7. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to the requirements of SNT-TC-1A.
    - a. The Engineer may also order nondestructive testing by an independent testing laboratory in addition to any testing specified herein. Except as otherwise specified herein, all costs for the independent testing laboratory to inspect and test field welds will be paid for by the Owner. If the weld is defective, the inspection costs shall be paid for by the Contractor. Defective welds shall be repaired and retested at the Contractor's expense.
    - b. Test reports of all laboratory tests shall be submitted as provided in the quality control section.
- B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. Lap Welded Joints: During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap as shown on the Drawings.
- D. Butt Straps: Where used or required, shall be as shown on the Drawings.



- E. After the pipe and pipe joint are properly positioned in the trench, weld and provide external joint protection for all joints except the special temperature control lap joint hereinafter specified. The length of pipe between special temperature control joints shall be backfilled to at least one foot above the top of the pipe as hereinafter specified. The special temperature control joints shall be welded after the pipe is backfilled to at least one foot above the top of the pipe for the full distance between the temperature control joints upstream and downstream. Joint protection shall be provided for special temperature control joints after completion of the joint welds and tests as specified. 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 special temperature control joint.
- F. Control of Temperature Stresses
1. Control temperature stresses in accordance with AWWA C206, the approved temperature stress control submittal, and these Specifications. Provide special temperature control lap joints at intervals of **400** feet or less, unless otherwise approved by the Engineer.
  2. To control temperature stresses, the unbackfilled special temperature control joint areas of all pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The "temperature control joint area" is defined as the entire length of pipe left exposed near a control joint after placing the pipe backfill between it and the other control joints in each direction. The term "special temperature control joint area" is defined as the entire length of pipe left exposed near a control joint after placing the backfill between it and the other control joints in each direction. 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 45 degrees F.
  3. At intervals not exceeding 400 feet along welded reaches of the pipeline, at the first regular lap-welded field joints outside concrete encasements and structures, and where shown, the pipe shall be supplied with a special temperature control lap joint and laid with an initial lap of not less than 3 inches greater than the typical lap joint. Where temperature control lap joints occur in a traveled roadway or other inconvenient location, the location of the joint may be adjusted, as acceptable to the Engineer.
  4. Provide and install thermocouple temperature gauges to monitor the temperature of the steel pipe wall on the inside top of the pipe as it lays in the trench. All pipe temperature requirements specified herein shall be measured at the top inside of the steel cylinder. Specific temperature requirements for the pipeline steel cylinder shall be met prior to installation of the controlled low strength material (CLSM), during and after placement of CLSM, and during welding of the special temperature control joints. If atmospheric conditions do not allow the conditions to be met, supplemental cooling shall be required by the Contractor. The following outlines the specific temperature control requirements.
    - a. Prior to and during placement of the CLSM, the pipeline steel temperature shall be at or below 90 degrees F. The specified temperature shall be maintained for at least three hours after the placement of CLSM. The specified temperature shall be maintained until the line is fully backfilled. Provide supplemental cooling as required.

- b. Placement of CLSM shall proceed in the direction of pipe laying from one special temperature control joint to the next. During placement of CLSM, the lead end of the pipe section (toward the next special temperature control joint) shall be left unbackfilled or otherwise unrestrained such that the end of the pipe is free to move in response to expansion or contraction due to temperature changes. CLSM shall not be placed in a direction which would result in CLSM placement proceeding in a direction toward previously or simultaneously placed CLSM without the written permission of the Engineer. The direction of CLSM placement will not be limited for placement at the short unbackfilled section immediately adjacent to the special temperature control joints.
  - c. During periods between CLSM placement operations, any section of pipeline that is backfilled with CLSM shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The temperature of the partially backfilled pipe shall not be allowed to exceed 110 degrees Fahrenheit at any time. Provide supplemental cooling as required. Shading materials shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the partially backfilled pipe need not be performed when the Contractor can demonstrate to the satisfaction of the Engineer, using thermocouple data, that shading is not necessary to the Contractor to meet the specified temperature requirement.
  - d. Prior to welding the special temperature control joints, the pipeline extending [400] feet each direction from the joint shall be maintained at or below 85 degrees F. Additionally, the pipeline extending [400] feet each direction from the joint shall be backfilled with CLSM to at least one foot over the top of the pipe. At the specified temperature, the special temperature control joints can be welded. Begin and complete the weld during the coolest interval of suitable length within a 24-hour day. Use the thermocouple temperature data to demonstrate to the Engineer the coolest interval of the day.
  - e. After welding any temperature control joint, the pipe temperature for 150 feet in each direction from the control joint shall be maintained below 110 degrees F for a minimum of 24 hours after the temperature control joint area has been backfilled to at least 1 foot over the top of the pipe. This requirement is in addition to the shading and CLSM placement temperature requirements indicated herein.
- G. Prior to the beginning of pouring CLSM or beginning the welding procedure, any tack welds or joint stops 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 ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.
- H. Testing of Joints: The pipeline joints shall be tested as specified herein and in Section 33 13 00 - Water Pipeline Testing and Disinfection.

- I. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these Specifications after which backfilling may be completed.
- J. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.
- K. Repair of Welds: All welds that are defective shall be repaired by the Contractor to meet the requirements of this Section at no additional cost to the Owner. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. 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 all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The grout for joint coating and lining shall be cement grout in accordance with Section 03 60 00 - Grouting, except that composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency
- B. Joint Coating: In accordance with the requirements of Section 09 97 01 – Pipeline Coating.
- C. Joint Lining:
  - 1. Clean joint to remove dirt, debris, and other contaminants.
  - 2. Apply a single application of NSF approved acrylic latex bonding admixture (Flex-Con, or equal) to wet out joint for the promotion of adhesion.
  - 3. The grout for joint lining shall be cement grout in accordance with Section 03 60 00 – Grouting, except that composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency. NSF approved acrylic latex admixture shall be added to develop a dough like consistency.
  - 4. Mortar mixture is hand packed into the joint area.
  - 5. Joint is troweled smooth to create a uniform transition between existing mortar lined pipe.
  - 6. Joint area is swept clean of debris.
  - 7. After the backfill has been completed to final grade, the interior joint recess of shop-lined pipe shall be filled with grout, tightly packed into the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout 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 containing one part cement to two parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

### 3.4 CEMENT-MORTAR LINING, FIELD-APPLIED

- A. Unless otherwise indicated, the Contractor shall construct the cement-mortar lining in-place after the pipeline is backfilled to approximate finished grade. The application of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602.

1. The lining machine shall be of a type that has been used successfully for a similar size of pipe. Perform all Work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining to pipelines of size comparable to this Work.
2. Curing of the in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602, except the Contractor shall be responsible for curing and maintaining the lining until final acceptance by the Owner. Provide a system to maintain a suitably moist environment within the pipe to properly cure and maintain the lining. Provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.
3. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.

### 3.5 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than two parts plaster sand. Following coating with cement mortar, the appurtenances shall be coated with a protective overcoat in accordance with the paragraph entitled "Protective Coating."
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation. Valves (body and seat) shall not be subjected to test pressures greater than manufacturer's recommendation. In some cases this may require an increase in the valve pressure class.
- C. All buried valves shall be coated and protected in accordance with Section 09 97 01 - Pipeline Coating.
- D. All valves shall be installed so that the valve stems are plumb and in the location indicated.
- E. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.
- F. All buried flanges shall be coated and protected in accordance with Section 09 97 01 - Pipeline Coating.
- G. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being 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.

- H. 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 with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.
  - I. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09 97 01 - Pipeline Coating.
- 3.6 CORROSION CONTROL (NOT USED)
- A. Cathodic Protection: Corrosion mitigation and testing materials shall be provided where indicated.
- 3.7 MARKING TAPE INSTALLATION
- A. Continuously install metallic marking tape along the pipe at the depth and shown on the Drawings.
- 3.8 PIPELINE TESTING
- A. The steel pipe shall be hydrostatically tested as specified in Section 33 13 00 – Water Pipeline Testing and Disinfection.

END OF SECTION

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**SECTION 33 11 12**  
**STEEL PIPE FABRICATED SPECIALS (AWWA C200, MODIFIED)**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide all bends, reducers, wyes, tees, crosses, outlets, manifolds and other steel plate specials, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ASME B 16.9	Factory-Made Wrought Steel Butt Welding Fittings
ASTM E 165	Practice for Liquid Penetrant Examination
ANSI/AWWA C200	Steel Water Pipe 6 In and Larger
ANSI/AWWA C205	Cement Mortar Lining and Coating – Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines - 4 In (100 mm) and Larger - In Place
ASTM A234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ANSI/AWS D.1.1	Structural Welding Code - Steel
API Standard 1104	Welding Pipelines and Related Structures
AWWA M-11	Steel Water Pipe - A Guide for Design and Installation
ASME	Boiler and Pressure Vessel Code

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Submit shop drawings including line and layout diagrams of all steel pipe fabricated specials in accordance with the requirements in Section 01 33 20 – Submittal Procedures. All submittals required for steel pipe and related work as listed in Section 33 11 11 - Steel Pipe, shall also be required for specials. Shop drawings shall indicate the type, size, and location of all reinforcement pieces.

- B. Design calculations shall be submitted to the Engineer for review prior to manufacture of steel pipe fabricated specials.
- C. Certifications: A certified affidavit of compliance with referenced Specifications and these Contract Documents shall be furnished for all steel pipe fabricated specials and other products or materials provided under this Section.

#### 1.4 QUALITY ASSURANCE

- A. Inspection: All specials shall be subject to inspection at the place of manufacturer/ fabrication as outlined in Section 33 11 11 - Steel Pipe.
- B. Shop Testing of Steel Pipe Fabricated Specials:
  - 1. If steel pipe fabricated specials have been fabricated from untested straight pipe, they shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure shown on the Drawings. If steel pipe fabricated specials have been fabricated from successfully tested straight pipe, no hydrostatic test shall be required unless otherwise indicated. In no case shall shop test pressure be less than 150 psi. All tees with crotch plates shall be hydrostatically tested as indicated regardless of whether or not the straight pipe sections used were previously tested.
  - 2. All welds shall be non-destructive tested at the specials fabricator's facility as specified below for various weld categories. Testing shall include submitting written documentation of procedures per Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
    - a. Butt Joint Welds: Spot radiographically examine pipe in accordance with paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Engineer, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
    - b. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
    - c. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
    - d. Welds on pipe seams for previously successfully tested straight pipe do not need to be retested.
    - e. All Welds: Contractor's certified welding inspector shall 100 percent visually examine all welds as a minimum.
    - f. In addition to weld tests herein before specified, doubler pads shall be air tested as stated in AWWA C206.
    - g. Refer to Section 33 13 00 - Water Pipeline Testing and Disinfection for field non-destructive testing.
  - 3. 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 all finished plate edges ground smooth, straight, recoated and prepared for the field joint.
  - 4. Testing shall be performed before pipe and joints have been coated or lined.
  - 5. Perform tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor, provided that the Contractor's schedule is not delayed for the convenience of the Engineer.



6. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.
- C. Field Testing: Field testing shall conform to the requirements of Section 33 13 00 - Water Pipeline Testing and Disinfection.
- D. Welding Procedure Specifications: All welding procedures used to fabricate pipe shall be in accordance with Section 33 11 11 - Steel Pipe.
- E. Welder Performance Qualifications: All welder performance qualifications shall be in accordance with Section 33 11 11 - Steel Pipe.
- F. Certified Welding Inspector: A certified welding inspector shall be provided for shop fabricated work and shall have the responsibilities outlined in Section 33 11 11 - Steel Pipe.
- G. The specials fabricator shall be experienced in the fabrication of fittings and specials similar to those required for the Work. All previous Work shall be for projects requiring fabrication to AWWA C200 and C208 standards. The fabricator shall have continuous experience with specials fabrication of the size shown and as specified for at least 3 years prior to the beginning of the Work.
- H. Fabrication: All specials shall be fabricated in the shop. No field fabrication of specials will be allowed.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Steel pipe fabricated specials (specials) are defined as fittings, closure pieces, bends, elbows, reducers, wyes, tees, crosses, outlets, manifolds, steel pipe wall sleeves, and other steel plate specials wherever located, and all piping above ground or in structures.

### 2.2 DESIGN

- A. Design: Except as otherwise provided herein, specials shall be fabricated from materials or straight pipe in full conformance with the requirements of Section 33 11 11 - Steel Pipe, ANSI/AWWA C200, and the dimensions of ANSI/AWWA C208. All fittings and specials shall be properly reinforced to withstand the internal pressure, with circumferential and longitudinal, or external loading conditions, whichever is greater. The minimum thickness of plate for pipe from which specials are to be fabricated shall be no less than the thickness of the adjacent mainline pipe, the thickness shown, or the following, whichever is thicker:

<b>Nominal Pipe Diameter (in)</b>	<b>Pipe Manifolds</b>	<b>Elbows</b>
	<b>Piping Above Ground Piping in Structures</b>	<b>Bends Reducers</b>
30 and under	Standard Weight	Standard Weight
Over 30	3/8-inch	Same as Adjacent Pipe

- B. Pipe 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 M-11, and other applicable industry standards.
- C. Joints: All joints and related work for field assembly of the pipe and specials shall conform to Section 33 11 11 - Steel Pipe. All shop joints shall be complete penetration butt-welds unless otherwise shown.

## 2.3 FABRICATION AND MATERIALS

- A. General: Reinforcement for wyes, tees, outlets, and nozzles shall be as shown. Shop welding shall conform to the applicable provisions of the ASME Boiler and Pressure Vessel Code. Field welding shall conform to ANSI/AWS D1.1 and ANSI/AWWA C206. 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 resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.
- B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application, using the same materials as are used for the pipe and in accordance with the applicable AWWA or ASTM Standards, and as modified in Section 09 97 01 - Pipeline Coating, or by other applicable sections in these Specifications. Coating and lining applied in this manner shall provide thickness and protection equal to that specified 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 removed and reapplied by hand-applications.
- C. Access manholes with covers shall be as indicated. All threaded outlets shall be forged steel suitable for 3,000-psi service, and shall be as manufactured by Vogt or equal.
- D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels and maximum joint deflections are not exceeded. 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 75 percent of the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. In no case shall pulled joints result in a gap between the bell and spigot at the weld location that exceeds 1/8 inch. All horizontal deflections or fabricated angles shall fall on the alignment, as shown.
- E. All vertical deflections shall fall on the alignment and 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 14-inch and smaller shall be fabricated from ASTM A 53, Type E or S, Grade B, standard weight steel pipe in the standard outside diameters, i.e., 14, 12-3/4-inch, 10-

- 3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch. Wall thickness and collar reinforcing shall be as shown.
2. In lieu of collar reinforcement as shown, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
  3. Where required by Manual M-11 or other industry standard, the design procedure for crotch plate reinforcement, such reinforcement shall be required.
- G. Steel Welding Fittings: Steel welding fittings for pipe spools and fittings smaller than 24 inches in diameter shall be in accordance with ANSI B16.9 conforming to ASTM A 234. Use standard weight. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thicknesses. The Contractor shall be fully responsible for coordinating the difference in diameter convention between these specials and AWWA C200/C208 pipe and fittings to provide complete piping systems as shown.
- H. Ends for Mechanical-Type Couplings: Except as otherwise indicated, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.
- I. Lining: All requirements pertaining to thickness, application and curing of cement mortar lining indicated for straight pipe shall apply to specials, with the following provision. If the special cannot be lined centrifugally or with field lining equipment, it shall be lined by hand. In such case, the lining shall be reinforced with welded wire fabric positioned approximately in the center of the lining and in accordance with AWWA C205 for lining of specials.
- J. Coating: All requirements pertaining to thickness, application and curing of coating indicated for straight pipe shall apply to specials. Unless otherwise indicated the coating on the buried portion of a pipe section passing through a structure wall shall extend to the center of the wall, or to the wall flanges, if one is indicated. Pipe above ground or in structures shall be shop primed and field-painted in accordance with Section 09 90 00 - Coatings and Painting.
- K. Marking: A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.
- L. Shop Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape or polyolefin coating in accordance with AWWA C209, C214, C215, or C216 shall be ground such that the maximum weld bead height will not exceed 1/32 inch. All ground weld seams shall be smooth and free of all burrs.
- M. Portions of wall sleeves that penetrate into hydraulic structures and will be embedded into concrete shall be shop lined and coated in accordance with requirements for submerged conditions as outlined in Section 09 90 00 - Coatings and Painting.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Provide all fittings, closure pieces, elbows, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated to provide a complete and workable installation. Where pipe support details are indicated, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically indicated. Where indicated, concrete thrusts blocks and welded joints shall be provided. At all times when the Work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials.
- B. Take all necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The 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 foreign materials and in a clean and sanitary condition until its acceptance by the Owner.
- C. Unless otherwise indicated, all specials shall be installed in full conformance with Section 33 11 11 - Steel Pipe, and other applicable sections of these Contract Documents.

END OF SECTION

**SECTION 33 13 00**  
**WATER PIPELINE TESTING AND DISINFECTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall perform flushing and testing of all pressure pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable and fire water, complete.
- B. This specification applies to all pipelines requiring hydrostatic tests (water medium) regardless of the pipeline service medium.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

**A. Commercial Standards**

ANSI/AWWA B300	Hypochlorites
ANSI/AWWA B301	Liquid Chlorine
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C651	Disinfecting Water Mains

**1.3 CONTRACTOR SUBMITTALS**

- A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 7 days before testing is to start.
- B. A copy of the Utah Pollutant Discharge Elimination System (UPDES) permit application shall be submitted a minimum of 30 days prior to the proposed date to start testing. A copy of the approved UPDES permit shall be submitted prior to the start of testing.
- C. Chlorine residual test data and bacteriological test data shall be submitted to document the results of the pipeline disinfection. Tests shall be conducted 24 hours after the start of disinfection.

**PART 2 - PRODUCTS**

**2.1 MATERIALS REQUIREMENTS**

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

- B. Used pressure gauges shall be recertified prior to testing.
- C. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- D. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
  - 1. In combination with appropriate gas flow chlorinators and ejectors;
  - 2. Under the direct supervision of an experienced technician;
  - 3. When appropriate safety practices are observed.
- E. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300 - Hypochlorite.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Cleaning: Prior to hydrostatic testing, the pipe shall be thoroughly cleaned by sweeping. Foreign matter adhering to the pipe walls shall be removed. Debris from all sources shall be removed from the pipe. Pipe smaller than 24-inch shall be flushed in accordance with AWWA C 651 - Disinfecting Water Mains. A final inspection for cleanliness will be scheduled immediately prior to testing and disinfection.
- B. Water for testing and disinfecting water pipelines shall be furnished by the Owner. The Contractor shall make all necessary provisions for conveying the water from the source to the points of use, and disposal of the water (and dechlorinating - where applicable).
- C. All potable water and pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination for all pipelines providing potable water or connected to a potable water system. All chlorinating and testing operations shall be performed in the presence of the Engineer.
- D. Disinfection operations shall be scheduled as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the Owner. Bacteriological testing (coliform bacteria) shall be performed by a certified testing laboratory approved by the Owner, and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the Utah DEQ or other appropriate regulatory agency.
- E. Pipeline pressure tests will include the following tests:
  - 1. Air test of double welded lap joints.
  - 2. Hydrostatic pressure test of all pipelines, either in sections or as a unit. Separate hydrostatic tests shall be conducted on each side of mainline valves.
  - 3. Contractor shall conduct the discharge in accordance with the Utah Pollutant Discharge Elimination System (UPDES) permit from the Utah Division of Environmental Quality (UDEQ). The Contractor shall apply a reducing agent to the discharged water to neutralize the chlorine residual and meet the chlorine residual limit required under the permit. The Owner shall conduct the water quality sampling

of the discharge as required by the permit. The Contractor shall notify local agencies, secure appropriate other permits and approvals, and provide erosion control measures for any releases as appropriate. Release of water after pipeline testing and disinfection have been completed shall be only if acceptable to the Engineer.

- F. Notification: Notify the Engineer at each of the following stages:
1. Three working days prior to the start of filling the pipeline with water.
  2. Three working days prior to the start of chlorination.
  3. Twenty-four hours before withdrawing samples for bacteriological testing.
  4. Three working days prior to the start of flushing.

### 3.2 HYDROSTATIC TESTING OF PIPELINES

- A. Test Pressure: The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours with zero leakage. The test pressure for distribution and transmission pipelines shall be 150 percent of the design pressure or 200 psi, whichever is greater, measured at the lowest point of the pipeline section being tested. The test pressure for yard piping shall be as shown or specified on the Drawings measured at the lowest point of the pipeline section being tested. All visible leaks shall be repaired in a manner acceptable to the Engineer.
- B. Field Pressure Testing: Pressure test installed valves, as installed in the field, and adjust as necessary to drip-tight performance. Butterfly and sleeve valves shall be tested with specified minimum pressure applied to each side independently, and the valve tested for drop tight performance with zero pressure on the other side of the valve. Other valves shall be tested from the upstream side only. If pipeline testing is to be bulkheaded with any valve, the valve shall be tested and adjusted before the pipeline test is applied. Provisions, satisfactory to the Engineer, shall be made for verifying "0" leakage within the duration of test selected.
- C. Air Testing of Pipeline Joints: All welded joints, at butt straps and restrained joints in pipe larger than 24-inch diameter, shall be air tested to a minimum of 40-psi for a period of 10 minutes per AWWA C206 in the presence of the Engineer. Any loss of pressure during an air test shall result in repairs as necessary, and retesting as many times as necessary, until the joint satisfactorily passes the test.
1. For payment purposes, a satisfactory joint test shall be presumed as a satisfactory test of the two adjacent pieces of pipe to the next joint on either side of the tested joint. However, the pipe lengths shall be subjected to the hydrostatic test of the remainder of the pipeline and defective pipe identified during that testing operation shall be repaired to the satisfaction of the Engineer, or replaced, at the Contractor's expense.
- D. Hydrostatic Pipeline Testing: Hydrostatic testing of the pipelines shall be performed as follows:
1. No section of the pipeline shall be hydrostatically tested until all field-placed concrete or mortar has attained a minimum age of 7 days unless other methods of thrust restraint are simultaneously provided. The test shall be made by closing valves, when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitable restrained to resist the thrust of the test pressure without

damage to, or movement of, the adjacent pipe. Any un-harnessed 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. The Contractor shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

2. The pipeline shall be filled at a rate which will not cause any surges exceeding 50 psi pressure above static pressure, or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. 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 what water it will and to allow the escape of air from any air pockets. No personnel shall be within or enter any vault or confined space subject to flooding during the initial filling and for a 24 hour period. After the 24 hour period bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.
3. All visible leaks during a test, regardless of leakage rate, shall be repaired and the pipeline retested until no visible leaks occur.
4. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.
5. The Contractor shall repeat the repairing and testing procedures until the leakage is less than the specified leakage rate, at no additional cost to the Owner.
6. The bacteriological test must be completed before performing the pressure test. Care must be exercised during the pressure test not to contaminate water in the new pipeline.

