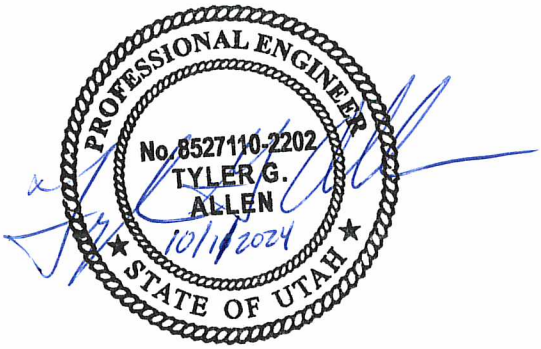
TECHNICAL SPECIFICATIONS



Project Engineer

HANSEN, ALLEN, & LUCE, INC.
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10/2024
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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.1 GENERAL

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The work comprises modifications and/or abandonment or removal of five JVWCD vaults, piping, and valves. Vaults are located at 4390S 2200W (Taylorsville), 4330S 300W (Commerce Ave, Murray), 4500S 350E (boundary of Murray and Millcreek), and 2 vaults on 11400S Street (the boundary between Sandy and Draper) at 100 E and at 700 E.

B. See Sheet G-3 and Section 01 31 00, Progress Schedule for Shutdown Requirements for Water Mains to construct the Work.

C. Work includes: two new manholes; steel, DIP, and PVC piping; valves, fittings, connecting pipes into existing system piping, and other equipment as identified on the drawings; asphalt road replacement and other surface improvements including curb, gutter and sidewalk; and all other associated work shown on the drawings. Valves are 12-inch and smaller except for 30-inch and 24-inch double eccentric class 300 butterfly valves at 11400S 100E.

D. Modifications to the valve vault piping include: removal of the existing piping and valves; installation and replacement of the piping and valves and other equipment as identified on the drawings; asphalt and concrete road replacement and other surface improvements including curb, gutter and sidewalk; and all other associated work shown on the drawings.

E. Abandonment of valve vaults includes: removal and disposal of all surface features; removal and disposal of all piping, valves, fittings and equipment; backfill vault with CLSM as indicated on drawings; abandoning piping; road base and asphalt concrete removal and replacement; and all other associated work shown on the drawings.

1.3 SEQUENCE AND SCHEDULE OF WORK

A. See Sheet G-3 for Sequence and Schedule of Work:

B. Unless noted otherwise, the water at each site will be shut off for a maximum time of two weeks.

1. Owner shutdowns may not completely turn off the water. Contractor shall anticipate some of the valves may leak and provide for pumping and/or removal of bypass water.

2. Final surface improvements and paving shall be completed during warm weather months (from April to October).
3. Temporary asphalt shall be installed during the cold weather months (November to March) and replaced with new hot mix asphalt in the spring.

1.4 CONTRACT METHOD

A. The work hereunder will be constructed under a single lump sum contract for modifications to each of the valve vaults and an “each” price for additive alternates.

1.5 CONTRACTOR USE OF PROJECT SITE

A. CONTRACTOR's use of the project site shall be limited to its construction operations, including on-site storage of materials and on-site construction of facilities.

1.6 PROJECT SECURITY

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

1.7 CHANGES IN THE WORK

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

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 14 19
CONTRACTOR'S USE OF PREMISES

PART 1 GENERAL

1.1 PROJECT LOCATION

A. The work covered by this contract will be performed at the locations shown on the drawings.

1.2 ACCESS TO THE SITE

A. Access to the sites shall be from public right-of-ways.

B. CONTRACTOR shall take necessary steps to protect the rights and property of private property owners.

1.3 WORKING HOURS

A. Contractor shall abide by all local ordinances or laws regarding work between 9:00 PM and 7:00 AM and shall obtain written variances from the regulating entities if needed or required. Contractor shall also abide by all conditions issued by OWNER.

1.4 MEASUREMENT AND PAYMENT

A. Contractors Use of Premises shall not be measured or paid as a separate item but shall be included as part of the item to which it relates.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

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SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 GENERAL

A. All work completed under this contract shall be in accordance with the Drawings and Specifications and will be measured by ENGINEER / OWNER. The quantities appearing on the Bid Schedule or Schedule of Values are approximate only and are prepared for the comparison of bids. Payment to CONTRACTOR on bid items with unit prices other than "Lump Sum" will be made for actual quantities of work performed and accepted, or material furnished in accordance with the Contract. The scheduled quantities of work to be done and materials to be furnished may be increased or decreased in accordance with the General Conditions.