### 3.3 DISINFECTING PIPELINES

- A. General: All potable water pipelines shall be disinfected in accordance with the requirements of ANSI/AWWA C651, using the Continuous-Feed Method, as modified below.
- B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be not less than 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected, from flowing back into the line supplying the water.
- C. Retention Period: Chlorinated water shall be retained in the pipeline at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 100 mg/l. Sampling points shall be not greater than 3,000 feet apart.
- D. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.



- E. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline, dechlorinated and disposed of per Section 01 74 19 – Disposal of Water.
- F. Bacteriological Testing: After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected by the Contractor from the end of the line and at other locations as designated by the Engineer, and shall be tested by the Owner for bacteriological quality in accordance with the requirements of the Utah DEQ or other appropriate regulatory agency. For this purpose the pipe shall be refilled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated as many times as needed, until acceptable results are obtained, at no additional cost to the Owner.
- G. Coliform bacteria and e. Coli tests must be run and must be negative for both total coliforms and e. Coli (P/A Method is acceptable). Heterotrophic plate counts also need to be run on each sample (Simplate Method is acceptable) with results of less than 30 MPN/mL.

#### 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 they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

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**SECTION 33 13 01**  
**HYDRAULIC STRUCTURES TESTING AND DISINFECTION**

**PART 1 - GENERAL**

1.1 THE REQUIREMENT

- A. The Contractor shall perform cleaning, flushing, disinfection and testing of all hydraulic structures and appurtenant piping, including conveyance of test water from Owner-designated source to point of use, and including all disposal of testing and disinfection water, complete and acceptable, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

- A. Commercial Standards:

ANSI/AWWA B300	Hypochlorites
ANSI/AWWA B301	Liquid Chlorine
ANSI/AWWA C651	Disinfecting Water Mains
ANSI/AWWA C652	Disinfection of Water-Storage Facilities
ANSI/AWWA C653	Disinfection of Water Treatment Plants
APHA/AWWA/WPCF Standard Methods for the Examination of Water and Wastewater (16th edition)	

1.3 CONTRACTOR SUBMITTALS

- A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection, shall be submitted in writing for approval a minimum of 2 days before testing is to start.

**PART 2 - PRODUCTS**

- A. All temporary valves, bulkheads, or any other control equipment shall be as determined by the Contractor subject to the Engineer's review.
- B. Chlorine for disinfection shall be in the form of liquid chlorine or sodium hypochlorite solution. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301; sodium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300. Liquid chlorine shall be used only (1) in combination with appropriate gas flow chlorinators and ejectors; (2) under the direct supervision of an experienced technician; and (3) when appropriate safety practices are observed.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Water for testing and disinfecting will be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use. The Contractor shall be responsible for all costs associated with retesting. Water supplied by the Owner for retesting will cost the Contractor \$150 per acre foot for water used.
- B. All hydraulic structures and appurtenant pressure piping shall be tested; those for potable water shall also be disinfected. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the Engineer. In the case of a reservoir, testing and disinfecting operations shall be combined.
- C. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the Owner. Release of water from structures, after testing and disinfecting have been completed, shall be acceptable to the Engineer.

### **3.2 PRELIMINARY CLEANING AND FLUSHING**

- A. Prior to both testing and disinfecting, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle. All water, dirt, and foreign material accumulated in this cleaning operation shall be removed from the structure. The water supply for the washdown system is supplied by Owner. The Owner will pay for the initial cleaning and flushing. Any additional cleaning and flushing shall be at the Contractor's expense.

### **3.3 TESTING OF HYDRAULIC STRUCTURES AND PIPELINES**

- A. General: Testing shall be performed prior to backfilling. Testing shall be performed no sooner than 14 days after all portions of structure walls and associated roof systems have been completed. The structure shall be filled with water to the maximum operating water surface. The rate of filling shall not exceed 48 inches of depth per day. All leakage shall be repaired.
- B. Leakage Test Requirements: After the structure has been filled, the water loss leakage test shall be performed as follows: an initial water level reading shall be made. Seven days following the initial reading, a second reading shall be made. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed 0.2 percent of the total volume of water in the structure, after allowance is made for evaporation loss. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action taken to correct the problem before commencing a new 7-day test period. Should the structure fail to pass the test, the test shall be repeated for up to 3 additional 7-day test period. If, at the end of 28 days, the structure still fails to pass the leakage test, the Contractor shall empty the structure as acceptable to the Engineer and shall examine the interior for evidence of any cracking or other conditions

that might be responsible for the leakage. Piping shall be tested as specified in Section 33 13 00 - Water Pipeline Cleaning, Testing and Disinfection.

Structural Repairs: The Contractor shall repair any cracks. Cracks shall be grooved and sealed with Xypex in accordance manufacturer's instructions and Contract Drawings. Any evidence of leakage shall be repaired. Following these operations, the Contractor shall again test the hydraulic structure. The structure will not be accepted as completed until the water loss leakage test is passed and all visible leakage repaired. In the case of a reservoir, the retesting shall again be combined with disinfection.

### 3.4 DISINFECTION OF HYDRAULIC STRUCTURES AND PIPELINES

- A. General: Hydraulic structures which store or convey culinary potable water shall be disinfected by chlorination. Chlorination of hydraulic structures shall be performed in accordance with the requirements of ANSI/AWWA C652 using a combination of chlorination Methods 2 and 3 as modified within this Section. All piping shall be disinfected as specified in Section 33 13 00 - Water Pipeline Cleaning, Testing and Disinfection.
- B. Chlorination: A chlorine solution (about 200 mg/l) shall be sprayed on all interior surfaces of the structure. The structure shall then be partially filled with water to a depth of approximately one-foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the inflowing water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/l upon completion of the partial filling operation. The Contractor's attention is directed that all precautions shall be taken to prevent the chlorine solution from flowing back into the inlet water supply lines. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the chlorinated water.
- C. Retention: Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorinated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/l. All valves shall be operated while the lines are filled with the heavily chlorinated water.
- D. Final Filling: After the chlorine residual has been checked, and has been found satisfactory, the water level in the structure shall be raised to its working water level elevation by adding potable water. Before final filling is commenced, the quantity of chlorinated water remaining in the structure after filling the piping shall, unless otherwise acceptable to the Engineer, be sufficient, when the water level is raised to its final elevation to produce a free chlorine residual of between 1 and 2 mg/l. After the structure has been filled, the chlorine residual of the water shall be determined. If the chlorine residual is less than 1 mg/l, an additional chlorine dosage shall be added to the water in the structure. If the chlorine residual is greater than 2 mg/l, the structure shall be partially emptied and additional potable water added. In no case shall water be released prior to the expiration of the required retention period.

### 3.5 BACTERIOLOGICAL SAMPLING AND TESTING

- A. Disinfected water storage facilities shall be sampled and tested in accordance with ANSI/AWWA C652. Bacteriological testing shall be performed by a certified testing laboratory acceptable to the Owner and paid for by the Contractor. Results of the testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.

### 3.6 VOLATILE ORGANIC COMPOUNDS TESTING

- A. Disinfected water storage facilities shall be tested for volatile organic compounds to verify compliance with drinking water maximum contaminant levels prior to placing tank in service.
- B. Verify that no tastes, odors, toxins, or contaminants that result in MCL exceedances are imparted to the water as a result of coatings.

### 3.7 CONNECTIONS TO EXISTING WATER 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 they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

END OF SECTION

**SECTION 33 41 01  
DRAINAGE PIPELINE SYSTEM TESTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall perform all pipeline flushing and testing, complete, for drainage system piping as specified herein and in accordance with the requirements of the Contract Documents.
- B. The Contractor shall be responsible for conveying flushing water from the source to the point of usage and also for disposal, as required, of water used in the flushing operations.
- C. For the purposes of this specification, drainage or drain pipelines are storm drains.

**1.2 CONTRACTOR SUBMITTALS**

- A. The Contractor shall submit minimum 48-hour advance written notice of its proposed testing schedule for review and concurrence of the Engineer. The Contractor's proposed plans for water conveyance, control, and disposal shall also be submitted in writing.

**PART 2 - PRODUCTS – (NOT USED)**

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. All testing operations shall be performed in the presence of the Engineer.
- B. All drainage pipes shall be tested for alignment, joint displacement and deflection as specified herein. All pipes shall be backfilled prior to testing. Any pipe found to be defective shall be repaired or replaced to the satisfaction of the Engineer.
- C. Pipe sizes from 12-inch through 30-inch in diameter shall require a displacement test. Pipe sizes from 36-inch diameter and larger shall require a displacement test and visual walk-through inspection. All flexible and semi-rigid pipe shall require a deflection test.

**3.2 TESTING OF PIPING**

- A. Deflection Test: All flexible and semi-rigid main line pipe shall be tested for deflection, joint displacement, or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing. The mandrel shall be a full circle, solid cylinder, or a rigid, non-adjustable, odd-numbered leg (9 leg minimum) steel cylinder, approved by the Engineer as to design and manufacture. The circular cross section of the mandrel shall have a diameter of at least 95 percent of the specified average inside pipe diameter of the pipe and the minimum length of the circular

portion of the mandrel shall be equal to the nominal diameter of the pipe. Obstructions encountered by the mandrel shall be corrected by the Contractor.

- B. Displacement Test: The displacement test shall be performed by flashing a light between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned, or displaced pipe or other defects, the defects designated by the Engineer shall be repaired to the satisfaction of the Engineer.
- C. Visual Test: A visual test shall be conducted on pipes 36-inch in diameter and larger. The test shall be conducted after the pipes have been flushed or otherwise cleaned. The test shall be performed by the Engineer or his representative and a representative of the Contractor. The interior of the pipe shall be visual inspected for alignment, cracking, displaced or improper joints or other defects. Defects shall be repaired to the satisfaction of the Engineer.
- D. Televised Inspection: After the drain pipe has been installed and cleaned; and the trench has been filled, the Contractor shall televise the drain pipe to locate defects in the drain pipe.
  - 1. The Contractor shall arrange for the televised inspections.
  - 2. The Contractor shall ensure safe access to each manhole for the television trucks.
  - 3. Lines to be video inspected shall be flushed within 24 hours prior to beginning of inspection.
  - 4. Any Work not conforming to these Design Standards and Construction Specifications shall be promptly removed, replaced and retested at no cost to the Owner.
    - a. In addition to other requirements identified in the Design Standards and Construction Specifications, the following conditions identified during video inspection shall be promptly corrected by removal, replacement and retesting of the unsatisfactory pipe by the Contractor at no cost to the Owner:
      - 1) Alignment (Vertical or Horizontal) is outside the specified limits.
      - 2) Water ponds in any section with depths equal to or greater than 2 times the grade tolerance specified in the Contract Documents.
      - 3) Pipe section with visible defects, such as: open joints, pinched gaskets, cracked barrels or bells, leaks, or other defects as determined by the Engineer.
  - 5. A copy of televised inspection shall be provided to the Owner in a format selected by the Owner (DVD, etc.).
  - 6. Video equipment shall be equipped with a device that can accurately measure the depth of any ponding encountered in the pipe. Measuring device shall be clearly visible in the video image.

END OF SECTION



**SECTION 33 41 02**  
**REINFORCED CONCRETE PIPE (ASTM C 76, MODIFIED)**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall construct all reinforced concrete culvert, storm drain conduits, complete, including connection to existing and new structures, all in accordance with the Contract Documents.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Commercial Standards:

ASTM C76	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
ASTM C443	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
ASTM C1479	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

**1.3 CONTRACTOR SUBMITTALS**

- A. The Contractor shall furnish certificates to the Engineer guaranteeing that the pipe furnished hereunder is in compliance with the requirements of these Specifications.

**1.4 QUALITY ASSURANCE**

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The Contractor shall notify the Engineer in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Test: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. The Contractor shall perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

- E. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.
- F. Any concrete pipe which arrives on site with voids, cracked, damaged, or with inadequate concrete cover over reinforcement or exposed reinforcement, or is cracked or damaged during installation shall be cause for rejection. Contractor shall remove precast section(s) from the project site and replace with new undamaged sections at no additional cost to Owner.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Handle concrete pipe in positions consistent with their shape and design. Lift and support only from the support points indicated on the shop drawings.
- B. Embedded Lifting or Handling Devices capable of supporting pipe in positions anticipated during manufacturing, storage, transportation and installation.
- C. Block and brace pipe during storage. Provide lateral bracing which is sufficient to prevent bowing and/or warping and will not inhibit curing of the exposed surfaces.

## PART 2 - PRODUCTS

### 2.1 PIPE MATERIALS

- A. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76 meeting the pipe class as shown on the drawings. Bell and spigot joints including rubber gaskets, shall conform to the requirements of the latest revision of ASTM C443. Pipe joints shall be so designed 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 end of pipes larger than 12 inches so that pipe movement or hydrostatic pressure cannot displace the gasket. All pipe shall be manufactured with Type II modified cement. Each pipe section shall be identified by a stamp indicating:
  - 1. Name of Manufacturer
  - 2. Date of Manufacture
  - 3. D-loading in pounds and/or Pipe Class

### 2.2 CONCRETE END SECTIONS

- A. End Sections: Precast reinforced concrete end sections shall have at least one line of reinforcement conforming to the requirements of AASHTO M170 equivalent to the square inches per linear foot for elliptical reinforcement for circular pipe, Class II, Wall B.

### 2.3 FABRICATION

- A. Maintain plant records and quality control program during fabrication of structural precast concrete sections. Make all quality control records available to Engineer upon request.

- B. Use molds that are rigid, and constructed of material that will result in uniform finished surfaces.
- C. If self-consolidating concrete is not used, thoroughly vibrate concrete to ensure proper consolidation, elimination of cold joints, and to minimize trapped air on at the concrete surface.
- D. Fabricate and provide the required lifting devices which are compatible with embedded components.
- E. Ensure reinforcing steel, anchors, inserts, plates, angle and other cast-in items are sufficiently embedded, properly secured, and correctly located. Ensure the reinforcing steel is properly supported to prevent movement or shifting during fabrication. Inadequate concrete cover over reinforcing shall be cause for rejection.
- F. Chairs or spacers between the reinforcement and forms shall be stainless steel or a nonferrous material.
- G. Cure concrete pipe under identical conditions to develop specified concrete quality.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of ASTM C 1479, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

#### **3.2 TRENCHING AND BACKFILL**

- A. Trench excavation and backfill shall conform to the requirements of Section 02200 – Earthwork.

#### **3.3 INSTALLATION**

- A. The pipe 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 adjoining 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 (1/2) inch maximum.

- B. All concrete pipe installation shall proceed up grade 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 of gaskets. Joints shall be clean and dry before a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating jointing surfaces 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. Place circular concrete pipe that contains elliptical reinforcing so that the reference line designating the top of the pipe is not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe.
  - E. Pipe zone 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 rejointed 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.
  - F. In addition to the above-mentioned requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.
  - G. During pipe installation, the trench shall be sufficiently dewatered that the joints will be free of water when jointed.
  - H. Grout all fittings to provide a smooth interior and exterior surface.
- 3.4 FIELD QUALITY CONTROL:
- A. All installations of reinforced concrete pipe shall be subject to the testing, inspection and acceptance requirements of Section 33 41 01 – Drainage Pipeline Testing and Inspection

END OF SECTION

**SECTION 33 41 03**  
**PVC NON-PRESSURE PIPE, RUBBER JOINTS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide PVC non-pressure pipe and appurtenant work, complete and in place, in accordance with the Contract Documents.
- B. This Section covers pipe from 4 to 48 inches diameter nominal size.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM F 1803	Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
ASTM D 2444	Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and FittingsCement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
ASTM D 3212	Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Gravity Sewer Pipe and Fittings
ASTM F 794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 913	Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe

### 1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 20 – Contractor Submittals.
- B. Shop Drawings: The Contractor shall submit shop drawings and laying diagrams of pipe, joints, bends, special fittings, and piping appurtenances.
- C. Certificates: The Contractor shall submit manufacturer's certificate that pipe conforms to these specifications.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and minimum pipe stiffness in psi.
- B. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

### 2.2 PIPE

- A. Pipe shall conform to one of the following requirements
  1. Solid Wall Pipe (4" through 15") - ASTM D 3034, SDR 35.
  2. Solid Wall Pipe (18" through 48") -- ASTM F 679 – 46 psi.
  3. Ribbed Pipe (21" through 48") - ASTM F 794
  4. Closed Profile Wall Pipe (21" through 54") - ASTM F 1803 (Vylon or approved equal only)
- B. Material for PVC pipe shall conform to the requirements of ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds, for cell classification 12454-C or 12364-A as defined therein. The manufacturer shall test a sample from each batch according to ASTM D 2444 - Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- C. Joints shall conform to ASTM D 3212. Elastomeric seals for compression type joints shall conform to the requirements of ASTM F 477, ASTM F 913 - Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

### 2.3 FITTINGS

- A. All fittings shall be of the same material as the pipe, molded or formed to suit the pipe size and end design, in required configurations.
- B. The stiffness of the fittings shall be not less than the stiffness of adjoining pipe.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Laying, jointing, and testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of ASTM D 2321, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

### **3.2 HANDLING AND STORAGE**

- A. Handling
  - 1. Handling of the PVC pipe shall be done with implements, tools, and facilities as recommended by the pipe manufacturer to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
  - 2. Pipe shall be inspected both prior to and after installation in the trench and all defective lengths shall be rejected and immediately removed from the working area.
  - 3. Fittings shall be lowered into trench by means of rope, cable, chain, or other means without damage. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope, or other device be attached through the fitting interior for handling or shall pipe or fittings be dropped or dumped into the trench.
- B. Storage: Pipe should be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe should be stored in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

### **3.3 TRENCHING AND BACKFILL**

- A. Trench excavation and backfill shall conform to the requirements of Section 31 23 00 – Earthwork and the Drawings.

### **3.4 LAYING PIPE**

- A. Pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of slope.
- B. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or will produce ragged, uneven edges.

- C. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- D. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the Work shall be the Contractor's responsibility.
- E. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with owners of such utility structures. Unless otherwise indicated, protection of existing utility structures shall be the Contractor's responsibility.

### 3.5 FIELD JOINTING

- A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. A thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.
- C. Fittings shall be carefully connected to pipe, and joint shall be checked to insure a sound and proper joint.
- D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the Engineer, the trench conditions or weather are unsuitable.

### 3.6 SMALL DIAMETER LATERALS (SEWER LATERAL CONNECTIONS)

- A. Laterals shall extend from the manhole, wye branch or similar fitting, as indicated in the Drawings. Wye fitting or other connection shall be positioned in the mainline such that it enters the mainline at an angle of at least 45 degrees from horizontal. Connections requiring a connection angle of less than 45 degrees shall be approved by the Engineer.
- B. Install a 22.5 degree or 45 degree bend, or combination of bends, as required on the mainline wye to obtain the proper alignment and grade.
- C. Lateral connections to manhole shall be made as directed in Section 33 05 16 – Precast Concrete Manholes and Vaults.



- D. Laterals shall be installed along the indicated horizontal alignment with a uniform slope, free of low spots or adverse grades. Minimum slopes shall be 1/4 inch per foot for 4" diameter laterals and 1/8 inch per foot for 6" diameter laterals.
- E. Cleanouts shall be installed on laterals at a horizontal spacing not to exceed 100 feet and at the locations indicated in the Drawings.
- F. Any one bend (horizontal or vertical) shall not exceed 45 degrees and no more the two bends (horizontal or vertical) shall be installed without a cleanout.
- G. Laterals shall be installed in accordance with all applicable requirements of the local plumbing codes.

### 3.7 INSTALLATION OF METALLIC LOCATING TAPE

- A. Polyvinyl chloride pipelines shall be provided with a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade OR above top of pipe. The Contractor shall furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the Engineer.

### 3.8 TESTING

- A. Field testing of gravity sewer pipe shall conform to the requirements of Section 33 08 00 – Gravity Piping Testing and Inspection.