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

C. When the accepted quantities of work vary from the quantities in the bid schedule, CONTRACTOR shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the work done. OWNER reserves the right to add to or delete from quantities listed in the bid schedule in order to match the total bid with the budgeted money available.

1.2 BID SCHEDULE

A. **BID ITEM 1: 4390 S 2200 W Vault Modifications (Sheets C-1, C-7)**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
2. **BASIS OF PAYMENT**. Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials and all work shown in plans and specs, including, but not limited to: mobilization/demobilization; preparing and executing SWPPP as required by City; traffic control; acquire necessary permits; excavation, dewatering, and shoring; protection of existing utilities; remove and dispose of manhole top sections, manhole frame and cover, existing 12” welded steel pipe, gate valve, and air-vac valve (salvage and reuse 2” air valve); furnish, install, & test (pass leak test and bac T test) 12” steel pipe specials, insulating flange, 12” and 4” buried gate valves with valve boxes, 4” blind flange with top tangent eccentric 2” threaded outlet, 2” stainless steel piping to air-vac, 60” manhole behind east sidewalk (within JVWCD easement) including vents, manhole frame and cover, ladder, etc.; leak test all valves and piping, provide zero leakage; furnish and install corrosion protection; CLSM backfill vault base; AC repave road; restore finished grade, curb and gutter, sidewalk, grass, and all other items as shown and/or specified in these documents.

B. **BID ITEM 2: 4330 S 300 W (Commerce Ave) Vault Modifications (Sheets C-2, C-8)**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
2. **BASIS OF PAYMENT**. Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials and all work shown in plans and specs, including, but not limited to: mobilization/demobilization; preparing and executing SWPPP as required by City; traffic control; acquire necessary permits; excavation, dewatering, and shoring; protection of existing utilities; sawcut / remove and dispose of vault roof, manhole frame and cover, and existing 12" and 8" piping in vault; furnish, install, & test (pass leak test and bac T test) new 12" WSP, 12" and 4" gate buried valves and valve boxes; furnish and install 4" SS blind flanges w/ top tangent eccentric 2" threaded outlets with 2" SS piping to air vac, 60" manhole behind east sidewalk (within public right of way) including vents, manhole frame and cover, ladder, etc.; leak test all valves and piping, provide zero leakage; furnish and install corrosion protection; CLSM backfill vault bottom; AC repave road; restore finished grade, curb and gutter, sidewalk, grass, and all other items as shown and/or specified in these documents.

C. **BID ITEM 3: 4500S 350E Vault Modifications (Sheets C-3 & C-9)**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
2. **BASIS OF PAYMENT**. Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials necessary, including but not limited to: mobilization/ demobilization; preparing and executing SWPPP as required by City; traffic control; acquire necessary permits; excavate / remove granular bottom of 60" manhole to expose top of 24" Pipe and 4" flanged outlet; remove 4" flanged piping and valves; furnish, install, & test (pass leak test and bac T test) new 4" WSP and 4" gate valves, onsite welding, mortar lining and Wasser coating with partial wax tape coating; Install drain rock at base of manhole; construct and install SS ladder; functional test new blowoff (gate) valves & demonstrate zero leakage; and all other items as shown and/or specified in these documents.

D. **BID ITEM 6: 11400 S 100 E Vault Modifications (Sheets C-5, C-11, C-11A, C-11B)**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
   BASIS OF PAYMENT. Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials necessary, including but not limited to: mobilization/ demobilization; preparing and executing SWPPP; traffic control; acquire necessary permits; excavation, dewatering, and shoring; protection of existing utilities; remove and dispose of existing vault lid, existing piping, valves, appurtenances, and vault ladder as shown on the drawings; remove existing wax tape coating, sandblast WSP exterior to SP5 pipe exterior and Wasser recoat after welding in vault is complete; furnishing and installing new piping with associated valves, fittings, and appurtenances, new 6" vents and vent standpipes, 2" air release line with piping and steel vent covers, pipe supports, sump pit, sump pump, sump piping, pipe

supports, ladder, pressure gauges, hose bib, electrical and SCADA components; commissioning of pipeline including cleaning flushing, disinfection, and pressure testing; furnishing and installing new precast vault lid with new ring and cover and HDPE cover sheeting; backfilling with CLSM, import backfill, and compaction; repair wall; pressure wash vault; furnish and install corrosion control protection system as shown on drawings; restoration of all surface improvements including temporary and permanent asphalt, curb and gutter, sidewalk, and landscaping as required; and all other items as shown and/or specified in these documents.