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**SECTION 33 41 05**  
**DUCTILE IRON PIPE (AWWA C151, MODIFIED)**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile Iron Piping and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile Iron and Gray Iron Fittings, 3-in. through 48-in. for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile Iron and Gray-Iron Pipe with Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C153/A21.53	Ductile Iron Compact Fittings, 3-in. through 12-in. for Water and Other Liquids
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
ANSI/AWWA C600	Installation of Ductile Iron Water Mains and their Appurtenances
ASTM C150	Specification for Portland Cement

### 1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The Contractor shall submit shop drawings of pipe and fittings in accordance with the requirements of Section 01 33 20 – Submittal Procedures, the requirements of the referenced standards and the following supplemental requirements as applicable and specified herein.
  - 1. Marking plan and details of standard pipe section showing dimensions, pipe joints, fitting and special fitting pressure rating and thickness, size, coating and lining data.
  - 2. Pipeline layout drawings showing the location of each pipe section, each special length, closure sections, location and angle of bends, outlets, location of valves, and other special fittings.
- B. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section, as specified in the referenced standards and the following supplemental requirements:
  - 1. Physical and chemical properties.
    - a. Hydrostatic Test Reports
- C. Sample Costs: All expenses incurred in making samples for certification of tests shall be borne by the Contractor.

### 1.4 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The Contractor shall notify the Engineer in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Test: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. The Contractor shall perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.
- E. In addition to those tests specifically required, the Engineer may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Standards: Mortar-lined and polyethylene-wrapped ductile iron pipe shall conform to ANSI/AWWA C151, C104, and C105, subject to the following supplemental requirements.

The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all flanges, specials and fittings shall be provided as required under the Contract Documents.

- B. Handling and Storage: The pipe shall be handled by devices acceptable to the Engineer, designed and constructed to prevent damage to the pipe coating/exterior. The use of equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the Engineer.
- C. Laying Lengths: Maximum pipe laying lengths shall be 20 feet with shorter lengths provided as required by the Drawings.
- D. Finish: The pipe shall have smooth and dense interior surfaces, and shall be free from fractures, excessive interior surface crazing, and roughness.
- E. 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 shown on the Drawings. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be acceptable to the Engineer.
- F. Pipe shall be new and recently manufactured. Refurbished pipe shall not be provided.

## 2.2 PIPE DESIGN CRITERIA

- A. General: Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section.
- B. Pipe Wall Thickness for Internal Pressure: The pipe shall be designed with a net thickness to withstand the design pressure in accordance with the hoop stress formula.
- C. Pipe Wall Thickness for External Load: The pipe shall also be designed with a net thickness to withstand internal loads using ANSI/AWWA C150 Design Equation (2) with the appropriate bending moment and deflection coefficients for Laying Condition Types 4 and 5 as applicable.
- D. The pipe deflection shall be checked using ANSI/AWWA C150 Design Equation (3) and the coefficients stated above. The allowable deflection shall not exceed 0.0225 times the nominal diameter.
- E. In lieu of ANSI/AWWA C150 Design Equation (4), the earth loads will be computed using the following two equations for trench or embankment loading as applicable:
  - 1. Trench Condition:
    - a.  $W_d = C_d w B_d^2$ ,  
Where:
    - b.  $W_d$  = Earth load in pounds per linear foot
    - c.  $C_d$  = Calculation Coefficient
    - d.  $Ku1$  = 0.13
    - e.  $w$  = 120 lb/ft<sup>3</sup>

- f.  $B_d$  = Trench width at top of pipe, feet
- 2. Positive Projecting Embankment Condition:
  - a.  $W_c = C_c w B_c^2$
  - b. Where:
  - c.  $W_c$  = Earth load in pounds per linear foot
  - d.  $C_c$  = Calculation Coefficient (based on  $r_{sdP}$  of 0.25)
  - e.  $K_u1$  = 0.13
  - f.  $w$  = 120 lb/ft<sup>3</sup>
  - g.  $B_c$  = Trench width at top of pipe, feet

F. The above two formulas are based on a depth of cover of 10 feet or greater. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of three feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommend by AASHTO in "Standard Specifications for Highway Bridges."

G. If the calculated deflection,  $Defl_x$ , exceeds 0.0225 times the nominal diameter, the pipe class shall be increased.

H. Minimum Pipe Wall Thickness: In addition to the requirements of this Section, the minimum wall thickness shall be in accordance with Table 50.5 of ANSI/AWWA C150.

## 2.3 MATERIALS

A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of ANSI/AWWA C151.

B. Cement: Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104, provided that cement for mortar lining shall be Type V. A fly ash or pozzolan shall not be used as a cement replacement.

C. Polyethylene Sleeve: Material for the polyethylene sleeve shall conform to the requirements of ANSI/AWWA C105.

## 2.4 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inch shall conform to the above-referenced standard with the necessary modifications for the larger size.

## 2.5 DESIGN OF PIPE

A. General: The pipe furnished shall be ductile iron pipe, mortar-lined and polyethylene-wrapped with rubber-gasketed joints as shown.

B. Manufacturing Requirements: The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to ANSI/AWWA C151.

- C. Pipe Dimensions: The pipe shall be of the diameter and class shown. The minimum wall thickness for each pipe size shall be as specified or shown.
- D. Fitting Dimensions: The fittings shall be of the diameter and class shown.
- E. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
  - 1. Mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11.
  - 2. Restrained Joint:
    - a. Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe without setscrews or devices with shoes or wedges activated by setscrews.
    - b. Rated at minimum working pressure equal to or greater than that of the pipe class.
    - c. The use of devices utilizing setscrews shall not be allowed. Primary permanent restraint for all buried pipe fittings shall be accomplished using concrete thrust blocks. Temporary fitting restraint for testing of pipelines can be accomplished using mechanical thrust restraint utilizing multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21/53. Temporary (or secondary) fitting restraint shall be in addition to primary permanent restraint. Permanent restraint for straight-run pipe joints can be accomplished using manufacturer's proprietary joint (e.g. Tyton Lock with Sure Stop gasket, or equal) or with mechanical joint restraints (e.g. EBAA Iron Megalug, or equal) utilizing multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21/53.
    - d. The use of field-lock, gripper ring type restraining devices shall be limited to only locations where unforeseen field conditions or closure places require the pipe to be field fit, cut, and joined, and as approved by the Engineer. Where field locking, gripper ring type restraining devices are used, the gripper ring shall be installed a minimum of one full pipe length away from the fitting or closure. The installation of gripper ring type restraining devices where used shall be in strict accordance with the manufacturer's installation instructions.
    - e. Field welding of ductile iron pipe and fitting shall not be allowed.
  - 3. Flanged joints shall conform to ANSI/AWWA C115/A21.15.
- F. Joint Clearances: For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.
- G. Coating and Linings Held Back: Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown, or as otherwise acceptable to the Engineer.

## 2.5 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe 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 faulty at the delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. Lining Thickness: The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (in)	Minimum Lining Thickness (in)
3-12	1/8
14-24	3/16
30-54	1/4

- C. Protection of Pipe Lining/Interior: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

## 2.6 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 90 00 – Painting and Coating.
- B. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately one mil thick.

## 2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: In accordance with AWWA C104, C105, C110, C111, C115, C150, C151, C153, and C606.

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the Site.
- B. Installation shall conform to the requirements of AWWA C600, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions



of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

### 3.2 INSTALLATION OF PIPE

- A. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe coating against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the Engineer. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. Damaged Pipe: All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- C. Contractor to Inspect Pipe: The Contractor shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe.
- D. Trench excavation and backfill shall conform to the requirements of Section 31 23 00 – Earthwork. Care shall be taken to ensure that pipe zone material is compacted and in full contact with the haunches of the pipe and that the pipe is fully supported.
- E. Clean Pipe: Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon, and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.
  - 1. Remove lumps, blisters, and excess asphaltic type coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
  - 2. Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.
- F. Pipe Laying: The pipe shall be installed in accordance with ANSI/AWWA C600.
  - 1. Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of Engineer.
  - 2. Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement. For restrained joint pipe and fittings, after each section is jointed and restraining devices are completely installed, fully extend the completed joint and place backfill as specified to prevent movement before installation of the next section of pipe or fitting.
  - 3. Take precautions necessary to prevent floating of pipe prior to completion of backfill operation.
  - 4. When using movable trench shield, take necessary precautions to prevent pipe joints from pulling apart when moving shield ahead.
  - 5. Do not allow foreign material to enter pipe while it is being placed in trench.

6. Close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day's work, or whenever workers are absent from job.
- G. Joining Push-On Joint Pipe and Mechanical Joint Fittings:
  1. Join pipe with push-on joints and mechanical joint fittings in strict accordance with manufacturer's recommendations.
  2. Provide special tools and devices, such as, special jacks, chokers, and similar items required for installation.
  3. Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.
  4. Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe. If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.
- H. Founding Pipe: Pipe shall be laid directly on the Pipe Zone material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- I. Unforeseen Obstructions: Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum designed deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.
- J. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which 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. All bends shall be properly installed as shown.
- K. Cold Weather Protection: No pipe 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 shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- L. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.
- M. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all 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.

- N. Cutting Pipe: General: Cut pipe for inserting closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
  - 1. Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.
  - 2. Dressing Cut Ends: Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.
- O. Field Welding:
  - 1. Field welding of ductile iron pipe shall not be allowed.
  - 2. Field welding of bars for restrained joint systems will not be allowed. All welding shall be performed in pipe manufacturer's shop.
- P. Field Installed Outlets: Field outlets may be installed with a saddle; however, the maximum nominal diameter of outlet for saddle shall be 2-inch. Opening in pipe shall be machine cut. Flame cut openings shall not be allowed.

### 3.3 RUBBER GASKETED JOINTS

- A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket, lubricated with an approved vegetable-based lubricant, shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

### 3.4 CORROSION PROTECTION

- A. Polyethylene Encasement: Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C105/A21.5.
  - 1. Encase pipe, fittings, and valves in accordance with AWWA C105, Method A.
  - 2. Cut polyethylene tube approximately 2 feet longer than pipe length.
  - 3. Slip tube around pipe, centering to provide 1-foot overlap on each adjacent section.
  - 4. Pull encasement to take out slack and wrap snug around pipe.
  - 5. Secure overlap in place and fold at quarter points of pipe length.
  - 6. Wrap and tape encasement snug around fittings and valves.

### 3.5 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with ANSI/AWWA C209, Type II. Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to insure proper operation.

- C. Valve Installation: All valves shall be installed so that the valve stems are plumb and in the location shown on the Drawings.

### 3.6 INSTALLATION OF METALLIC LOCATING TAPE

- A. Buried pipelines shall be provided with a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade OR above top of pipe. The Contractor shall furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the Engineer.

### 3.7 FIELD TESTING AND DISINFECTION

- A. Field testing shall conform to the requirements of Section 33 13 00 – Water Pipeline Testing and Disinfection as applicable.

END OF SECTION

**SECTION 33 46 00  
RESERVOIR UNDERDRAINS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall furnish and install all specified drain piping, imported bedding, liners, geotextile fabrics and all appurtenant work, complete and in place, in accordance with the Contract Documents.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 31 23 00 Earthwork
- B. Section 31 32 19 Geotextiles

**1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Commercial Standards:

ASTM D 1785                      Polyvinyl Chloride Pipe

**1.4 CONTRACTOR SUBMITTALS**

- A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures.
- B. Shop Drawings: Drawings and laying diagrams of all pipe, joints, bends, special fittings, and piping appurtenance.
- C. Certificates: Manufacturer's certificates for all materials indicating conformance to the Contract Documents.
- D. Samples: Samples of all the materials proposed for use on the Work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions.

**1.5 QUALITY ASSURANCE**

- A. Testing: All materials testing will be based upon applicable ASTM Test Methods referenced herein for the materials specified.
- B. All costs of such inspection and testing shall be the Contractor's responsibility.

## **PART 2 - PRODUCTS**

### **2.1 DRAIN PIPE**

- A. Drain pipe used for footing drains and under drains shall be PVC pipe as specified herein. Drain piping shall be perforated and non-perforated as noted in the drawings. Perforations shall be as specified herein.
- B. Footing and under drain pipes shall be rigid PVC pipe conforming to the requirements of ASTM D 1785 Schedule 80 for polyvinyl chloride pipe and fittings. Perforations shall be located at four o'clock and eight o'clock positions. The perforations shall be drilled at a ¼-inch diameter spaced at 5 inches on center (on alternating sides of pipe).

### **2.2 GRANULAR DRAINAGE MATERIALS**

- A. When called for, granular drainage backfill material shall be as specified in Section 31 23 00 – Earthwork as follows:
  - 1. Graded drain rock shall be Type H material specified in Section 31 23 00 – Earthwork.

### **2.3 GEOTEXTILE FILTER FABRIC**

- A. Geotextile filter fabric shall be of non-woven needle-punched construction and consist of long-chain polymeric fibers. The geotextile fabric shall be as specified in Section 31 32 19 – Geotextiles. All joints in the filter fabric shall be lapped a minimum of 18 inches.
  - 1. The geotextile filter fabric shall be as manufactured by Mirafi 180N, or equal.

### **2.4 WATERPROOF MEMBRANE LINER**

- A. Waterproof membrane liner shall be EPDM liner of minimum thickness 45 mils. EPDM liner shall be supplied with suitable solvent or adhesive for sealing overlap joints per manufacturer's recommendations. All overlap joints shall have minimum lap width of 12 inches.
  - 1. Firestone GeoGard EPDM membrane, or approved equal.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. The Contractor shall notify the Engineer when the excavation has reached the final subgrade prior to placement of any under drain materials to allow examination of the foundation materials by the soils engineer.
- D. Drain pipe shall be bedded in the Type H gravel and the drain pipe installed with perforations placed down. The backfill of the drain pipe with drain rock shall proceed as detailed on the

drawings placing the material around the pipe to provide a solid backing and to prevent lateral movement. Above the top of the pipe, compact the rock material with a vibratory plate.

### 3.2 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing, solidly in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirement indicated.
  - 1. Install piping pitched down in direction of flow, at a minimum slope of 0.25 percent or as noted on Drawings.
  - 2. Provide recessed in excavation bottom to receive bells and pipe bell ends. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
  - 3. Apply and compact impervious fill material to raise low areas or where unsatisfactory bearing soil may occur.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fitting being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Excavate for underfloor drainage system after subgrade material has been compacted but before drainage fill has been placed. Grade bottom of trench excavations to required slope and compact to firm, solid bed for drain system.
- D. Maintain swab or drag in piping with tight joints and pull past each joint as it is completed.
- E. Extend piping and connect to sumps and storm drainage system, of sizes and in locations indicated. Terminate piping as indicated.
- F. Provide piping with caps at locations indicated on the drawings. If pipe to be connected is already in place make connection.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

### 3.4 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

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**DIVISION 40**  
**PROCESS INTEGRATION**

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**SECTION 40 05 00  
PIPING, GENERAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

**A. Commercial Standards**

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI/AWS D1.1	Structural Welding Code
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
ASTM D 2000	Classification System for Rubber Products in Automotive Applications

### 1.3 CONTRACTOR SUBMITTALS

- A. Submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements in Section 01 33 20 – Submittal Procedures, and as indicated in the individual piping sections. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. All expenses incurred in making samples for certification of tests shall be borne by the Contractor at no increased cost to the Owner.
- C. Submit as part of the shop drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe.

### 1.4 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. Perform all tests at no additional cost to the Owner.
- C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, 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.
- D. Welder Qualifications: All 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 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 Work shall be used in qualification tests. Furnish all material and bear the expense of qualifying welders at no increased cost to the Owner.

### 1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, furnish such assistance at no additional cost to the Owner.

## 1.6 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

## 1.7 CLEANUP

- A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Division 33 and this Section.
- B. Miscellaneous Small Pipes: Miscellaneous small pipes and fittings shall be provided by the Contractor in accordance with the requirements of Section 40 05 10 - Mill Piping - Exposed and Buried and this Section.
- C. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 40 05 07 - Pipe Supports, and as indicated.
- D. Lining: All requirements pertaining to thickness, applications, and curing of pipe lining, are in accordance with the requirements of the applicable Sections of Division 33, unless otherwise indicated.
- E. Coating: All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division 33, unless otherwise indicated. Pipes above ground or in structures shall be field-painted in accordance with Section 09 99 90 - Coatings and Painting.
- F. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined in Section 33 13 00 - Water Pipeline Testing and Disinfection, or as indicated on the piping schedule.
- G. Grooved Piping Systems: Piping systems with grooved joints and fittings may be provided, if approved by the Engineer, in lieu of screwed, flanged, welded, or mechanical joint systems for steel and ductile iron yard piping above and below ground within the property limits of pump stations, and similar installations. All grooved couplings on buried piping must be bonded. To assure uniform and compatible piping components, all grooved fittings, couplings, and valves shall be from the same manufacturer. The Contractor shall make the coupling manufacturer responsible for the selection of the correct style of coupling and gasket for each individual location.

## 2.2 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. However, AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-pound class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: Contractor shall supply all bolts and nuts in conformance with Section 05 50 00 – Metal Fabrications. Studs and bolts shall extend through the nuts a minimum of 1/4 inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.
- E. Insulating Flanges: Insulated flanges shall have bolt holes 1/4 inch diameter greater than the bolt diameter.
- F. Insulating Flange Sets: Insulating flange sets shall be provided by the Contractor where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
- G. Insulating Flange Manufacturers, or Equal
  1. JM Red Devil, Type E
  2. Maloney Pipeline Products Co., Houston
  3. PSI Products, Inc., Burbank, California.
- H. Flange Gaskets: Contractor shall provide flange gaskets for all pipe flanges. Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of asbestos-free aramid fiber base, with nitrile binder and nonstick coating, suitable for temperatures to 700 degrees F, a pH of 1 to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the

entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

I. Flange Gasket Manufacturers, or Equal

1. John Crane, Style 2160.
2. Garlock, GYLON Style 3505.

2.3 THREADED INSULATING CONNECTIONS

- A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
- B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

- A. Construction: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The Contractor shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.
- B. Couplings for Steel Pipe, Manufacturers, or Equal
1. Victaulic Style 44 with Type D Heavy Duty Grooved Adaptor Ends.
- C. Ductile Iron Pipe Couplings, Manufacturers, or Equal
1. Gustin-Bacon.
  2. Victaulic Style 31 (flexible or rigid grooving).
  3. Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.
- D. Couplings for PVC Pipe, Manufacturers, or Equal
1. Gustin-Bacon.
  2. Victaulic Style 775.
  3. Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends. Grooved end couplings shall be used on PVC pipe only for Schedule 80 vent piping at the vaults. Grooved end couplings shall not be used for PVC C905 water pipe.
- E. Restrained Dynamic Movement Joints, Manufacturers (no Equal)
1. EBAA Iron Flex-Tend
  2. Victaulic Style W257.

## 2.5 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 unless otherwise indicated, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4 inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. Buried sleeve-type couplings shall be epoxy-coated at the factory.
- B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64 inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer.
1. The rubber in the gasket shall meet the following specifications:
    - a. Color - Jet Black.
    - b. Surface - Nonblooming.
    - c. Durometer Hardness - 74 " 5.
    - d. Tensile Strength - 1,000 psi Minimum.
    - e. Elongation - 175 percent Minimum.
  2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.
- D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- E. Restrained Joints: All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the requirements of the appropriate reference standard, or as shown.
- F. Manufacturers, or Equal
1. Dresser, Style 38.
  2. Ford Meter Box Co., Inc., Style FC1 or FC3.
  3. Smith-Blair, Style 411.



4. Baker, Series 200

2.6 FLANGED END CONNECTORS

- A. Flanged coupling adapters, shall be in accordance with AWWA C219.
- B. Dismantling joints for connecting flanged pipe shall be AWWA C219 compliant. Provide studs and nuts to seal gasket separate and independent from tie-bar restraint system.
- C. All dismantling joints shall be the restrained type per AWWA M-11. Tie-bar restraint system shall conform to ASTM A193-B7 per AWWA M-11 and be designed to withstand the test pressure shown on the Drawings.
- D. All dismantling joints shall use standard flanges in accordance with AWWA C207. The thickness of the dismantling joint flanges shall be equal to or greater than the class of flange that is connected to as required by the test pressure as shown on the drawings. Buried flanges shall be wrapped with petroleum was tape per AWWA C217.
- E. Manufacturers, or Equal
  - 1. Smith-Blair, Style 972 or 975
  - 2. Baker, Series DJ

2.7 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown. The final material selection shall be approved by the manufacturer. Submit manufacturer's shop drawings and calculations.

2.8 EXPANSION JOINTS

- A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. Submit detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.9 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

## 2.10 AIR AND GAS TRAPS

- A. Air and gas pipes shall be sloping to low points, provided with drip legs, shutoff valves, strainers and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150-pound iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.
- B. Manufacturers, or Equal
  - 1. Armstrong Machine Works.
  - 2. Spirax Sarco, Inc.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 33. The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.
- B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.
- C. Flanges shall be installed at least 6-inches from a wall. Fittings shall be installed with sufficient clearance for maintenance and removal and reinstallation.

### 3.2 FIELD TESTING

- A. All piping shall be tested in accordance with applicable standards and the contract documents.

END OF SECTION

**SECTION 40 05 01**  
**PIPING IDENTIFICATION SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide identification for all exposed piping and valves, in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards

ANSI A13.1 Scheme for the Identification of Piping Systems

1.3 CONTRACTOR SUBMITTALS

- A. All submittals shall be in strict accordance with the requirements of Section 01 33 20 – Submittal Procedures.
- B. Submit samples of all types of identification devices to be used in the Work.
- C. Submit a list of suggested wording for all valve tags prior to fabrication.

**PART 2 - PRODUCTS**

2.1 IDENTIFICATION OF PIPING

- A. Identification of all exposed pipe shall be accomplished in accordance with the Owner's standard, and where no standard exists, in accordance with the following: by color-coding with bands and by lettering as specified in Part 3, herein, and in Section 09 90 00 - Coatings and Painting. Color bands shall either be painted directly upon the pipe or shall be pressure-sensitive adhesive-backed vinyl cloth or plastic tape.
- B. Each pipe identification shall consist of two color-coded bands OR color-coded coating, a printed label identifying the name of the pipe, and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels or integral to the preprinted label.
- C. Letter sizes and colors for lettering, arrows, and background shall conform to ANSI A13.1.
- D. Preprinted identification devices shall be as manufactured by Marking Services Inc.; W.H. Brady Co.; Seton Nameplate Corp., or equal.

## 2.2 EXISTING IDENTIFICATION SYSTEMS

- A. In installations where existing piping identification systems have been established, continue to use the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the specified system. The objective is to fully identify all new piping, valves, and appurtenances to the level specified herein.

## 2.3 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

- A. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal or plastic tags as indicated.
- B. Metal tags shall be of type 304L or 316L stainless steel with embossed lettering. Plastic tags shall be of solid black plastic laminate with white embossed letters. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. All labels and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.

### 3.2 VALVE TAGS

- A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws or stainless steel wire.
- B. The wording on the valve tags shall describe the exact function of each valve, e.g., "HWR-BALANCING," "CLS THROTTLING", " PUMP SHUT-OFF," etc.
- C. Tags attached to valves must be placed in such a way that the operation of the valve is not hindered or jeopardized.

### 3.3 PIPE IDENTIFICATION

- A. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.
- B. Pipe identification shall consist of these elements, i.e., 2 color bands OR color coating as specified, a lettered label, and a directional label. If bands are used. The bands shall be arranged so that the lettered label and the directional arrow are placed between the 2 bands.

### 3.4 IDENTIFICATION SCHEDULE

- A. Application of identifying devices shall conform to the following color codes where no colors are indicated in the Owner's standard.

<u>Fluid Abbreviation</u>	<u>Function and Identification</u>	<u>Identification Color</u>
AV	Air Vent	
D	Drain	
HW	Domestic hot water	green
NG	Natural gas	yellow
PW	Potable water	blue
SA	Sample lines	blue
SPD	Sump pump discharge	green
TW	Tepid Water	green
UW	Utility Water	blue
V	Vent	

END OF SECTION

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**SECTION 40 05 07  
PIPE SUPPORTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Provide pipe supports, seismic restraints, hangers, guides, and anchors, complete and in place in accordance with the Contract Documents.
- B. Where specific pipe support elements and systems are not indicated on the Drawings, design and provide the necessary supports in accordance with this Section.

**1.2 RELATED SECTIONS**

- A. Section 01 81 10 Seismic Design Criteria
- B. Section 03 30 00 Cast-in-Place Concrete
- C. Section 09 90 00 Painting

**1.3 REFERENCES**

- A. ASTM International (ASTM) standards, most recent editions:
  - ASTM A123                      Specification s for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - ASTM A575                      Specification for Steel Bars Carbon, Merchant Quality, M-Grades
  - ASTM E84                      Test Method for Surface Burning characteristics of Building Materials
- B. Manufacturers' Standardization Society of the Valve and Fittings Industry, (MSS) standards, most recent editions:
  - MSS SP 58                      Pipe Hangers and Supports - Materials, Design, and Manufacture
  - MSS SP 69                      Pipe Hangers and Supports - Selection and Application.

**1.4 COORDINATION**

- A. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports.

## 1.5 SYSTEM DESCRIPTION

- A. Be responsible for the design, engineering, construction, and safety of all pipe hangers and supports.
- B. Code Compliance: Properly support and anchor piping systems and pipe connections to equipment to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. Supports and parts thereof shall conform to the requirements MSS SP 58 and MSS SP 69 except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.
- C. Design, furnish, and install all bracing, supports, and appurtenances necessary to accommodate seismic loadings given in Section 01 81 10 Seismic Design Criteria.

## 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 20 – Submittal Procedures.
- B. Product Data
  - 1. Manufacturers' catalogs, literature, and engineering data for all hangers and supports.
- C. Shop Drawings
  - 1. Drawings of pipe supports, restraints, hangers, anchors, and guides.
  - 2. Schedule of support types, number, parts, and location of installations.
  - 3. Do not use Contract Drawings for erection drawings.
- D. Structural Calculations for special supports and anchors.

## 1.7 QUALITY ASSURANCE

- A. Qualifications
  - 1. Licensed Professionals in responsible charge of the designs specified herein shall be licensed to practice in the applicable discipline in the state of Utah.
- B. Component Supply and Compatibility
  - 1. Obtain all products included in this Section, regardless of the component manufacturer, from a single pipe hanger and support manufacturer.
  - 2. The pipe hanger and support product manufacturer is to review and approve or to prepare all shop drawings and other submittals for the components furnished under this Section.
  - 3. Pipe hanger and support product manufacturer must specifically construct all components for the specified service conditions and integrate into the overall assembly.
- C. Fabrication
  - 1. Fabricate and install pipe hangers, supports, and seismic restraints and using experienced welders and fitters. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.



## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.
- B. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in concrete in ample time to prevent delay of that Work.
- C. Acceptance at Site
  - 1. Inspect all boxes, crates, and packages upon delivery to the site. Notify Engineer, in writing, if any loss or damage exists to products or components. Replace loss and repair damage to new condition in accordance with manufacturer's original specifications and specific instructions.
- D. Storage And Handling Requirements
  - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
  - 2. Store materials in covered storage off the ground and prevent condensation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment. Provide hangers with a means of vertical adjustment after erection. Design hangers to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. Design hanger rods for tensile loading only.
- B. Furnish standard and fabricated hangers and supports complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
- C. Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- D. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.
- E. Provide spring-type pipe hangers for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. Size spring-type hangers to the manufacturer's printed recommendations and the loading conditions encountered. Provide variable spring supports with means to limit misalignment, buckling, eccentric loading, or to

prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.

- F. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. Components shall be structurally suitable to withstand loads imposed.
- G. Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment.
- H. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- I. When it is not practical to support piping on the floor, support pipes from structural members. Where it is necessary to frame structural members between existing members, provide such supplementary members at no additional cost to Owner. Design all supplementary members in accordance with the requirements of the applicable building code. Designs must be acceptable to Engineer.
- J. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Support exterior, free-standing overhead piping on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- K. Support meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, equip all supports on PVC, FRP, and other plastic piping with extra wide pipe saddles or galvanized steel shields.
- L. To reduce transmission of noise in piping systems, wrap copper tubes in buildings and structures with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

## 2.2 MANUFACTURERS

- A. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
  - 1. Pipe hangers and supports
    - a. Basic Engineers Inc., Pittsburgh, PA.
    - b. Bergen-Paterson Pipesupport Corp., Woburn, MA.
    - c. Grinnell Corp. (Supply Sales Company), Cranston, RI
    - d. NPS Products, Inc., Westborough, MA.
    - e. Power Piping Company, Pittsburgh, PA.
    - f. Engineer approved equal.
  - 2. Concrete inserts
    - a. Unistrut Corporation, Wayne, Michigan.
    - b. Elcan Metal Products Company, Franklin Park, ILL.

- c. B-Line.
- d. Anvil International
- e. Engineer approved equal.

## 2.3 MATERIALS

- A. Provide pipe support assemblies, including framing, hardware, and anchors, of steel construction, galvanized after fabrication, unless otherwise indicated.
- B. Submerged Supports: Support submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24 inches of the water level, with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.
- C. Corrosive: Support piping in chemical and corrosive areas with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.
- D. Prevent contact between dissimilar metals when supporting copper tubing by using copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
- E. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.

## 2.4 HANGERS AND SUPPORTS

- A. For necessary hangers and supports not shown on the Contract Drawings, provide in accordance with Drawing details, MSS SP58, and MSS SP 69.
- B. Chemical Piping Systems
  - 1. All pipe supports and fasteners used in chemical piping systems shall be glass fiber-reinforced plastic with a flame spread rating of 25 per ASTM E84.
  - 2. Materials manufactured by either the pultrusion or extrusion process.
  - 3. On all pipe supports, provide a surface veil over 100 percent of the surface which, along with a filler system, protects against degradation from ultra-violet light.
  - 4. Manufacture all fasteners from long glass fiber-reinforced polyurethane to ensure strength and corrosion resistance.
  - 5. Provide all-thread rods made from vinylester resin only.

## 2.5 ACCESSORIES

- A. Provide hanger rods conforming to ASTM A575 with square head nut on top and running thread on bottom end.
- B. Concrete Inserts:
  - 1. Provide concrete inserts conforming to MSS SP 58 malleable, Type 18.
- C. Steel Beam Clamps:
  - 1. Provide steel beam clamps of malleable iron and conforming to MSS SP 48, Type 32.

## 2.6 SUPPORT SPACING

- A. Space supports for piping with the longitudinal axis in approximately a horizontal position to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, modify the pipe support spacing in accordance with the pipe manufacturer's recommendations. Provide vertical supports to prevent the pipe from being overstressed from the combination of all loading effects.

### 1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2	6
3/4 and 1	8
1 - 1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and Greater	30

### 2. Support Spacing for Welded Fabricated Steel Pipe

Maximum Spans for Pipe Supported in Minimum 120 degree contact saddles (feet)										
Nominal Pipe Diameter (inches)	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	42	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	--	40	43	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	41	44	48	51	53	58	62		
54	--	41	44	48	51	54	58	62		
57	--	41	44	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70
63	--	41	45	49	52	55	60	64	67	71

Maximum Spans for Pipe Supported in Minimum 120 degree contact saddles (feet)										
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	45	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

3. For steel pipe sizes not presented in this table, design the support spacing so that the stress on the pipe does not exceed 5,000 psi. Limit maximum deflection of pipe shall to 1/360th of the span as calculated by using the following formula:

$$L = \sqrt{\frac{7500tD}{32t + D}}$$

Where:

t	=	Thickness (inches)
D	=	Diameter (inches)
L	=	Maximum span (feet)

4. Support Spacing for Ductile-Iron Pipe:

Normal Pipe Diameter (inches)	Maximum Span (feet)
All diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

5. Support Spacing for Copper Tubing:

Normal Pipe Diameter (inches)	Maximum Span (feet)
1/2 to 1 - 1/2	6
2 to 4	10
6 and greater	12

6. Support Spacing for Schedule 80 PVC Pipe:

Normal Pipe Diameter (inches)	Maximum Span at 100 degrees F (feet)
1/2	4
3/4	4.5
1	5
1 - 1/4	5.5
1 - 1/2	5.75

Normal Pipe Diameter (inches)	Maximum Span at 100 degrees F (feet)
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

7. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:
- a.  $\Delta L = L \times \Delta T \times \alpha$ , where:
    - 1)  $\Delta L$  = pipe length change (inches).
    - 2)  $L$  = pipe length between fixed anchors (inches).
    - 3)  $\Delta T$  = change in temperature of 100 Degrees F.
    - 4)  $A$  = coefficient of thermal expansion (inch/inch/Degree F) for the pipe material.
  - b. Design expansion compensation as an integral part of the piping hanger, support, and anchorage system.

## 2.7 COATING

- A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A123.
- B. Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09 90 00 – Painting and Coating.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Position pipe supports and hangers to produce an orderly, neat piping system. Install hanger rods vertical, without offsets. Adjust hangers to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.
- B. Do not use chains, plumber's straps, wire, or similar devices for permanently suspending, supporting, and restraining piping.
- C. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.
- D. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

- E. Use flush shells only when specifically indicated on the Drawings.
- F. Do not use stud-type powder actuated fasteners for securing metallic conduit or steel pipe larger than 1 inch diameter to concrete, masonry, or wood.
- G. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves and anchor between expansion loops and direction changes to prevent axial movement through anchors.
- H. Locate hangers and supports to prevent vibration or swaying and to provide for expansion and contraction.
  - 1. Temperature differential specified in this Section.
  - 2. Support piping independently so that equipment is not stressed by piping weight or expansion.
  - 3. Support horizontal piping at maximum spacing given in this Section.
  - 4. Provide additional supports at the following locations:
    - a. Change in direction.
    - b. Branch piping and runouts over five feet.
    - c. Concentrated loads due to valves, meters, or other similar equipment.
  - 5. Unless shown otherwise, provide hanger types for horizontal piping as follows:
    - a. Forged steel adjustable clevis type, rod support for all services.
    - b. Slide Bases:
      - 1) Pipe stand, brackets, trapeze, or other equivalent structural support.
      - 2) For piping 2-inches and larger.
    - c. For pipe and covering, provide
      - 1) Saddles for rollers or slide bases.
      - 2) Protective shields or saddles for all other types of supports.
    - d. Threaded steel rods
      - 1) Two-inch vertical adjustment with two nuts on each end for positioning and locking.
      - 2) Size hanger rods according to the schedule below unless otherwise shown or noted:

Normal Pipe Diameter (inches)	Rod Diameter (inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8
6	3/4
8 through 12	7/8

- 3) For double rod hangers, provide one size smaller than above.
    - 4) Connection to structure for piping up to 2 inch diameter: Concrete inserts or general concrete anchors in shear into sides of beams.
    - 5) Connection to structure for piping 2-1/2 inch diameter and larger: Concrete inserts, beam clamps, or suitable bridging.
  - e. Vertical piping

- 1) Base support: Base elbow or welded equivalent, with bearing plate on structural support.
  - 2) Guides, not to exceed:
    - a) 25 feet for piping up to 2-inch diameter.
    - b) 36 feet for piping 2-1/2 inch diameter and larger.
  - 3) Top supports:
    - a) Provide special hanger or saddle in horizontal connection.
    - b) Allow for expansion.
  - 4) Intermediate supports:
    - a) Bolted or welded to pipe.
    - b) Extension ends bearing on structural steel or bearing plates on concrete.
  - 5) For multiple pipe installations, coordinate guides, bearing plates, and accessory steel as necessary.
- I. Install items to be embedded in concrete construction before concrete placement in accordance with Section 03 30 00 Cast-in-Place Concrete. Fasten embedded items securely to prevent movement during concrete placement.
- J. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.
- K. Bring all piping systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions and correct all support malfunctions.

END OF SECTION



**SECTION 40 05 10**  
**MILL PIPING – EXPOSED AND BURIED**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall furnish and install all exposed and buried mill piping as shown and indicated, complete, including small steel pipe, stainless steel pipe, red brass pipe, copper tubing, solvent-welded PVC pipe, polypropylene pipe, polyvinylidene fluoride pipe, fiber glass reinforced plastic pipe, process glass pipe, cast iron soil pipe, corrosion-resistant cast iron pipe, fittings, gaskets, bolts, insulating connections, pipe insulation, and such other specialties as required for a complete and operable piping system in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASME B16.3 Malleable Iron Threaded Fittings

ANSI/ASME B16.4 Gray Iron Threaded Fittings,

ASME B16.5 Pipe Flanges and Flanged Fittings,

ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded

ANSI B16.12 Cast-Iron Threaded Drainage Fittings

ANSI/ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250

ANSI B16.21 Nonmetallic Flat Gaskets for Pipe Flanges

ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 74 Specification for Cast Iron Soil Pipe and Fittings

ASTM A 105 Specification for Carbon Steel, Forgings for Piping Applications

ASTM A 106 Specification for Seamless Carbon Steel Pipe for High Temperature Service

ASTM A 312 Specification for Seamless and Welded Austenitic Stainless Steel Pipe

ASTM A 518 Specification for Corrosion-Resistant High-Silicon Iron Castings

ASTM B 43 Specification for Seamless Red Brass Pipe, Standard Sizes

- ASTM B 62      Specification for Composition Bronze or Ounce Metal Castings
- ASTM B 88      Specifications for Seamless Copper Water Tube
- ASTM C 599    Specification for Conical Process Glass Pipe and Fittings.
- ASTM D 1785   Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- ASTM D 2996   Specification for Filament-Wound Reinforced Thermosetting Resin Pipe
- ASTM D 3222   Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding, Extrusion, and Coating Materials
- ASTM D 4101   Specification for Propylene Plastic Injection and Extrusion Materials
- ASTM F 441    Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- Chlorine Institute Pamphlet 6   Piping Systems for Dry Chlorine

### 1.3      CONTRACTOR SUBMITTALS

- A.      For the materials and equipment items supplied under the provisions of this Section, submit copies of the manufacturer's product specifications and performance details according to the requirements of Section 01 33 20 – Submittal Procedures.

## **PART 2 - PART 2 - PRODUCTS**

### 2.1      SMALL STEEL PIPE

- A.      Unless otherwise indicated, galvanized steel pipe and black steel pipe in sizes 6 inches in diameter and smaller shall conform to the requirements of ASTM A 53 or ASTM A 106, as called out in the piping schedule and shall be Schedule 40 or 80 as indicated. Galvanized steel pipe shall not be cement mortar lined unless otherwise indicated. Fittings for galvanized steel pipe shall be of galvanized malleable iron, with NPT or grooved ends. Black pipe may have welded joints, with standard or extra strong welding fittings, or fittings indicated.
  - 1.      Black steel pipe for chlorine pressure service shall conform to Chlorine Institute Pamphlet 6, ASTM A 106, Grade A or B, and shall be Schedule 80. Except where required to match mating fittings of vacuum regulator-check units, gas filters, valves, and protective diaphragms for gauges and switches, all fittings shall be socket welded. Socket welded fittings shall conform to ASTM A 105 and ANSI B16.11, 3,000 pound, forged carbon steel. Bushings will not be allowed.
  - 2.      Flanges for chlorine and sulfur dioxide service shall conform to ASTM A 105, ANSI B16.5, Class 300 and shall be 1/16-inch raised face.
  - 3.      Unions for chlorine service shall be four-bolt tongue and groove, ammonia type, suitable for chlorine service. Unions shall have female thread and connection and matched tongue and groove flanges employing a lead gasket. High tensile alloy steel corrosion-resistant bolts and nuts shall be used with each set of flanged unions.

Unions shall be rated for 500 lb CWP service pressure. Furnish reducing-type, straight-type or blind-type unions, as required for the installation. Blind unions shall be provided as cleanouts where shown. Provide a straight union adjacent to each threaded valve or piece of equipment.

4. Unions shall be as manufactured by Henry Valve Company; Vogt Valve Co.; or equal.
5. Gaskets for chlorine service flanges shall be 1/16-inch, high temperature compressed self-centering ring type conforming to ANSI B16.21.

## 2.2 STAINLESS STEEL PIPE

- A. Unless otherwise indicated, stainless steel pipe shall be Type 316 Schedule 40 threaded pipe conforming to ASTM A 312 with stainless steel threaded fittings, or with stainless steel welding fittings, where indicated. Lightweight stainless steel pipe shall be Type 316 Schedule 10 pipe conforming to ASTM A 312, with stainless steel welding fittings, or fittings as indicated.

## 2.3 RED BRASS PIPE

- A. Brass pipe shall conform to the requirements of ASTM B 43. Fittings shall be of bronze conforming to the requirements of ASTM B 62 with threaded ends, conforming to ANSI/ASME B16.15.

## 2.4 COPPER TUBING

- A. Copper tubing shall conform to the requirements of ASTM B 88 and shall be Type K, soft temper for buried tubing and hard-drawn for above-ground application. Fittings shall be soldered or sweated on and shall be of wrought copper conforming to ANSI B16.22. Soldered joints shall contain 95-percent tin and 5-percent antimony. No solders or fluxes containing more than 0.2 percent of lead shall be used.

## 2.5 PVC (POLYVINYL CHLORIDE) PRESSURE PIPE, SOLVENT-WELDED

- A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 80, conforming to ASTM D 1785, unless otherwise indicated. Fittings shall be of the same material as the pipe. Unless otherwise indicated, joint design shall be for solvent-welded construction to the pipe manufacturer's specifications. Threaded joints shall be made with Teflon tape, only.

## 2.6 PP (POLYPROPYLENE) PIPE

- A. PP pipe, for chemical drains and where indicated, shall be Type 1, Schedule 80 pipe conforming to ASTM D 4101, with drainage pattern fittings made of the same material, joined by the thermo-seal fusion process, or by threading, or flanging.

## 2.7 PE (POLYETHYLENE) TUBING

- A. Chemical Service:
  1. Polyethylene tubing, for all analyzers, turbidimeters, chemical conveyance, and testing apparatus shall be linear high density polyethylene tubing. All tubing shall have a minimum working pressure of 150 psi at 75 deg F.

- B. Potable Water Service
  - 1. Polyethylene tubing potable water service shall be multiple-layered, UV-protected, chlorine resistant cross-linked polyethylene. Tubing supplied shall have nominal CTS (copper tube size) outside diameter. The SDR rating shall be 9. The pressure rating of the tubing shall be 200 psi at 75 degrees. Potable water service tubing shall be Vanex Ultra Pex tubing or Engineer approved equal.
- 2.8 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)
  - A. Mechanical-type couplings shall be furnished and installed in accordance with the requirements of Section 40 05 00 - Piping, General.
- 2.9 SLEEVE-TYPE COUPLINGS
  - A. Sleeve-type couplings shall be furnished and installed in accordance with the requirements of Section 40 05 00 - Piping, General.
- 2.10 GASKETS AND BOLTS
  - A. Except as otherwise indicated, gaskets for flanged joints shall be in accordance with the requirements of Section 40 05 00 - Piping, General.
  - B. Except as otherwise indicated, bolts shall conform to the requirements of Section 05 50 00 - Metal Fabrications.
- 2.11 INSULATING CONNECTIONS
  - A. General: Insulating bushings, unions, couplings or flanges, as appropriate, shall be used for joining pipes of dissimilar metals, and for piping systems where corrosion control and cathodic protection are involved, in accordance with the requirements of Section 40 05 00 - Piping, General.
  - B. Material: Insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.
- 2.12 PIPE SUPPORTS
  - A. Pipe Supports, hangers, anchors, seismic restraints, and guides shall be in accordance with the requirements of Section 40 05 07 - Pipe Supports.