E. **BID ITEM 7: 11400 S 700 E Vault Modifications (Sheets C-7 & C12)**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
   BASIS OF PAYMENT. Payment shall be made at the contract lump sum bid price. Payment shall be considered complete compensation for all labor, equipment, tools, and materials necessary, including but not limited to: mobilization/ demobilization; preparing and executing SWPPP; traffic control; acquire necessary permits; excavation, dewatering, and shoring; protection of existing utilities; remove existing JVWCD 12" buried butterfly valve and replace with 12" gate valve and valve box per detail in drawings; remove and dispose of existing piping, valves, appurtenances, as shown on the drawings; sandblast remaining existing pipe and field coat; furnish and install new piping with associated valves, fittings, and appurtenances, pipe supports, pressure gauges, hose bibs, electrical and SCADA components; pressure wash vault; furnish and install cathodic protection; replace existing 16" WaterPro valve; commission pipeline including cleaning flushing, disinfection, and pressure testing; backfilling with CLSM (UDOT Rapid Set CLSM where required) import backfill, and compaction; restoration of all surface improvements including temporary and permanent concrete, curb and gutter, sidewalk, and landscaping as required; and all other items as shown and/or specified in these documents.

F. **BID ITEMS 4 & 8: TESTING AGENCY SERVICES**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
2. **BASIS OF PAYMENT**. Payment shall be considered complete compensation for all labor for testing agency services and materials testing for all vaults in specific bid schedule as shown and/or specified in these documents.

G. **BID ITEMS 5 & 9: PERMITS**

1. **METHOD OF MEASUREMENT**. This Bid Item shall not be measured but paid for on a lump sum basis for all of the work per Plans and Specifications.
2. **BASIS OF PAYMENT**. Payment shall be made based on the actual costs of any special permits that are not specified in the Contract but are found during construction to be necessary to complete the work.

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SECTION 01 31 00
PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:

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

1.2 PROGRESS SCHEDULE

A. WATER MAIN SHUTDOWN REQUIREMENTS TO CONSTRUCT THE WORK

Vault Location	Shutdown Duration	2024-2025 Shutdown Period	Concurrent Shutdowns and Other Requirements
4390S 2200W	2 Weeks	Oct 15 to Mar 15	24" Pipe Shutdown from 1175W to 3600W.
4330S 300W	1 night**	Any Time	12” Pipe Shutdown is from 4200 S to 4500 S
4500S 350E	2 Weeks	Oct 15 to Mar 15	24” Pipe Shutdown is from Main St to 900 E.
11400S 100 E & 700 E	Preparatory Work	Preparatory Work	33” Pipe Shutdown is from 300 W to 900 E. **Show the following Work is done before shutdown:** 2. Shop construct, test & assemble all NEW 100E materials (piping & roof) (Sheets C-5, C-11 to C-11B) 3. Shop construct, test & assemble all NEW 700E materials (piping) (Sheets C-6, C-12). 4. Excavate Shore & Expose all sides of 12” buried BFVs on 11400S at 700E.
11400S 100 E & 700 E	72 hours (Fri 6am to Mon 6am)	Oct 15 to Mar 15	**Complete ALL Connections to 11400 South Pipe and WaterPro** at 100 E & 700E (Tie Ins on C-4 to C-6 & C10 to C-12)

Notes:

1. **1 Night is 8 hours from 10 pm to 6 am.
2. District will shut down water mains for schedule requested by Contractor. Contractor shall not operate water mains. See Other Scheduling and Coordination Requirements in Drawings.
3. Shutdowns for the 4390 South 2200 West and 4500 South 350 East locations shall be completed at separate times. The work may not be done simultaneously.

B. In addition to the water main shutdown requirements above, and the basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed through Final Completion.

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

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

D. Update the Overall Progress Schedule monthly; as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Progress Schedule is updated in a manner acceptable to Owner/Engineer.

1.3 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work
4. Adjusted or modified sequences of Work
5. Other identifiable changes
6. Revised projections of progress and completion
7. Report of changed logic

1.4 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL PROCEDURES

A. Within 21 days after Notice to Proceed, submit a complete list of anticipated submittals, including Specifications and Drawing references for each.

B. Wherever submittals are required by the Contract Documents, Shop Drawings, and data shall be transmitted in an electronic format to ENGINEER with a submittal transmittal form which is acceptable to ENGINEER.

C. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix, i.e. Submittal 1, Submittal 1.A, etc.