### **PART 3 - EXECUTION**

- 3.1 INSTALLATION
  - A. Small Steel Pipe: Buried galvanized or black steel pipe shall be coated as specified in Section 09 90 00 - Painting or provided with an extruded high density polyethylene coating with minimum thickness of 35 mils.

- B. Plastic Pipe: PVC, CPVC, and FRP pipe joints shall be solvent-welded in accordance with the manufacturer's instructions. Expansion joints or pipe bends shall be provided to absorb pipe expansion over a temperature range of 100 degrees F, unless otherwise indicated. Care shall be taken to provide sufficient supports, anchors, and guides, to avoid stress on the piping. Obtain the services of the pipe manufacturer, to instruct the pipe fitters in the correct way of making solvent welded and threaded joints. Only clean, fresh primer and solvent shall be used at all times at the recommended temperatures.
- C. Couplings: Pipe couplings shall be installed in strict accordance with the manufacturer's printed recommendations, using the correct style coupling and gasket for any given application.
- D. Gaskets for Flanged Joints: Gaskets shall be in accordance with the requirements of Section 40 05 00 - Piping, General.
- E. Insulating Connections: All insulating connections shall be installed in accordance with manufacturer's printed instructions. Care shall be exercised to prevent damage to insulating fittings, while making up the joints.

### 3.2 CONTINUITY BONDS

- A. Where required by the Contract Documents, all metallic pipe joints, except field-welded joints and insulating joints, shall be continuity bonded in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

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**SECTION 40 05 50  
MISCELLANEOUS VALVES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 05 51 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 20.

**PART 2 - PRODUCTS**

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

- A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.
- B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated. Provide specially designed Low Pressure Air Release Valve where working pressure is less than 20 psi. Valves shall include isolation valves as indicated on the drawings.
- C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves. Provide specially designed Low Pressure Air Release Valve where working pressure is less than 20 psi. Valves shall include isolation valves as indicated on the drawings.
- D. Manufacturers, or Equal
  - 1. APCO (Valve and Primer Corporation)
  - 2. Crispin - Multiplex Manufacturing Company
  - 3. GA Industries
  - 4. Val-Matic (Valve and Manufacturing Corporation)

## 2.2 BACKFLOW PREVENTER VALVES

- A. General: Backflow preventers shall work on the reduced pressure principle. They shall consist of 2 spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall be in accordance with AWWA C511 standard.
- B. The number and sizes of backflow preventors required are given on the Contract Drawings.
- C. Manufacturers, or Equal
  1. Cla-Val Company
  2. Febco (CMB Industries)
  3. Hersey Products
  4. Watts, ACV
  5. Wilkins Regulator Division (Zurn Industries)

## 2.3 CORPORATION STOPS

- A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required. Note that corporation stops on special chemical diffuser ports shall be 316 stainless steel – unless indicated otherwise.
- B. Manufacturer, or Equal
  1. Ford Meter Box Company, Inc.
  2. James Jones Company (Watts, ACV)
  3. Mueller Company

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Backflow preventers shall be installed in utility water lines where required by applicable codes or regulations, and where indicated on Contract Drawings.
- B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with Section 40 05 51.
- C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

END OF SECTION



**SECTION 40 05 51  
VALVES, GENERAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.
- C. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- D. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

**1.2 CONTRACTOR SUBMITTALS**

- A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures
- B. Shop Drawings: Shop Drawings shall contain the following information:
  - 1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
  - 2. Complete information on valve actuator, including size, manufacturer, model number, limit switches, and mounting.
  - 3. Cavitation limits for control valves.
  - 4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
  - 5. Data in accordance with Section 40 05 57 – Valve and Gate Actuators for electric motor-actuated valves.
  - 6. Complete wiring diagrams and control system schematics.
  - 7. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.
- C. Technical Manual: The Technical Manual shall contain the required information for each valve.
- D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

- E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS**

- A. General: Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.
- B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 57 - Valve and Gate Actuators.
- C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be coated in accordance with Section 09 90 00 - Painting and Coating. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.
- D. Valve Labeling: Except when such requirement is waived by the construction manager in writing, a label shall be provided on shut-off valves and control valves except for hose bibs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2-inches by 4-inches in size, as indicated in Section 40 05 01 - Piping Identification Systems, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the construction manager.
- E. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4-inches in diameter and larger shall be factory tested as follows:
  - 1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.
  - 2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. All valves 24 inches and larger shall be factory tested as complete assembled units including actuator and the tests shall be witnessed by the Engineer. The Contractor shall furnish notification to the Engineer a minimum of 4 weeks prior to testing. The Contractor shall submit all written factory testing results to the Engineer for review prior to shipment.
  4. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.
- F. Certification: Prior to shipment, the Contractor shall submit for valves over 12-inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.
- G. Valve Marking: Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

## 2.2 MATERIALS

- A. General: Materials shall be suitable for the intended application. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:
1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
  3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
  4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.
  5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.
  6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.
  7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.
  8. NSF Standard 14: Materials shall be listed for use in contact with potable water.

## 2.3 VALVE CONSTRUCTION

- A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

- B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.
- C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Bronze valve stems shall conform to ASTM B 584, except that zinc content shall not exceed 16 percent.
- E. Stem Guides: Stem guides shall be provided, spaced 10-feet on centers unless the manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.
- F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 05 50 00 – Metal Fabrications.

#### 2.4 VALVE ACCESSORIES

- A. Valves shall be furnished complete with the accessories required to provide a functional system.

#### 2.5 SPARE PARTS

- A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

#### 2.6 MANUFACTURERS

- A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

### **PART 3 - EXECUTION**

#### 3.1 VALVE INSTALLATION

- A. General: Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates

shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

- B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION

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**SECTION 40 05 57  
VALVE AND GATE ACTUATORS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Contractor shall provide valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to valves and gates except where otherwise indicated in the Contract Documents.
- C. Unit Responsibility: The valve or gate manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the Contractor shall be responsible to the Owner for compliance of the valves, gates, and actuators with the Contract Documents.
- D. Single Manufacturer: Where 2 or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.
- E. The requirements of Section 26 00 00 - Electrical General Provisions apply to the Work of this Section.

**1.2 CONTRACTOR SUBMITTALS**

- A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and Section 40 05 51 - Valves, General.
- B. Shop Drawings: Shop Drawing information for actuators shall be submitted together with the valve and gate submittals as a complete package.
- C. Calculations: Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.
- D. Technical Manuals: The Contractor shall furnish technical manuals for the butterfly valves, butterfly valve manual actuators, and butterfly valve electric motor actuators under one cover and in accordance with the requirements of Section 01 33 20 – Submittal Procedures.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves and gates shall be provided with manual or power actuators. The Contractor shall furnish actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques,

whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Actuator torque ratings for butterfly valves shall be determined in accordance with AWWA C504 - Rubber-Seated Butterfly Valves. Wires of motor-driven actuators shall be identified by unique numbers.

- B. Manufacturers: Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.
- C. Materials: Actuators shall be current models of the best commercial quality materials and be liberally-sized for the required torque. Materials shall be suitable for the environment in which the valve or gate is to be installed.
- D. Actuator Mounting and Position Indicators: Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.
- E. Standard: Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Slide Gates.
- F. Functionality: Electric, pneumatic, and hydraulic actuators shall be coordinated with the power requirements of Division 26 and instrumentation equipment indicated Division 40.
- G. Fasteners: Fasteners shall be in accordance with Section 05 50 00 – Metal Fabrications.
- H. Protective Coatings: Protective coatings shall be in accordance with Section 09 90 00 – Painting and Coating.

## 2.2 MANUAL ACTUATORS

- A. General: Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psi, valves 24-inches in diameter and larger, and where so indicated, shall have worm gear actuators, hermetically-sealed water-tight and grease-packed. Other valves 6-inches to 20-inches in diameter may have traveling nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.
- B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local



Utility Company or the Engineer. Wrench nuts shall comply with AWWA C 500 - Metal - Seated Gate Valves for Water Supply Service.

- C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be provided with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains provided by the valve manufacturer. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5-feet 6-inches above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.
- D. Floor Stands: Valve actuator floor stands shall be cast iron or fabricated steel pedestals. The centerline of the actuator shall be approximately 42 to 48 inches above the base of the pedestal.
- E. Floor Boxes: Hot dip galvanized cast iron or steel floor boxes and covers to fit the slab thickness shall be provided for operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.
- F. Tee Wrenches: Buried valves with floor boxes shall be furnished with 2 operating keys or 1 key per 10 valves, whichever is greater. Tee wrenches sized so that the tee handle will be 2 to 4 feet above ground, shall fit the operating nuts.
- G. Manual Worm Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90 degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. Gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. Gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof. Manual worm gear actuators shall be Auma GS Series, Limitorque HBC Series, no "Or-Equals".
- H. Traveling-Nut Actuator: The actuator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weatherproof cast iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the actuator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of nipples. Gearing shall be designed for a 100 percent overload.
- I. Schedule for Manual Actuator Types: For a complete schedule of manual actuators required on project valves (4" diameter and larger), see Contract Drawing M-01.

## 2.3 ELECTRIC MOTOR ACTUATORS

### A. General

1. Equipment Requirements: Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adapter piece.
2. Gearing: The motor actuator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel, and the worm gear shall be alloy bronze. Gearing shall be accurately cut with hobbing machines. Power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.
3. Starting Device: Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.
4. Switches
  - a. Switches: Limit switches shall be furnished to sense valve position at each end of travel. Limit switch adjustment shall not be altered by manual operation. One set of normally open and one set of normally closed contacts will be furnished at each end of travel. Contacts shall be of silver and capable of reliably switching the source power from the control system as shown on the drawings. A torque sensor shall be furnished. The torque limit may be adjusted from 40 to 100 percent of rating in 1 percent increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating, and a "jammed valve" protection feature with automatic retry sequence shall be incorporated to de-energize the motor if no movement occurs. Valve actuators with limit switches shall be as manufactured by Auma or Rotork.
  - b. The actuator shall be wired in accordance with the schematic diagram. Wiring for external connections shall be connected to marked terminals. Two conduit connections shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Switches shall not be subject to breakage or slippages due to over-travel. Limit switches shall be of the heavy-duty open contact type with rotary wiping action.
5. Handwheel Operation: A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 lb.ft, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel. A clutch lever shall be provided to put actuator into handwheel operation. Valves with electric motor actuators having stems more than 7-feet above the floor shall be provided with chain activator handwheels. The clutch

lever shall be provided with a cable secured to the chain to allow disengagement for manual operation.

6. Motor: The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480 volt, 3-phase 60 Hz current (unless noted otherwise on Drawing M-01) and have Class F insulation and a motor frame with dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. Bearings shall be of the ball type, and thrust bearings shall be provided where necessary. Bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement. Two Class B thermal contacts or solid state thermistors imbedded within the motor windings shall be provided to protect against over-temperature damage. The motor shall be provided with a space heater suitable for operation on 120 volt, single phase, 60 Hz circuit unless the entire actuator is a hermetically sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion. Each electric motor actuator shall be provided with a local disconnect switch or circuit breaker to isolate power from the motor and controller during maintenance activities.
7. Cycle time: Size open-close/throttling service valve motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes unless otherwise indicated elsewhere in the specifications.
8. Schedule for Electric AC Actuator Type: For a complete schedule of electric actuators required on project valves (4-inch diameter and larger), see Drawing M-01.
9. Remote Actuator Control Station. Valves with electric motor actuators where the valve is located in the lowest level of a multi-level vault with a mezzanine, shall provide a remote actuator control station at the mezzanine level. The Contractor shall provide conduit and wiring between the actuator controls and the valve actuator for these applications. The actuator controls shall be handrail-mounted above the valve at a location approved by the Design Engineer.
10. All electric motor actuators shall be configured for Modbus TCP/IP communication protocol.

B. Electric Motor Actuators (AC Reversing (Open / Close) Control Type)

1. General: Where indicated, electric motor actuators shall be the AC reversing type complete with local control station with open / stop / close and local/off/remote selector switches on the actuator local control station. Valves shall be capable of stopping at operator-controlled set point.
2. Actuator Appurtenances: The actuator for each valve shall be provided with a padlockable disconnect switch, open and closed status lights, open, close and lockout stop pushbuttons, a local/off/remote selector switch, and other devices indicated. The disconnect switches in certain applications are required to be located remotely

from the actuator body itself, as shown on the Contract Drawings. The local control station may also be provided as an integral part of the actuator or remotely as otherwise indicated or required to permit operation by a person at mezzanine elevation and within sight of the valve actuator. The Contractor shall provide conduit and wiring between the actuator controls and the valve actuator for these applications.

3. Starter: The starter shall be a suitably sized amperage rated reversing starter with its coils rated for operation on 480 volt, 3-phase, 60 Hz current (unless otherwise noted on Drawing M-01). A control power transformer shall be included to provide a 120 volt source, unless otherwise indicated. The starter shall be equipped with 3 overload relays of the automatic reset type. Its control circuit shall be wired as indicated. The integral weatherproof compartment shall contain a suitably sized 120 volt ac, single phase, 60 Hz space heater to prevent moisture condensation on electrical components. A local power disconnect switch shall be provided with each actuator. A close-coupled, padlockable switch shall be provided with each actuator.
4. Local Control Station: Each actuator shall be provided with a local control station with the valve actuator assembly. The station shall include open, close, and stop push buttons, and a local/remote selector switch.
5. Manufacturers:
  - a. Rotork, IQ with worm gear.
  - b. Auma, SIPOS SEVEN with worm gear.
  - c. No "Or-Equals" allowed.

### **PART 3 - EXECUTION**

#### **3.1 SERVICES OF MANUFACTURER**

- A. Field Adjustments: Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

#### **3.2 INSTALLATION**

- A. Valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.
- B. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the Site and witness the following:
  1. Installation of the equipment for not less than one (1) Work Day.
  2. Inspection, checking, and adjusting the equipment for not less one (1) Work Day.
  3. Startup and field-testing for proper operation for not less than one (1) Work Day.
- C. Instruction of Owner's Personnel: The authorized service representative shall visit the Site for not less than 1 Day to instruct the Owner's personnel in the operation and maintenance

of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

END OF SECTION

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## **SECTION 40 05 61 GATE VALVES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. The Contractor shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 05 51 - Valves, General apply to this Section.
- C. The requirements of Section 40 05 57 - Valve and Gate Actuators apply to this Section.

#### **1.2 CONTRACTOR SUBMITTALS**

- A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and 40 05 51 - Valves, General.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 40 05 57.
- B. Gate valves 18-inches and larger shall be provided with a bypass line and isolation valve.

#### **2.2 RESILIENT-SEATED GATE VALVES**

- A. General: Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the Engineer.
- B. Construction: Resilient-seated gate valves shall conform to AWWA C509 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a minimum design working water pressure of 150 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 1 of AWWA C509. The stem, stem nuts, glands, and bushings shall be bronze, with the stem seal per AWWA C509.
- C. Pressure Ratings:
  - 1. AWWA C509 valves that are 3, 4, 6, 8, and 12 inches in size shall be rated for 200 psig minimum design working water pressure, and 16-, 20-, 24-, and 30-inch valves shall be rated for 150 psig minimum design working water pressure.
- D. Protective Coating: Valves shall be factory coated in accordance with Section 09 90 00 – Coatings and Painting. The Contractor shall submit a test report from a coating inspector that

the coating is holiday-free. The Contractor shall be aware that it may retain the services of a third party coating applicator to achieve the holiday-free requirement.

- E. Actuators: Unless otherwise indicated, resilient-seated gate valves shall have manual actuators in accordance with Section 40 05 57.
- F. Manufacturers, or Equal
  - 1. American Flow Control
  - 2. Clow Valve Company
  - 3. Mueller Company
  - 4. M & H Valve Company.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Gate valves shall be installed in accordance with the provisions of Section 40 05 51. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION



**SECTION 40 05 63**  
**BALL VALVES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 05 51 - Valves, General apply to this Section.
- C. The requirements of Section 40 05 57 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 40 05 51 - Valves, General.

**PART 2 - PRODUCTS**

2.1 METAL BALL VALVES (3-INCHES AND SMALLER)

- A. General: Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inches shall have actuators in accordance with Section 40 05 57 - Valve and Gate Actuators.
- B. Metal ball valves for submerged service (e.g. reservoir washdown) shall be Type 316 stainless steel.
- C. Body: Ball valves up to and including 1.5-inches in size shall have bronze or stainless steel 2 or 3 piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inches to 3-inches in size shall have bronze or stainless steel 2 or 3 piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated.
- D. Balls: The balls shall be solid chrome-plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings. Reservoir washdown valves shall have full port openings.
- E. Stems: The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced teflon seal.
- F. Seats: The valve seats shall be of teflon or Buna-N, for bi-directional service and easy replacement.
- G. Manufacturers, or Equal
  - 1. Conbraco Industries, Inc. (Apollo)
  - 2. ITT Engineered Valves
  - 3. Neles-Jamesbury, Inc.
  - 4. Watts Regulator

5. Worcester Controls

2.2 PLASTIC BALL VALVES (1.5-INCHES AND SMALLER)

- A. General: Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for the specific fluid application. Valves shall have manual actuators in accordance with Section 40 05 57 - Valve and Gate Actuators, unless otherwise indicated.
- B. Construction: Plastic ball valves shall have true-union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges for easy removal. The balls shall have full size ports and teflon seats. Body seals, union O-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of [Section 11258]. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. Ball valves for sodium hypochlorite solution service shall be drilled through the ball or body per valve manufacturer recommendation to relieve offgas and equalize pressure across the valve. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.
- C. Manufacturers, or Equal
  - 1. ASAHI-America
  - 2. George Fischer, Inc.
  - 3. NIBCO Inc., (Chemtrol)
  - 4. Plast-O-Matic Valves, Inc.
  - 5. Spears Mfg. Co.
  - 6. Watts Regulator

**PART 3 - EXECUTION**

3.1 GENERAL

- A. Valves shall be installed in accordance with Section 40 05 51. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

**SECTION 40 05 64  
BUTTERFLY VALVES**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 05 51 - Valves, General apply to this Section.
- C. The requirements of Section 40 05 57 - Valve Actuators apply to this Section.
- D. Valves shall be of the body type, pressure class, end joint, and actuator type as indicated on the valve schedules on Contract Drawing M-01.
- E. Valves shall be NSF 61 certified for use in drinking water.

**1.2 QUALIFICATION REQUIREMENTS**

- A. The valve manufacturer shall have manufactured waterworks double eccentric butterfly valve for at least 10 years. At the Owner's request, submit at least 10 of the manufacturer's butterfly valves installation of comparable size and complexity to units indicated in this Section or a project similar in size and technical requirements.
- B. The list shall include the following information:
  - 1. Name of facility, owner of facility, contract name, addresses and telephone number.
  - 2. Pressure class.
  - 3. Model number and size.
  - 4. Name, location and contact information of local representative.
- C. Published manufacturers literature showing the valve is intended for sale into the water market and typical application of the project. Only valves specifically designed for high velocity and continuous pressurized waterworks applications will be accepted. General service or industrial valves will not be accepted.
- D. Butterfly Valves shall have undergone FEA (Finite Element Analysis) to verify structural stress and deformation analysis as well as dynamic modal analysis and transient dynamic response. On more complicated and larger size applications, the owner reserves the right to review the manufacturers computational design output. Where a critical threshold headloss is communicated and required, CFD modeling shall be available.
- E. The manufacturer shall demonstrate structured compliance to a repeatable build design and shall be ISO 9000 certified.
- F. Valve manufacturer shall demonstrate a commitment to continuous improvement and quality control of their products. As such they shall have an "in use" and working in-house

R&D lab. Valve testing shall be suitable for water hydraulic tests for sizes to a minimum of 12 inches. Photo documentation may be required.

### 1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51.

B. Shop Drawings

1. Complete Shop Drawings of butterfly valves and actuators.
2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.
3. Certification of proof-of-design test from the valve manufacturer.
4. Certification: The Contractor shall obtain written certification from the butterfly valve manufacturer, addressed to the Owner, stating that the butterfly valves and the valve operators will efficiently and thoroughly perform the required functions in accordance with these Specifications and as shown, and that the manufacturer accepts joint responsibility with the Contractor for coordination of all butterfly valves and valve operators, including motors, drives, controls, and services required for proper installation and operation of the completely assembled and installed units. The Contractor shall submit all such certificates to the construction manager.
5. Technical Manuals: The Contractor shall furnish technical manuals for the butterfly valves, manual operators, and electric motor valve operators under one cover and in accordance with the requirements of Section 01 33 20 – Submittal Procedures.
6. Valve Labeling: The Contractor shall submit a schedule of butterfly valves to be labeled indicating in each case the valve location and the proposed wording for the label.
7. Field Procedures: Written instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to delivery of the butterfly valves and valve operators.

### 1.4 QUALITY ASSURANCE

A. FACTORY TESTS

1. General: Inspection shall be made and tests performed at the manufacturer's facilities on the valves listed in this Subsection.
  - a. Submit test reports to the Engineer. Test reports shall include all factory and field required tests showing each valve is in conformance.
  - b. Notice of each type of valve test shall be given to the Engineer no later than 14 days prior to the scheduled tests.
2. The Contractor shall perform factory tests in the following sequence with valve and actuator completely assembled as a unit.
  - a. Valve Body Hydrostatic Test: The test shall be performed with the valve positioned vertically as if installed in a horizontal pipeline, with both flanged ends bulkheaded and the disc in a slightly open position. Apply internal hydrostatic pressure twice the pressure rating of the valve to the inside of the valve. With the disc in the slightly open position and both flanges bulkheaded, water shall be allowed to enter and completely fill the cavity between both flanged ends; then compressed air or high-pressure water shall be applied through one of the bulkheads into the cavity supplying up to and maintaining

the test pressure for a 5 minute test duration. During the hydrostatic test, there shall be no leakage through any portion of the valve, the metal, end flange joints or the valve shaft seal, and there shall be no permanent deformation of any valve component.

- b. Valve Shutoff Leak Test: All valves shall initially be tested per section 5.2 of ANSI/AWWA C504. Unless otherwise noted, all valves will be leak tested in both flow directions. A secondary test shall be performed with the valve positioned as if installed in a horizontal pipeline, and with one flanged end bulkheaded and the disc in the fully closed position. The test for valves shall be performed at a differential pressure equal to the pressure rating of the valve with the body flanges in a vertical plane and one end flange bulkheaded. The test shall be the same for valves larger than 72", except the differential pressure shall be equal to 100% of the design pressure. With the disc in the closed position, water shall be allowed to enter and completely fill the cavity between the disc and bulkheaded flange, and then compressed air or high-pressure water applied through the bulkheaded flange into the cavity, supplying up to and maintaining the test pressure for a 5-minute test duration. The entire surface of the valve disc shall be visible. There shall be no indication of any water or air leaks during the test period. Unless specifically noted, this test shall be performed in both flow directions.
  - c. Valve Actuator and Operations Test: Manually Actuated Valves: The torque required on the AWWA nut to unseat the valve under a differential pressure of 150 psi shall be recorded. Recording may be performed at the completion of the valve shutoff leak test by using a torque wrench on the AWWA nut before the pressure is released. The valve completely assembled with the actuator shall be manually operated two complete cycles, from the fully open to the fully closed position, under a no-flow condition to show smooth operation. At the end of the first cycle, 300 foot-pounds of input torque shall be applied to the AWWA nut for 15 seconds at both fully open and fully closed positions. No signs of permanent deformation or binding shall be evident. The valve shall be completely cycled a second time after the torque test. Over the full travel of the actuator, during all cycles, there shall be no sign of binding, scraping, misalignment of parts, permanent deformation, or other defects. Actuator stops shall be adjusted so that the valve disc will travel 90 degrees, plus or minus one-half degree, from the closed position to the fully open position and shall be 90 degrees, plus or minus one-half degree, to the flange face when fully open.
3. Protective Coating Testing: All valves 48 inch and larger shall be tested for coating thickness and porosity. Porosity shall be tested using the high voltage spark method. Test shall be taken at all locations with critical focus around seat and seal. Coating thickness measurements at raised cast lettering may be visual. Results and validation shall be signed and dated.

## B. FIELD TESTS

- 1. Field Tests: An authorized service representative of the manufacturer shall visit the site for a minimum of one service day for each two valves which are electrically, pneumatically or hydraulically actuated. They shall sign and certify in writing that the equipment and controls have been properly installed, tested and readied for

operation. Performance tests shall be made on all completely installed valves as follows:

- a. Butterfly Valves, 16-Inch and larger:
  - 1) Each valve shall be operated 3 times from fully closed to fully opened position, and the reverse, under a no-flow condition.
  - 2) Valves shall be hydrostatically tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage. Repair any joints that show signs of leakage prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. Repair any damage caused by the testing.
  - 3) A leak test will be conducted to verify that bubble tight shut-off has been achieved in both flow directions with operating pressure on one side of the disc and atmospheric pressure on the other. The owner reserves the right to field verify that valve leakage is zero.
  - 4) Failure by the Owner to inspect or witness tests at the manufacturer's plant shall not be construed as waiving inspection upon delivery.

## **PART 2 - PRODUCTS**

### **2.1 BUTTERFLY VALVES 4-INCH AND LARGER – CLASS 150B AND 250B**

- A. General: A. General: The butterfly valve shall be designed expressly for waterworks applications and shall be of the double offset design whereby the elastomeric seal is not compressed with the valve in the open position. Zero, single and API based triple offset butterfly valve designs are not acceptable. Butterfly valves for water working pressures up to 150 psi shall conform to ANSI/AWWA C504 Class 150B (including lay-lengths). Butterfly valves for water working pressures greater than 250 psi shall conform to the design requirements of ANSI/AWWA C-504, Class 250B but shall have a minimum of 350 psi working pressure and shall be subject to the following requirements. Valves shall be of the size and class indicated in the valve schedule or in the plans. All valves unless noted otherwise, shall be sized for bi-directional water service, full rated pressure and a line velocity of 16 feet per second and suitable for higher linebreak velocities of 50 fps. Lifting lugs will be provided for all valves 24-inch and larger.
- B. Flanges: Class 150B flanged valves shall have ANSI B16.1 Class 125 pound flanges. Class 250B flanged valves shall comply with ANSI B16.1 Class 250 up through 48-inch unless otherwise noted or if mating to ductile iron pipe. Above 48-inch, flange outside diameter, number of bolts, diameter of bolt circle, and diameter of bolts shall comply with ANSI/AWWA C 207 Class E and the flange thickness shall be designed in accordance with ASME Section VIII, flange design requirements.
- C. Body: Valve bodies shall be ductile iron, ASTM A536 65-45-12 or A536 60-40-18. Cast gray iron is not allowed due to near zero elongation and as it vulnerable to shear stress. The valve body shall include integrally cast support feet top and bottom. It shall be mechanically equipped with a fastened stainless steel stamped or engraved tag indicating manufacturer and reference build data. Valves 54 inch and larger shall include two tags diametrically opposed. The valve build data shall be made available upon request by the customer and

shall be retained by the manufacturer for no less than 70 years unless noted longer. The entire valve body and flanges shall be epoxy corrosion coat protected except for the valve shaft bores.

- D. Disc: The disc shall be ductile iron ASTM A536 65-45-12 or ASTM A536 60-40-18. The entire disc and all its wetted surfaces shall be coated without exception. The disc's elastomeric seal retainer shall be 316 stainless steel. Neither bronze nor carbon steel is acceptable. Both the disc and elastomeric seal retainer shall have recesses designed to retain a dual shouldered seal under extreme localized velocities, at full differential opening and/or linebreak closing. The disc shall be mechanically fastened to the valve shaft using tangential stainless steel shaft pins of type 316 or higher alloy. Disc pins shall extend completely through the valve and shall be mechanically fastened. The disc shall be completely coated except for the disc shaft bores.
- E. Shaft: Valve shafts shall be dual stub shafts of stainless steel ASTM A276 Type 316. The valve shaft material and thickness shall be suitable for the applications pressure and velocity without the use of its safety factors. Shafts may not be turned down to fit drive splines without accompanying torsional strength reduction calculations and its effect on the safety factor.
- F. Elastomeric Seal and Seal Ring: Valve seals shall be EPDM, secured to a completely coated valve disc by a 316 stainless steel, continuous non-segmented seal ring and secured by 316 stainless steel fasteners. The seal shall not scallop, cold flow or tear at localized velocities less than 300 fps. The elastomeric seal shall not be penetrated by fasteners. The valve shall be bi-directionally leak free. The elastomeric seal shall be double shouldered and extend no greater than 0.25 inches past the disc edge to seat the valve. The seal shall be designed to flex in either flow direction. There shall be a small gap on both sides of seal which will allow for pipeline pressurized media to further expand the seal against the metallic seat- the higher the differential pressure or velocity. The elastomeric seal shall be field replaceable and adjustable in line. It shall not require special skills or tools to replace the seat. With access to the seat retaining bolts, the seat removal, replacement and readiness for service must be able to be accomplished in a maximum of 3 hours for all size valves. Seat methods which do not comply or use either irreplaceable vulcanized seals or which use hardened epoxy or grout in a dovetailed groove are not acceptable.
- G. Metallic Seat: The metallic valve seat shall be located in the valve body. It shall be a highly wear resistant stainless steel alloy. There shall be no gap between the valve body and metallic body seat and consequently no potential for corrosion or lifting of the seat. The seat shall be applied through a high alloy weld overlay process. Metallic seats shall not be mechanically retained by fasteners.
- H. Shaft Seals: Shaft seals shall not need periodic manual adjustment. They shall be multi-oring seals protecting both the OD and ID of the shaft bearings. They shall prevent pressurized system water from entering the uncoated valve disc hub and valve body shaft bore. The valve shaft shall remain non-wetted and unpressurized. The non-wetted shaft shall allow the actuator to be removed without dewatering the pipeline. It shall prevent debris and system pressurized water from entering into the uncoated valve body shaft bore. It shall prevent waters or contaminated media, external to the valve, from entering through the valve shaft under vacuum/ negative pressure conditions in the pipeline such as at line break. It shall

additionally prevent an ingress breach where external hydrostatic forces exceed pipeline pressures such as in dewatered pipelines. Neither manual pulldown packing glands nor braided packing are allowed. The outer shaft seals shall be a replaceable cartridge type, bolted to the valve body. Packing shall not be held in place with an adapter plate or by the valve actuator.

- I. Shaft Bearings: Valve shaft bearings shall be corrosion resistant, self-lubricating sleeve type made of bronze, stainless steel or stainless steel backed PTFE. Bearing choice and consequent bearing friction shall be correctly added to valve input torque requirements.
- J. Strength: The proportion and dimensions of all parts of the valve and actuator shall be designed to withstand, without failure, the stresses occurring under the testing and operating conditions. The maximum allowable stress in any material shall not exceed 1/5 of the ultimate tensile strength or 1/3 of the minimum yield strength. Class 150B valves shall be rated to and shall receive a pressure test of 250 psi and Class 250B valves shall be rated to and shall receive a pressure test of 350 psi applied to one side of the disc with zero pressure applied to the other side of the disc while in the closed position, without damage or permanent deformation to any part of the valve, seat, disc or shaft. The valve shall be capable of withstanding such pressures in both directions.
- K. Safety Disc Pinning (Not Required): Where noted herein, where noted on the plans or in the bid documents, an integrated safety locking device shall be incorporated. The valve shall have an externally lockable disc in the closed position. Calculations shall be provided to verify that the disc cannot rotate even with the full stall output torque of the actuator. The disc shall remain in the zero leak sealed closed position even if the entire actuator is removed for safety or maintenance. With the actuator and or the adapter plate removed, the valve will not leak through the stem. The locking device shall be handwheel operated; stainless steel wetted construction, pad lockable and suitable for lockout/tag out safety procedures.
- L. Manual Actuators: Actuators shall conform to Section 40 05 57 - Valve and Gate Actuators and to ANSI/AWWA C 540, subject to the following requirements. All actuators shall be self-locking and shall hold the valve disc in the closed, open and any intermediate position without creeping or fluttering. All actuators shall incorporate a mechanical stop-limiting device to prevent over travel of the disc. Unless direct buried or otherwise indicated, all manually actuated butterfly valves shall be equipped with a handwheel and external position indicator. The number of turns for direct buried valves shall be a minimum of 1.4 times the nominal valve size with no fewer than 25 turns. The valve manufacturer shall be responsible for mounting and testing the actuator. Screw-type (traveling nut) actuators are not permitted due to their inconsistent output torques through the 90 degree stroke. All manual direct buried service actuators shall be designed for a 300 foot-pound input torque against the closed and open travel stops. The owner reserves the right to field verify.
- M. Worm-Gear Actuators: All valves including submerged and buried valves, shall be equipped with top tier AWWA worm-gear actuators (per Section 40 05 57 - Valve and Gate Actuators), lubricated and sealed to prevent entry of dirt or water into the housing. Buried service valves shall be 90% or greater, grease packed. Submerged service valves in potable water applications shall be 100% grease filled with FDA approved food grade grease. Documentation for the selected grease for submerged service valves shall accompany submittals. The owner reserves the right to field verify grease levels. Non-complying gears



shall be remedied by the factory, verified by the customer and signed off by both parties. Gears are recommended to be Limitorque or Rotork and are required to be of an equal or better quality. No-name or unbranded actuators will not be accepted.

- N. Hardware: All fasteners and hardware shall be Type 316 Stainless Steel.
- O. Paint and coatings: The manufacturer is required to have and follow a system of valve preparation and coating which assures a quality holiday free application and which maximizes the available multi-decade protection the coating offers. Manufacturers that do not properly prepare or coat their valves properly will not be accepted.

The manufacturer must provide their written system of valve preparation and coating. This document shall include the methodologies used (quality compliance) as well as post application review (quality assurance). It will be based on a professional system of coating and grading such as NACE, SSPC, GSK, ISO or DIN and will include both text and color photo-documentation. The manufacturers coating system must be documented as well as implemented with a quality assurance program to prevent unacceptable deviation. This coating system shall be submitted for approval. It shall be titled, signed and dated by the manufacturers Coating Department Head, its' Compliance Officer or an equal ranking staff.

- 1. Valves 48-inch and smaller (open-close): All external and internal surfaces except for the seating surface shall be 400 degree F plus, heat bonded fusion coated. Coating damaged in shipping or installation shall be noted and properly repaired to the satisfaction of the utility or its authorized agent.
  - 2. Valves 48-inch and smaller (modulating): All external surfaces except for the seating surface shall be 400 degree F plus, heat bonded fusion coated. All internal surfaces shall be rubber (i.e. ebonite) lined. Coatings and linings damaged in shipping or installation shall be noted and properly repaired to the satisfaction of the utility or its authorized agent
  - 3. Valve coating shall be white or blue. Red Oxide or any near color to rust shall not be acceptable.
- P. Manufacturers, No Equal
  - 1. VAG Armaturen, EKN Double Offset.
  - 2. Av-Tek DEX Double Offset.
- Q. Schedule: Valve manufacturer must demonstrate the ability to meet the project construction schedule. Valve submittal shall include estimated delivery date for valves. If manufacturer is unable to meet the schedule, Engineer will work with Contractor to identify an alternative manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. All exposed butterfly valves shall be installed in a manner whereby the complete valve can be removed without dismantling the valve or operator. The installation shall be in accordance with Section 40 05 51- Valves General.

- B. Contractor shall use the provided lifting lugs to move all project valves. The use of chains, lifting straps, rope or any type other strapping through the valve body is strictly prohibited. Correct lifting procedures shall be the Contractor's responsibility. As necessary, consultation with the valve manufacturer is recommended. The contractor shall be responsible for all damage and project delays resulting from improper lifting and moving procedures, these shall include but shall not be limited to: pulling the valve body out of round, gouges, scratches, displacing the gear box etc.
- C. Butterfly valves 54-inch and larger must be inspected and certified by the manufacturer that the final installation meets all the manufacturers requirements, and that the actuator and disk have not changed positions from that as successfully tested at the factory.
- D. Strict care shall be taken to assure valves are not installed under stress. In no instance shall adjacent mating flanges be forced into position. A progressive and proper star cross pattern shall be used to tighten valve flange mating bolts.

END OF SECTION

**SECTION 40 05 65**  
**VALVES FOR PUMP CONTROL AND CHECK SERVICE**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. The Contractor shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 40 05 50 - Valves, General apply to this Section.

1.2 SUBMITTAL PROCEDURES

- A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and 40 05 50 – Valves, General.

**PART 2 - PRODUCTS**

2.1 INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE – SILENT CHECKS)

- A. General: Internal spring-loaded check valves shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated. Check valves for working pressures less than 20 psi shall be designed accordingly. Check valves for reservoir inlet and outlet service shall be low head loss design.
- B. Body: The bodies of valves 3-inches and larger shall be of cast iron conforming to ASTM A126 with 125 lb flanged ends conforming to ASME B16.1 unless otherwise indicated. Where necessary, there shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body or screwed into the body.
- C. Valves smaller than 3-inches shall have bronze bodies with screwed ends conforming to ASME B1.201, suitable for a minimum working pressure of 200 psi, and a temperature of 250 degrees F, unless otherwise indicated. The type of bronze shall be suitable for the intended service.
- D. Disc and Stem: The disc and stem of all valves in sizes 3-inches and larger shall be of bronze conforming to ASTM B584 - Copper Alloy Sand Castings for General Applications, or stainless steel. The stem shall have 2 point bearings. The downstream bearing shall have a bronze or other suitable bushing, to provide a smooth operation.
- E. Valves smaller than 3-inches shall have discs and retaining rings of Teflon, nylon, or other suitable material, and stems of bronze, brass, or stainless steel, suitable for the intended service.
- F. Stem Guide: The stem guide shall be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall

provide each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the Shop Drawing submittal.

- G. Seat: Valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating of bronze or stainless steel, as recommended by the manufacturer for the specific service condition. Resilient seats shall be firmly attached to the seating ring by compression molding or other acceptable method.
- H. Spring: Valves in sizes 3-inches and larger shall have Type 316 stainless steel springs, and valves smaller than 3-inches shall have stainless steel or beryllium copper springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve.
- I. Manufacturers, no Equal
  1. APCO (Valve and Primer Corp.)
  2. VAL-MATIC (Valve and Manufacturing Corporation)

## 2.2 PLASTIC BALL CHECK VALVES

- A. General: Plastic ball check valves for corrosive fluids, in sizes up to 4-inches, shall be used for vertical up-flow conditions only, unless the valves are provided with spring actions.
- B. Construction: The valve bodies and balls shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) construction, as best suited for each individual service condition. They shall have unions with socket connections or flanged ends conforming to ASME B16.5 - Pipe Flanges and Flanged Fittings, class 150. Seals shall have Viton O-rings, and valve design shall minimize possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.
- C. Manufacturers, or Equal
  1. Asahi-America
  2. George Fischer, Inc.
  3. NIBCO Inc. (Chemtrol Division)
  4. Spears Mfg. Co. (PVC, CPVC, AND PP only)

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Valves shall be installed in accordance with provisions of Section 40 05 50 - Valves, General.

END OF SECTION

**SECTION 40 72 13**  
**LEVEL-ULTRASONIC**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes
  - 1. Instruments for instrumentation and control systems that are to be permanently installed.
- B. Related Sections
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.2 REFERENCES**

- A. All instruments shall comply with the latest edition and standards of the International Society of Automation.

**1.3 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. NEC: National Electrical Code.
  - 2. IEEE: Institute of Electrical and Electronic Engineers.
  - 3. ISA: International Society of Automation.
  - 4. NFPA: National Fire Protection Association.

**1.4 SYSTEM DESCRIPTION**

- A. Furnish all instruments as identified on the P&IDs and instrument list.
- B. Install and connect all instruments per the manufacturer's recommendations for the particular installation.
- C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor (ICSC).

**1.5 SUBMITTALS**

- A. Furnish complete submittals in accordance with Sections 01 33 20.
- B. Product Data:
  - 1. Complete manufacturer's brochures which identify instrument construction, accuracy, ranges, materials, and options.
  - 2. Completed instrument data sheets including catalog number and source for determining catalog number.

3. Manufacturer's installation instructions. Follow all installation and material recommendation based on the manufacturers recommendations. Verify with engineer any discrepancies found.
- C. Shop Drawings
  1. Mechanical connection diagrams.
  2. Sensor transducer mounting requirements with dimensions and elevations.
  3. Electrical connection diagrams.
- D. Test Reports
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
- E. Operating Manuals
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
  2. Complete installation, calibration, and testing manuals.
- F. Record Drawings
  1. Complete field calibration sheets, including range, span, PLC/PAC I/O address, registers, and scaling coefficients.

## 1.6 QUALITY ASSURANCE

- A. All instruments of similar nature must be furnished by the same manufacturer.
- B. Manufacturer's representative shall be responsible for proving all 4-20mA output loops.
- C. Instruments shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated storage structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
  1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

## 1.8 PROJECT/SITE CONDITIONS

- A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

## 1.9 WARRANTY

- A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

## 1.10 MAINTENANCE

- A. Provide all necessary materials and equipment required for proper calibration purposes.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. As identified on the instrument list in Section 40 75 01.
- B. Hardware Commonality:
  - 1. All instruments, which utilize a common measurement principle, for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head, shall be furnished by a single Manufacturer.
  - 2. All panel-mounted instruments shall have matching style and general appearance.
  - 3. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

### 2.2 EQUIPMENT

- A. Ultrasonic Level Transmitter
  - 1. Shall be of the non-contact microprocessor-based type for the continuous measurement of liquid levels.
  - 2. Components.
    - a. A transducer with sufficient cable attached to the transducer for a complete, non-spliced, cable run from the transducer to the transmitter.
    - b. A control transmitter unit which can be located up to 1200 feet away from the sensor.
    - c. A removable programming unit.
  - 3. Transmitter
    - a. The transmitter shall store the ultrasonic profile in the processor memory and moment by moment, analyze the profile to determine the actual liquid level.
    - b. Unit shall alter the ultrasound profile to enhance the echo with every momentary variation in the various level measuring conditions.
    - c. All program data shall be safeguarded internally in non-volatile EEPROM memory.
    - d. Enclosure NEMA 4X enclosure with an integral front panel mounted meter indicating in scaled engineering units.
    - e. 4-20 mA output directly proportional to level.
    - f. The unit shall be capable of displaying by software selection either:
      - 1) Distance to liquid surface from transmitter.
      - 2) Distance from bottom of tank to liquid surface.
      - 3) Remaining volume in tank.
    - g. Shall contain a minimum of two relays for use as programmable alarm points.
    - h. Power requirements shall be specific to site conditions; either 120 VAC, 24 VDC or loop powered.
    - i. Shall be short circuit proof with respect to transducer connections.

4. Transducer
  - a. Shall be encapsulated.
  - b. Operating temperature range -20°C - 60°C with an accuracy of  $\pm 0.25\%$  of range.
  - c. Measuring range 45 feet.
  - d. Provided for flange mounting.
  - e. Integral temperature compensation.
  - f. Manufacturer to furnish sufficient cable attached to the transducer for a complete, non-spliced, cable run from the transducer to the transmitter.
5. Programming Unit
  - a. Shall be Windows OS compatible software capable of mapping out echoes through the use of a laptop computer (computer furnished by Owner).
6. Performance requirements:
  - a. Accuracy: 0.25% or range or 0.24 inches; whichever is greater.
  - b. Resolution: 0.1% or range or 0.08 inches; whichever is greater.
  - c. Electronics Ambient Temperature: -5°F to 122 °F ( -20°C to 50 °C).
  - d. Transducer Process Temperature: -40°F to 300 °F (-40°C to 150 °C).
7. As manufactured by:
  - a. Siemens HydroRanger 200 w/ Echomax Sensor
  - b. Siemens SITRANS LU Series w/ Echomax Sensor.
  - c. No Equal.

## 2.3 ACCESSORIES

- A. Furnish two copies (licensed to the Owner) of the configuration and mapping software ("Time-of-Flight") tools. In addition to the software, furnish two tool cables/adapters, which allow the software to function correctly without the HART interface.

## 2.4 SOURCE QUALITY CONTROL

- A. All instruments and/or representative instruments shall be calibrated with instruments traceable to the National Bureau of Standards.
  1. Provide complete documentation covering the traceability of all calibration instruments.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

## 3.2 PREPARATION

- A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances, weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.



### 3.3 INSTALLATION

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  - 1. It is the ICSC's responsibility to install all instruments in conformance with manufacturer's recommendations.
  - 2. It is the ICSC's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. The ICSC shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 61 00.

### 3.5 ADJUSTING

- A. All instruments shall be field calibrated to match the installed conditions.

### 3.6 CLEANING

- A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

### 3.7 DEMONSTRATION

- A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.
- B. All instrument calibration shall be witnessed by the Owner's Representative.
- C. Each and every instrument shall be tested during the Loop Validation Tests and the Owner's Representative shall witness the response in the PLC/PAC control system and associated registers.

### 3.8 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
  - 1. The Engineer shall be the sole party responsible for determining the corrective measures.

### 3.9 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the ICSC's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review at no additional costs to the Owner.
- B. The ICSC shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with Paragraph 1.5 of this section.

1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

## **SECTION 40 72 76 LEVEL-SWITCHES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Instruments for instrumentation and control systems that are to be permanently installed.
  - 2. Level switches and floats used for level measurement.
    - a. Mechanical.
    - b. Tipping Float.
    - c. Reed.
- B. Related Sections:
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

#### **1.2 REFERENCES**

- A. All instruments shall comply with the latest edition and standards of the International Society of Automation.

#### **1.3 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. National Electrical Code.
  - 2. Institute of Electrical and Electronic Engineers.
  - 3. International Society of Automation.
  - 4. National Fire Protection Association.

#### **1.4 SYSTEM DESCRIPTION**

- A. Furnish all instruments as identified on the P&IDs and instrument list.
- B. Install and connect all instruments per the manufacturer's recommendations for the particular installation.
- C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor.

#### **1.5 CONTRACTOR SUBMITTALS**

- A. Furnish complete submittals in accordance with Sections 01 33 20.
- B. Product Data:

1. Complete manufacturer's brochures which identify instrument construction, accuracy, ranges, materials, and options.
  2. Completed instrument data sheets including catalog number and source for determining catalog number.
  3. Manufacturer's installation instructions.
- C. Shop Drawings:
1. Mechanical connection diagrams.
  2. Sensor transducer mounting requirements with dimensions and elevations.
  3. Electrical connection diagrams.
- D. Record Drawings:
1. Complete field calibration sheets, including range, span, PLC I/O address, register, and scaling coefficients.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.
- 1.7 PROJECT/SITE CONDITIONS
- A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.
- 1.8 WARRANTY
- A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. As identified on the instrument list in Section 40 75 01.
- B. Hardware Commonality:
1. All instruments which utilize a common measurement principle, for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head, shall be furnished by a single Manufacturer.
  2. All panel mounted instruments shall have matching style and general appearance.
  3. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

### **2.2 EQUIPMENT**

- A. As identified on the instrument list in Section 40 75 01.

## 2.3 SOURCE QUALITY CONTROL

- A. All instruments and/or representative instruments shall be calibrated with instruments traceable to the National Bureau of Standards.
  - 1. Provide complete documentation covering the traceability of all calibration instruments.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

### 3.2 PREPARATION

- A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances, including weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

### 3.3 INSTALLATION

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  - 1. It is the Instrumentation and Control Systems Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
  - 2. It is the Instrumentation and Control Systems Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations

### 3.4 FIELD QUALITY CONTROL

- A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 61 00.

### 3.5 ADJUSTING

- A. All instruments shall be field calibrated to match the installed conditions.

### 3.6 CLEANING

- A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

### 3.7 DEMONSTRATION

- A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.

- B. All instrument calibration shall be witnessed by the Owner's Representative.
- C. Each and every instrument shall be tested during the Loop Validation Tests and the Owner's Representative shall witness the response in the PLC control system and associated registers.

### 3.8 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
  - 1. The Engineer shall be the sole party responsible for determining the corrective measures.

### 3.9 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the Instrumentation and Control Systems Contractor's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review at no additional costs to the Owner.
- B. The Instrumentation and Control System Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with Paragraph 1.05 of this section.
  - 1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

**SECTION 40 73 13  
PRESSURE GAUGES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Instruments for instrumentation and control systems that are to be permanently installed.
- B. Related Sections:
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.2 REFERENCES**

- A. All instruments shall comply with the latest edition and standards of the International Society of Automation.

**1.3 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. National Electrical Code.
  - 2. Institute of Electrical and Electronic Engineers.
  - 3. International Society of Automation.
  - 4. National Fire Protection Association.

**1.4 SYSTEM DESCRIPTION**

- A. Furnish all instruments as identified on the P&IDs and instrument list.
- B. Install and connect all instruments per the manufacturer's recommendations for the particular installation.
- C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor.

**1.5 SUBMITTALS**

- A. Furnish complete submittals in accordance with Sections 01 33 20.
- B. Product Data:
  - 1. Complete manufacturer's brochures which identify instrument construction, accuracy, ranges, materials, and options.
  - 2. Completed instrument data sheets including catalog number and source for determining catalog number.
  - 3. Manufacturer's installation instructions.

- C. Shop Drawings:
  - 1. Mechanical connection diagrams.
  - 2. Sensor mounting requirements with dimensions and elevations.
  - 3. Electrical connection diagrams.
- D. Test Reports:
  - 1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
- E. Operating Manuals:
  - 1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
  - 2. Complete installation, calibration, and testing manuals.
- F. Record Drawings:
  - 1. Complete field calibration sheets, including range, span.

## 1.6 QUALITY ASSURANCE

- A. All instruments of similar nature must be furnished by the same manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
  - 1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

## 1.8 PROJECT/SITE CONDITIONS

- A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

## 1.9 WARRANTY

- A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

## 1.10 MAINTENANCE

- A. Provide all necessary materials, fluids, etc. for calibration purposes.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Ashcroft 1279 with Performance Plus.



B. No equals.

## 2.2 MANUFACTURED UNITS

### A. Pressure, Vacuum, Compound Gauges.

#### 1. General.

- a. Furnish and install pressure and vacuum gauges as specified, complete, including all fittings, snubbers, connections, gaskets, supports, and accessories in the locations shown or specified, in accordance with the Contract Documents.
- b. Pressure gauges shall be provided whether or not shown on the plans:
  - 1) On suction and discharge connection to all pumps.
  - 2) On discharge connection from blowers and compressors.
  - 3) On each side of pressure reducing valves.
  - 4) In other locations as shown on the P&IDs and/or mechanical plans.
- c. Vacuum gauges shall be provided whether or not shown on the plans:
  - 1) On all supply side eductor type chemical feeders.
  - 2) In other locations as shown on the P&IDs and/or mechanical plans.
- d. Sleeve pressure gauges.
  - 1) Shall be provided where shown on the plans.
  - 2) Pressure shall be sensed by a flexible sleeve contained in a flanged cast iron or steel spool or wafer body, and transmitted to the gauge through a captive fluid.
  - 3) Sleeve shall be of BUNA A and fabricated so as to isolate the body from the process liquid.
  - 4) Gauges shall be calibrated to read in applicable units.
  - 5) Accuracy of  $\pm 1\%$  to 150% of the working pressure of the system to which they are connected

#### 2. Construction:

- a. Gauges shall be industrial quality type with Type 316 stainless steel movement.
- b. Phenolic case.
- c. Liquid filled.
- d. Unless otherwise shown or specified, gauges shall have:
  - 1) A 4-1/2-inch dial.
  - 2) 1/2-inch threaded connection.
  - 3) Type pulsation dampener adapter.
    - a) Pulsation Dampener as manufactured by:
      - i. Cajon Co.
      - ii. Weksler Instruments, Corp.
      - iii. Ashcroft.
      - iv. No equals.
  - 4) A block and bleed valve - 1/2 inch national pipe thread process connection and bleed/calibrate valve between block valve and outlet port.
- e. Gages shall be calibrated to read in applicable engineering units.
- f. Accuracy of  $\pm 0.5\%$  to 150 % of the working pressure or vacuum of the pipe or vessel to which they are connected.
- g. All gauges shall be vibration and shock resistant.

3. Snubbers as manufactured by:
  - a. Cajon Co.
  - b. Weksler Instruments, Corp.
  - c. Ashcroft.
  - d. No Equal
4. Pulsation dampeners as manufactured by:
  - a. Cajon Co.
  - b. Weksler Instruments, Corp.
  - c. Ashcroft.
  - d. No Equal

## 2.3 ACCESSORIES

- A. Gauges shall be liquid filled or have some equivalent technology.

## 2.4 SOURCE QUALITY CONTROL

- A. All instruments and/or representative instruments shall be calibrated with instruments traceable to the National Bureau of Standards.
  1. Provide complete documentation covering the traceability of all calibration instruments.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

## 3.2 PREPARATION

- A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances. weldolets, valves, orientation, etc. for proper installation of the instruments.

## 3.3 INSTALLATION

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  1. It is the Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
  2. It is the Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations
  3. Install two 2-valve instrument manifolds for each gauge pressure transmitter.
  4. Bolt 3 valve manifolds at non-flange diaphragm type differential pressure transmitters in place of standard flange adapters.
  5. Install root valves at process taps except insertion elements.
  6. Install gauge valves on process connections to instruments where multiple instruments are connected to one tap or where root valves are not readily accessible.

7. All gauges shall be installed with the face in the vertical position.
8. In strict accordance with the manufacturers printed instructions.
9. At the locations shown on the drawings, when so shown.
10. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges.
11. In extreme cases, and with the approval of the Engineer, gauges may be mounted independently, with flexible connectors.

#### 3.4 FIELD QUALITY CONTROL

- A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 61 00.

#### 3.5 ADJUSTING

- A. All instruments shall be field verified.

#### 3.6 DEMONSTRATION

- A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.

#### 3.7 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
  1. The Engineer shall be the sole party responsible for determining the corrective measures.

#### 3.8 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the Contractor's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The Contractor shall provide documented evidence for a differential plus or minus that results from these changes.
- B. The Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with Paragraph 1.05 of this section.
  1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

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**SECTION 40 73 26**  
**PRESSURE-TRANSMITTERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes
  - 1. Instruments for instrumentation and control systems that are to be permanently installed.
- B. Related Sections
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.2 REFERENCES**

- A. All instruments shall comply with the latest edition and standards of the International Society of Automation.

**1.3 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. National Electrical Code.
  - 2. Institute of Electrical and Electronic Engineers.
  - 3. International Society of Automation.
  - 4. National Fire Protection Association.

**1.4 SYSTEM DESCRIPTION**

- A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.
- B. Install and connect all instruments per the manufacturer's recommendations for the particular installation.
- C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor.

**1.5 SUBMITTALS**

- A. Furnish complete submittals in accordance with Sections 01 33 20.
- B. Product Data:
  - 1. Complete manufacturer's brochures which identify instrument construction, accuracy, ranges, materials, and options.
  - 2. Completed instrument data sheets including catalog number and source for determining catalog number.

3. Manufacturer's installation instructions.
- C. Shop Drawings:
  1. Mechanical connection diagrams.
  2. Sensor transducer mounting requirements with dimensions and elevations.
  3. Electrical connection diagrams.
- D. Test Reports:
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
- E. Operating Manuals:
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
  2. Complete installation, calibration, and testing manuals.
- F. Record Drawings:
  1. Complete field calibration sheets, including range, span, PLC I/O address, register, and scaling coefficients.

#### 1.6 QUALITY ASSURANCE

- A. All instruments of similar nature must be furnished by the same manufacturer.
- B. Manufacturer's representative shall be responsible for proving flow meter operation and 4-20 mA loop accuracy.
- C. Instruments shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
  1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

#### 1.8 PROJECT/SITE CONDITIONS

- A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

#### 1.9 WARRANTY

- A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

## 1.10 MAINTENANCE

- A. Provide all necessary materials, fluids, etc. for calibration purposes.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. As identified in Section 40 75 01 – Instrument List.
- B. Hardware Commonality:
  - 1. All instruments, which utilize a common measurement principle, for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head, shall be furnished by a single Manufacturer.
  - 2. All panel-mounted instruments shall have matching style and general appearance.
  - 3. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

### 2.2 EQUIPMENT

- A. Pressure Transmitters Direct
  - 1. Ranges:
    - a. As noted in Section 40 75 01 – Instrument List
  - 2. As manufactured by:
    - a. See Section 40 75 01 – Instrument List
    - b. No equals.

### 2.3 SOURCE QUALITY CONTROL

- A. All instruments and/or representative instruments shall be calibrated with instruments traceable to the National Bureau of Standards.
  - 1. Provide complete documentation covering the traceability of all calibration instruments.
  - 2. Provide 3 copies of calibration curve – One with the instrument, one to the engineer and a third copy in the O&M located with its corresponding ISA data sheet. Calibration curve shall be matched by instrument tag.
- B. Manufacturer's representative shall be responsible for proving flow meter operation and 4-20 mA loop accuracy.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

### 3.2 PREPARATION

- A. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances, weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

### 3.3 INSTALLATION

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  - 1. It is the Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
  - 2. It is the Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations

### 3.4 FIELD QUALITY CONTROL

- A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 61 00.

### 3.5 ADJUSTING

- A. All instruments shall be field calibrated to match the installed conditions.

### 3.6 CLEANING

- A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

### 3.7 DEMONSTRATION

- A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.
- B. All instrument calibration shall be witnessed by the Owner's Representative.
- C. Each and every instrument shall be tested during the Loop Validation Tests and the Owner's Representative shall witness the response in the PLC control system and associated registers.

### 3.8 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
  - 1. The Engineer shall be the sole party responsible for determining the corrective measures.

### 3.9 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the



Contractor's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The Contractor shall provide documented evidence for a differential plus or minus that results from these changes.

- B. The Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.05 of this section.
  - 1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

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**SECTION 40 73 37**  
**PRESSURE-SWITCHES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes
  - 1. Instruments for instrumentation and control systems that are to be permanently installed.
- B. Related Sections
  - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

**1.2 REFERENCES**

- A. All instruments shall comply with the latest edition and standards of the International Society of Automation.

**1.3 DEFINITIONS**

- A. Definitions of terms and other electrical considerations as set forth in the:
  - 1. National Electrical Code.
  - 2. Institute of Electrical and Electronic Engineers.
  - 3. International Society of Automation.
  - 4. National Fire Protection Association.

**1.4 SYSTEM DESCRIPTION**

- A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.
- B. Install and connect all instruments per the manufacturer's recommendations for the particular installation.
- C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor.

**1.5 SUBMITTALS**

- A. Furnish complete submittals in accordance with Sections 01 33 00.
- B. Product Data:
  - 1. Complete manufacturer's brochures which identify instrument construction, accuracy, ranges, materials, and options.
  - 2. Completed instrument data sheets including catalog number and source for determining catalog number.

3. Manufacturer's installation instructions.
- C. Shop Drawings:
  1. Mechanical connection diagrams.
  2. Sensor transducer mounting requirements with dimensions and elevations.
  3. Electrical connection diagrams.
- D. Test Reports:
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
- E. Operating Manuals:
  1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
    - a. Including factory calibration for each instrument with stated accuracy.
  2. Complete installation, calibration, and testing manuals.
- F. Record Drawings:
  1. Complete field calibration sheets, including range, span, PLC I/O address, register, and scaling coefficients.

#### 1.6 QUALITY ASSURANCE

- A. All instruments of similar nature must be furnished by the same manufacturer.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
  1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the OWNER.

#### 1.8 PROJECT/SITE CONDITIONS

- A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

#### 1.9 WARRANTY

- A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

#### 1.10 MAINTENANCE

- A. Provide all necessary materials, fluids, etc. for calibration purposes.

## **PART 2 - - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. As identified in Section 40 75 01 Instrument List

### **2.2 MANUFACTURED UNITS**

#### **A. Pressure Switches.**

1. General:
  - a. Enclosure NEMA 4X.
  - b. Manual Reset trip on increasing pressure.
  - c. Relay Switches shall be DPDT.
  - d. Actuator Seal: Teflon (verify with manufacturer for each and every installation)
  - e. Each pressure switch shall have visible scale and contact operation.
2. Pressure switches shall have a contact rating of 10 Amps at 125 VAC.
3. Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.
4. Diaphragm seals shall be provided and included at the locations indicated in the drawings.
5. Any pressure switch used to detect high pump discharge shall be equipped with a manual reset.

#### **B. Differential Pressure Switches.**

1. General
  - a. NEMA 4X.
  - b. Variable Deadband.
  - c. Actuator Seal - Viton 20°F to 300°F (-6°C to 149°C).
  - d. Verify with manufacturer for each and every installation.
  - e. Relay Switch shall be DPDT.
  - f. Each pressure switch shall have visible scale and contact operation.
  - g. Pressure switches shall have a contact rating of 10 Amps at 125 VAC.
  - h. Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.
  - i. Diaphragm seals shall be provided and included at the locations shown.
2. Automatic reset.
3. Adjustable differential

### **2.3 SOURCE QUALITY CONTROL**

- A. All instruments and/or representative instruments shall be calibrated with instruments traceable to the National Bureau of Standards.
  1. Provide complete documentation covering the traceability of all calibration instruments.

## **PART 3 - - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

### **3.2 PREPARATION**

- A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances, weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

### **3.3 INSTALLATION**

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  - 1. It is the CONTRACTOR's responsibility to install all instruments in conformance with manufacturer's recommendations.
  - 2. It is the CONTRACTOR's responsibility to notify the ENGINEER of any installation conditions that may be shown at variance with the manufacturer's recommendation.

### **3.4 FIELD QUALITY CONTROL**

- A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 61 00.

### **3.5 ADJUSTING**

- A. All instruments shall be field calibrated to match the installed conditions.

### **3.6 CLEANING**

- A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

### **3.7 DEMONSTRATION**

- A. Performance of all instruments shall be demonstrated to the ENGINEER prior to commissioning.
- B. All instrument calibration shall be witnessed by the OWNER's Representative.
- C. Each and every instrument shall be tested during the Loop Validation Tests and the OWNER's Representative shall witness the response in the PLC control system and associated registers.

### 3.8 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. The CONTRACTOR shall replace any instruments damaged prior to commissioning at no additional cost to the OWNER.
  - 1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

### 3.9 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the CONTRACTOR's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The CONTRACTOR shall provide documented evidence for a differential plus or minus that results from these changes.
- B. The CONTRACTOR shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.5 of this section.
  - 1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

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**SECTION 40 75 01  
INSTRUMENT LIST**

**PART 1 - GENERAL**

1.1 INSTRUMENT LIST

- A. Instrument list is shown in the attached table following this section.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

END OF SECTION

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Instrument List (New 6.8 MG Reservoir and Vaults)			
Tag	Location	Device	Description
LSH-140	Inlet Outlet Valve Vault	Flood Alarm	Gem Sensor 01702
PIT-141	Inlet Outlet Valve Vault	Level (Secondary)	Rosemount 3051 or Endress+Hauser PMC71
PSH-142	Inlet Outlet Valve Vault	Washdown Pressure	Mercoird (Series CXA), SOR (Series NN), adjustable pressure switch with at least 1 NC contact that opens on increasing pressure and is set to open at > 100 psi
ZSC-143	Inlet Outlet Valve Vault	Entry Switch (Hatch Closed)	Limit Switch with Roller Lever, side mount with at least 1 normally open contact. Contact to close when level is 'pressed'. Square D (Class 9007) 9007C54B2.
ZSC-144	Inlet Outlet Valve Vault		
ZSC-145	Inlet Outlet Valve Vault		
ZSC-146	Inlet Outlet Valve Vault		
LE-150	6.8 MG Reservoir	Level (Primary)	Siemens Echomax XPS-15. Range 0 to 50 feet, with 100 meter cable.
LIT-150	Inlet Outlet Valve Vault	Level (Primary)	Siemens Hydromanager 200 HMI.
LSH-151	6.8 MG Reservoir	Overflow Alarm	Tipping float level switches, internal weight, no mercury. Contractor to provide manufacturer's cable at length required for tank levels. Switches shall be Eco-Float by Anchor Scientific, part number GSI(cable length in feet)NONC. High water level: 4742.50. Overflow water level: 4743.5. High and High High alarm to automatically reset as alarms level drops.
LSHH-151	6.8 MG Reservoir		
ZSC-152	6.8 MG Reservoir	Entry Switch (Hatch Closed)	Limit Switch with Roller Lever, side mount with at least 1 normally open contact. Contact to close when level is 'pressed'. Square D (Class 9007) 9007C54B2.
ZSC-153	6.8 MG Reservoir		
ZSC-154	6.8 MG Reservoir		
ZSC-161	6.8 MG Reservoir		
LSH-170	Underdrain Vault	Flood Alarm	Gem Sensor 01702
ZSC-171	Underdrain Vault	Entry Switch (Hatch Closed)	Limit Switch with Roller Lever, side mount with at least 1 normally open contact. Contact to close when level is 'pressed'. Square D (Class 9007) 9007C54B2.
LSL-180	Drain Vault	Pump Control	Tipping float level switches, internal weight, no mercury. Contractor to provide manufacturer's cable at length required for tank levels. See specification 40 72 76 2.2 B.
LSH-180	Drain Vault		
ZSC-181	Drain Vault	Entry Switch (Hatch Closed)	Limit Switch with Roller Lever, side mount with at least 1 normally open contact. Contact to close when level is 'pressed'. Square D (Class 9007) 9007C54B2.

Notes: Substitutions allowed with written approval of Owner and Engineer only.

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**DIVISION 43**  
**GAS, LIQUID, AND STORAGE**

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## **SECTION 43 20 10 PUMPS, GENERAL**

### **GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The Contractor shall provide all pumps and pumping appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated in the Contract Documents.
- C. Unit Responsibility: A single manufacturer shall be made responsible for furnishing the Work and for coordination of design, assembly, testing, and installation of the Work of each pump Section; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each pump Section. Unless otherwise indicated, the single Manufacturer shall be the Manufacturer of the pump.
- D. Single Manufacturer: Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same Manufacturer.

#### **1.2 CONTRACTOR SUBMITTALS**

- A. General: Submittals shall be furnished in accordance with Section 01 33 20 - Contractor Submittals.
- B. Shop Drawings: Shop drawings shall contain the following information:
  - 1. Pump name, identification number, and specification Section number.
  - 2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable frequency drive.
  - 3. The Contractor shall require the Manufacturer to indicate on the performance curves the limits recommended for stable operation without surge, without cavitation, and without vibration (except vibration within specified allowable limits). The stable operating range shall be as wide as possible based on actual hydraulic and mechanical measurements taken during the factory performance tests of the pumps.
  - 4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
  - 5. Data, in accordance with Section 26 19 00 - Medium-Voltage Induction Motors, for the electric motor proposed for each pump.
  - 6. Elevation of proposed Local Control Panel showing panel-mounted devices, details of enclosure type, single line diagram of power distribution, and current draw of panel,

- and list of all terminals required to receive inputs or to transmit outputs from the Local Control Panel.
- 7. Wiring diagram of field connections with identification of terminations between Local Control Panels, junction terminal boxes, and equipment items.
- 8. Complete electrical schematic diagram.
- C. Operation and Maintenance Manual: The Manual shall contain the required information for each pump Section.
- D. Spare Parts List: A Spare Parts List shall contain the required information for each pump Section.
- E. Factory Test Data: Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.
- F. Certifications
  - 1. Manufacturer's certification of proper installation.
  - 2. Contractor's certification of satisfactory field testing.

### 1.3 QUALITY ASSURANCE

- A. Warranty: Unless otherwise specified, each pump shall be supplied with manufacturer's standard warranty of one (1) year from substantial completion.

## PRODUCTS

### 2.1 GENERAL

- A. Compliance with the requirements of the individual pump Sections may necessitate modifications to the Manufacturer's standard equipment.
- B. Performance Curves: All centrifugal pumps shall have a continuously rising curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine, or encroach on the service factor.
- C. No cavitation shall be allowed in pumps operating within the stable operating range for the specified operating conditions. For the purposes of this provision, cavitation shall be recognized and accepted as being present in a pumping unit if cavitation noise can be perceived either by the human ear or by acoustic instruments or devices. The presence or absence of cavitation noise shall be verified by the Owner during both the factory performance tests of the pumps and during operation of the pumps up to the end of the warranty period. To assist in revealing potential cavitation during the factory performance tests, in addition to all other required tests, the Manufacturer shall force the pumps to operate at the specified minimum net positive suction head available for each of the following conditions: minimum flow rate, design flow rate and head, and maximum flow rate.
- D. All components of each pump system provided under the pump Sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms,



couplings, electric motors, variable frequency controls if required, necessary mountings, and appurtenances.

## 2.2 MATERIALS OF CONSTRUCTION

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
1. Cast iron pump casings and bowls shall be of austenitic ductile iron, conforming to ASTM A 439 - Specification for Austenitic Ductile Iron Castings, or equal.
  2. Bronze pump impellers shall conform to ASTM B 62 - Specification for Composition Bronze or Ounce Metal Castings, or B 584 - Specification for Copper Alloy Sand Castings for General Applications, where dezincification does not exist.
  3. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel parts shall be of Type 316.
  4. All anchor bolts, nuts, and washers that are not buried or submerged shall be hot-dip galvanized, unless otherwise specified in individual pump Sections. Buried or submerged bolts, nuts, and washers shall be stainless steel in accordance with Section 05 50 00 – Metal Fabrications.

## 2.3 PUMP COMPONENTS

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or B16.5 - Pipe Flanges and Flanged Fittings Dimensions.
- B. Lubrication: Vertical pump shafts of clean water pumps shall be product water-lubricated, unless otherwise specified. Deep-well pumps and pumps with dry barrels shall have water- or oil-lubricated bearings and seals and enclosed lineshafts. Pumps for other process fluids shall be lubricated as indicated.
- C. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.
- D. Vortex Suppressors: Vertical pumps with marginal submergence shall be provided with vortex suppressors.
- E. Drains: All gland seals, air valves, cooling water drains, and drains from variable frequency drive equipment shall be piped to the nearest floor sink, or drain, with galvanized steel pipe or copper tube, properly supported with brackets.
- F. Grease Lubrication: For all vertical propeller, mixed-flow, and turbine pumps, other than deep well pumps, of bowl sizes 10-inches and larger, the Contractor shall provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.
- G. Stuffing Boxes: Where stuffing boxes are indicated for the pump seal, they shall be of the best quality, using the Manufacturer's suggested materials best suited for the specific application. For drainage and liquids containing sediments, the seals shall be fresh-water flushed, using lantern rings.

1. Unless otherwise specified, the packing material shall be interlaced Teflon braiding, containing 50 percent ultrafine graphite impregnation to satisfy the following:
  - a. Shaft speeds - up to 2500 rpm
  - b. Temperature - up to 500 degrees F
  - c. pH range - 0 to 14.
2. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by John Crane Co., Lakos (Claude Laval Corp.), or equal.

H. Mechanical Seals: Mechanical seals shall be fresh water-flushed unless indicated otherwise; in which case product water cleaned by a solids separator as above shall be used. Mechanical seals shall be as manufactured by the following, or equal:

Type	Manufacturer
Water Pumps Hot and Cold	Single seals: John Crane, Type I, 21; Borg-Warner Type L; Chesterton

- I. Where indicated, a buffer fluid must be circulated a minimum 20 psi above discharge pressure, or as required by the Manufacturer, in order to maintain reliable seal performance.
- J. Mechanical seals for all services other than chemicals and corrosives shall be equipped with nonclogging, single coil springs and nonsliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel, Alloy 20, or Hastelloy B or C.

## 2.4 PUMP APPURTENANCES

- A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number. Dimension and flow information shall be in metric units, followed by English units in parentheses.
- B. Solenoid Valves: The pump Manufacturer shall provide solenoid valves on the water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical ratings shall be compatible with the motor control voltage.
- C. Gauges: all pumps (except sample pumps, sump pumps, and hot water circulating pumps) shall be equipped with pressure gauges installed at pump discharge lines. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
  1. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.
  2. Pressure and compound gauges shall be provided in accordance with Section 17205 – Pressure Gauges.

## EXECUTION

### 3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: Where required by the individual pump Sections, an authorized service representative of the Manufacturer shall visit the site for the number of days indicated in those Sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
  - 1. Installation of the equipment.
  - 2. Inspection, checking, and adjusting the equipment.
  - 3. Startup and field testing for proper operation.
  - 4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.
- B. Instruction of the Owner's Personnel
  - 1. Where required by the individual pump Sections, an authorized training representative of the Manufacturer shall visit the site for the number of days indicated in those Sections to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
  - 2. The representative shall have at least two years' experience in training. A resume for the representative shall be submitted.
  - 3. Training shall be scheduled a minimum of three weeks in advance of the first session.
  - 4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.
  - 5. The training materials shall remain with the trainees.
  - 6. The Owner may videotape the training for later use with the Owner personnel.

### 3.2 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the Manufacturer's written recommendations.
- B. Alignment: All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The Contractor shall provide the necessary oil and grease for initial operation.

### 3.3 PROTECTIVE COATING

- A. Materials and equipment shall be coated as required in Section 09 90 00 – Painting and Coating.

### 3.4 FIELD TESTS

- A. Where required by the individual pump Sections, each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.
- B. The following field testing shall be conducted:
  - 1. Startup, check, and operate the pump system over its entire speed range. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.
  - 2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.
  - 3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test, unless insufficient liquid volume is available.
  - 4. Electrical and instrumentation tests shall conform to the requirements of the Sections under which that equipment is indicated.
- C. Field testing will be witnessed by the Engineer. The Contractor shall furnish 5 days advance notice of field testing.
- D. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- E. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- F. The Contractor shall bear all costs of field tests, including related services of the Manufacturer's representative, except for power and water which the Owner will bear. If available, the Owner's operating personnel will provide assistance in field testing.

END OF SECTION

**SECTION 43 23 09**  
**ANSI HORIZONTAL END SUCTION PUMPS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The CONTRACTOR shall provide ANSI horizontal frame mounted end suction pumps, with horizontal electric motors and all appurtenant work, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 43 20 10 – Pumps, General apply to this Section.
- C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will best satisfy the indicated requirements.

**1.2 REFERENCES**

- A. American Bearing Manufacturers Association (ABMA):
  - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
  - 1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
  - 2. B16.5 - Pipe Flanges and Flanged Fittings.
  - 3. B73.1 - Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process.
- C. American National Standards Institute/Hydraulic Institute (ANSI/HI):
  - 1. 1.1-1.5 - Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.
  - 2. 1.6 - Centrifugal Pump Tests.
  - 3. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application and Sound Measurement.
- D. American Society for Testing and Materials (ASTM):
  - 1. A 108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
  - 2. A 276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
  - 3. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
  - 4. A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
  - 5. A 494 - Specification for Castings, Nickel, and Nickel Alloy.
  - 6. A 743 - Standard Specification for Casting, Iron-Chromium, Iron-Nickel, Corrosion Resistant, for General Application.
  - 7. B 367 - Specification for Titanium and Titanium Alloy Castings.
  - 8. E 10 - Test Method for Brinell Hardness of Metallic Materials.

### 1.3 DEFINITIONS

- A. Pump Head (Total Dynamic Head), Flow Capacity, Pump Efficiency, Net Positive Suction Head Available, and Net Positive Suction Head Required: As defined in ANSI/HI 1.1-1.5 and 9.1-9.5 and as modified in this Section.
- B. Suction Head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.
- C. Tolerances: In accordance with Hydraulic Institute 1.1-1.5, 1.6, and 9.1-9.5, unless specified more restrictively.

### 1.4 SYSTEM DESCRIPTION

- A. Supply horizontal, centrifugal, ANSI/ASME B73.1 end suction, magnetic-drive pump. Non-metallic, lined magnetic drive pumps shall utilize ductile cast iron outer shell with injection molded liner and encapsulated inner rotating assembly, including a set of inner magnets within a containment shell or rear casing. Inner magnets are magnetically coupled or driven by outer magnet ring or drive magnet coupled to a conventional drive motor. Liquid end is hermetically sealed by static o-ring or gasket(s). Provide components as specified and other items as required for a complete and operational system. Pumps shall comply with the latest additions of the following codes and standards as specified herein:
  - 1. ANSI B73.1
  - 2. Hydraulic Institute Standards
  - 3. National Electric Code (NEC)
  - 4. OSHA Rules and Regulations
- B. Design Requirements:
  - 1. Pump Performance Characteristics: As specified in the Pump Schedule.
  - 2. Motor Characteristics: As specified in the Pump Schedule.

### 1.5 SUBMITTALS

- A. Submittals shall be provided in accordance with the requirements of Sections 01 33 20 – Submittal Procedures and 43 20 10 – Pumps, General.

### 1.6 QUALITY ASSURANCE

- A. Testing shall be in accordance with the requirements of Section 43 20 10 – Pumps, General.
- B. Multiple pumps supplied under this Section shall be from the same manufacturer.
- C. Pump manufacturer shall furnish and coordinate pump, driver, and pump components as scheduled below and to provide written installation and check out requirements and procedures as part of submittal package.

## 1.7 WARRANTY

- A. Pumps shall be provided with manufacturer standard warranty for minimum of one year from date of project substantial completion to cover parts, labor, shipping, and travel.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Pump: One of the following or equal:
1. Goulds Pumps
  2. Flowserve
  3. Peerless Pump Company

### 2.2 GENERAL DESCRIPTION:

A. Identification

Pump Name	Washdown Water
Equipment Number	P-130
Quantity	1
Location	Inlet/Outlet Valve Vault

- B. Operating Conditions: For all end-suction centrifugal pumps the WORK of this Section shall be suitable for long term operation under the following conditions:

Duty	Continuous
Drive	Constant Speed
Ambient environment	Indoors, and passive ventilation
Ambient temperature, degrees F	40 to 80
Ambient relative humidity, percent	100
Fluid service	Potable water
Fluid temperature, degrees F	40 to 70
Fluid pH range	7.5 to 8.8
Fluid specific gravity	1.0

Fluid viscosity, absolute centipoises at 50 degrees F	1.31
Project site elevation, ft (m.s.l)	4720.0
Minimum Available NPSH, ft absolute	10

C. Performance Requirements

Maximum shutoff head, ft	240
Design flow capacity, gpm	100
Design flow pump head, TDH ft	215
Design flow minimum pump efficiency, percent	55
Maximum flow capacity at maximum speed, gpm	180
Maximum flow pump head TDH, ft, plus or minus 5 ft	150
Maximum flow minimum pump efficiency, percent	50
Maximum flow NPSH required, ft absolute	8
Maximum pump speed, rpm	3550
Maximum motor speed, rpm	3600
Minimum motor size, hp	15.0

D. Pump Dimensions

Min impeller diameter, in	As required
Min suction flange size, in	1.5
Min discharge flange size, in	1.0
Suction flange rating, ANSI, psig	150



Discharge flange rating, ANSI, psig	150
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## 2.3 PUMP REQUIREMENTS

- A. Construction: Construction of horizontal ANSI end-suction pumps shall conform to the following requirements:

Casing, foot-mounted	Cast iron, ASTM A 48, back pullout design with gauge connections
Pump base	Steel base plate with drain rim or pan. All steel plates shall be primed and epoxy coated per Section 09 90 00.
Impeller	Ductile iron ASTM A395 or A536, statically and dynamically balanced, semi-open impeller.
Case wear rings	Type 316 stainless steel
Shaft	Steel SAE 4140, designed for max 0.002 inch deflection at sealing face at max load
Shaft sleeve	Type 316 stainless steel
Seal	Single mechanical seal w/ external filtered water flush. CONTRACTOR to provide solenoid valve and stainless steel tubing to provide flush water to the seals.
Coupling	Flexible heavy duty spacer shaft coupling with guard
Mounting	Frame mounted
Bearings	Ball bearings with min L-10 life of 50,000 hours at max load, double row thrust bearing outboard, and single row radial bearing inboard
Lubrication	Grease with inlet and drain fittings

- B. Drive: Drives shall be direct with flexible couplings with heavy duty, horizontal, electric motor suitable for 480-volt, 3-phase, 60-Hz power supply.

## 2.4 PUMP CONTROLS

- A. Pumps shall be controlled in accordance with control wiring diagram.

## 2.5 SPARE PARTS

- A. Deliver spare parts in accordance with Section 43 20 10 – Pumps, General and as follows for each pump:
  - 1. One mechanical seal.
  - 2. One set of all bearings
  - 3. One shaft sleeve
  - 4. Two sets of all washers, seals, and O-rings

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as specified in Section 43 20 10 – Pumps, General.
- B. CONTRACTOR shall furnish transition fittings to connect piping to pumps.

### 3.2 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer or certified manufacturer representative shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up as specified in this section and Sections 43 20 10 – Pumps, General. Manufacturer shall provide training services to comply with the requirements specified in Section 43 20 10 – Pumps, General.

END OF SECTION

**SECTION 43 25 15  
SUBMERSIBLE PUMPS**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall provide submersible pumps and appurtenant work, complete and operable, in accordance with the Contract Documents.
- B. The requirements of 43 20 10 – Pumps, General apply to the work of this Section.
- C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will satisfy the indicated requirements.

**1.2 CONTRACTOR SUBMITTALS**

- A. Shop Drawings: Submittals shall be made in accordance with Section 01 33 20 – Contractor Submittals and Section 43 20 10 – Pumps, General.
- B. Spare Parts List: The Contractor shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of manufacturer suggested spare parts for each piece of equipment specified. The Contractor shall also furnish the name, address and telephone number for the nearest distributor for each piece of equipment.
- C. Operation and Maintenance Manual: Provide technical operation and maintenance manuals in accordance with Section 01 33 20 – Submittal Procedures.

**1.3 QUALITY ASSURANCE**

- A. Provide pump manufacturer's standard one-year warranty which starts upon substantial completion of the project.

**PART 2 - PRODUCTS**

**2.1 GENERAL DESCRIPTION:**

**A. Identification**

Pump Name	Submersible drain pump and sump pumps
Equipment Number	P-131, P-132, P-133, and P-134
Quantity	A total of 4
Location	Inlet/Outlet Valve Vault (P-131), Drain Vault (P-132, P-133), Underdrain Vault (P-134)

- B. Operating Conditions: The work of this Section shall be suitable for long term operation under the following conditions:

Duty	Continuous
Drive	Constant speed
Ambient environment	Inside concrete vault
Ambient temperature, degrees F	40 to 80
Ambient relative humidity, percent	100
Fluid service	Structural underdrain water, wash-down water from vault, drain water from reservoir
Fluid temperature, degrees F	40 to 70
Fluid pH range	7.5 to 8.5
Fluid specific gravity	1.0
Fluid viscosity (absolute), centipoises at 50 deg. F	1.31
Project site elevation, ft. a.s.l	4,720
Minimum available NPSH, ft absolute	20
Maximum size of spheres to pass, in. dia	0.5

C. Performance Requirements (P-131, P-133, and P-134)

Maximum shutoff head, ft	45
Design flow capacity, gpm	50
Design flow pump head, TDH ft	40
Design flow minimum pump efficiency, percent	50
Maximum flow NPSH required at Design Flow, ft absolute	< 20
Minimum flow capacity at maximum speed, gpm	20
Minimum flow pump head, TDH, at maximum speed, ft	40
Minimum flow pump efficiency, percent	50
Maximum pump speed, rpm	1750 or 3550
Maximum motor speed, rpm	3600
Minimum motor size, hp	1.0

D. Performance Requirements (P-132)

Maximum shutoff head, ft	50
Design flow capacity, gpm	1,500
Design flow pump head, TDH ft	22
Design flow minimum pump efficiency, percent	60
Maximum flow NPSH required at Design Flow, ft absolute	< 20
Minimum flow capacity at maximum speed, gpm	2,000
Minimum flow pump head, TDH, at maximum speed, ft	10
Minimum flow pump efficiency, percent	50
Maximum pump speed, rpm	1750 or 3550
Maximum motor speed, rpm	3600
Minimum motor size, hp	20

E. Pump Dimensions (P-131, P-133, and P-134)

Sump dimensions, ft x ft	2.0 x 2.0
Sump depth, ft	2.5
Sump top	FRP grating with frame open
Pump discharge size, inches	2" minimum. Transition to 4" pipe outside vaults.
Discharge flange rating minimum, psig	75

F. Pump Dimensions (P-132)

Vault dimensions, ft x ft	8.0 x 8.0
Sump depth, ft	See drawings
Manhole for pump removal	3' x 8'
Pump discharge size, inches	8"
Discharge flange rating minimum, psig	125

## 2.2 PUMP REQUIREMENTS

A. Construction: Construction of submersible sump pump shall conform to the following requirements:

Pump casing	Stainless Steel (P-131, P-133, and P-134) Cast Iron (P-132)
Impeller	Semi-open, non-clog cast iron
Bearings	Permanently lubricated ball and sleeve type
Shaft	Stainless steel, series 400
Seal	Mechanical seal
Mounting Method	Flexible hose, stainless steel lifting chain with hook. (P-131, P-133, and P-134)  Cast duckfoot bend or discharge elbow mounted to concrete floor with Type 316 stainless steel hardware. Stainless steel lifting chain. (P-132)
Pump Connection	Flange

- B. Drive: Enclosed, submerged, electric 1800 or 3600 rpm motor, suitable for:
  - 1. 230-volt, single phase (P-131, P-133, and P-134)
  - 2. 480-volt, three phase (P-132)
  - 3. 60 Hz ac power supply, with armored cable, in accordance with Section 26 20 00 - Electric Motors.
- C. Automatic Control: Sump pumps (P-131, P-133, and P-134) shall be supplied by Manufacturer with automatic control based on low and high level floats supplied with the pump by the Manufacturer. Drain pump (P-132) shall be controlled by floats as shown in drawings.

## 2.3 PROTECTIVE COATING

- A. Pumps shall be coated in accordance with Section 09 90 00 – Coatings and Painting.

## 2.4 MANUFACTURERS

- A. Tsurumi Pumps, no Equal (P-131, P-133, and P-134)
- B. Flygt Pumps, Sulzer Pumps, Flowserve, or Equal (P-132)

## PART 3 - EXECUTION

- A. INSTALLATION
- B. Pumping equipment shall be installed in accordance with the approved Shop Drawings and as indicated.
- C. General installation requirements shall be in accordance with Section 43 20 10 - Pumps, General.

END OF SECTION

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