D. Identify Project, Contractor, subcontractor and/or supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

E. CONTRACTOR shall review submittals prior to submission to ENGINEER. Apply Contractor's stamp, signed and dated, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents. Identify any deviations from the Contract Documents on the submittal transmittal form.

F. Schedule submittals to expedite Project and deliver to ENGINEER at their business address. Coordinate submission of related items.

G. Submittals shall be submitted sufficiently in advance to allow ENGINEER not less than ten regular working days for examining the drawings. These drawings shall be accurate, distinct, and complete and shall contain all required information, including satisfactory identification of items and unit assemblies in relation to the contract drawings and/or specifications.

H. Identify variations from Contract Documents and product or system limitations which may adversely affect successful performance of completed Work.

I. If a submittal is returned to CONTRACTOR marked “APPROVED”, or similar notification, formal revision and resubmission will not be required.

J. If a submittal is returned marked “APPROVED – MAKE CORRECTIONS NOTED”, or similar notification, CONTRACTOR shall make the corrections on the submittal, however, formal revision and resubmission will not be required.

K. Resubmittals

1. If a Submittal is returned marked “AMEND AND RESUBMIT”, or similar notification, CONTRACTOR shall revise the submittal and resubmit an electronic copy.
2. Identify changes made since the previous submission.

L. Rejected Submittals

1. If a submittal is returned marked “REJECTED – RESUBMIT”, or similar notification, it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that is cannot be reviewed, or is a substitution request not submitted in accordance with Section 01 60 00 – Product Requirements.
2. CONTRACTOR shall prepare a new submittal or submit a substitution request according to Section 01 60 00 – Product Requirements and shall submit an electronic copy.

M. Instruct parties to promptly report inability to comply with requirements.

N. Submittals not requested will not be recognized or processed.

O. Unless noted otherwise, corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

P. Fabrication or purchase of an item may only commence after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either “APPROVED” or “APPROVED – MAKE CORRECTIONS NOTED”.

Q. ENGINEER's review of CONTRACTOR submittals shall not relieve CONTRACTOR of the entire responsibility for the corrections of details and dimensions. CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. CONTRACTOR shall be responsible for dimensions and quantities, coordinating with all trades, the design of adequate connections and details, and satisfactory and safe performance of the work.

1.2 CONSTRUCTION PROGRESS SCHEDULES

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

1.3 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 78 50 -Project Closeout.

1.4 SHOP DRAWINGS

A. Shop Drawings: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Fabrication of an item may be commenced only after ENGINEER has reviewed the pertinent submittals and returned copies to CONTRACTOR marked either "APPROVED", or "APPROVED - MAKE CORRECTIONS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.

C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.

1. Include signed and sealed calculations to support design.
2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 78 50 - Project Closeout.

1.5 SAMPLES

A. Whenever indicated in the specifications or requested by ENGINEER, CONTRACTOR shall submit at least 1 sample of each item or material to ENGINEER for acceptance at no additional cost to OWNER.

B. Samples, as required herein, shall be submitted for acceptance prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delay in the Work.

C. Unless otherwise specified, all colors and textures of specified items will be selected by ENGINEER from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.6 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to ENGINEER, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to ENGINEER.

1.7 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to ENGINEER for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.8 MANUFACTURER'S FIELD REPORTS

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

1.9 OPERATIONS AND MAINTENANCE MANUAL SUBMITTAL

A. CONTRACTOR shall furnish ENGINEER one copy of the Operations and Maintenance Manuals in PDF electronic format. A Table of Contents shall be provided which indicates all equipment and suppliers in the Operations and Maintenance Manuals.

B. CONTRACTOR shall include in the Operations and Maintenance manuals full details for care and maintenance for all visible surfaces as well as the following for each item of mechanical, electrical, and instrumentation equipment (except for equipment furnished by OWNER):

1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
2. Preventative maintenance procedures and schedules
3. A description of proper maintenance activities
4. Complete parts lists, by generic title, identification number, and catalog number, complete with exploded views of each assembly.
5. Disassembly and reassembly instruction
6. Name and location of nearest supplier and spare parts warehouse
7. Name and location of manufacturer
8. Recommended troubleshooting and start-up procedures
9. Prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.

C. All Operations and Maintenance manuals shall be submitted in final form to ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by ENGINEER in the Operations and Maintenance manuals shall be corrected by CONTRACTOR prior to final acceptance of the project.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 42 13
ABBREVIATIONS

PART 1 GENERAL

1.1 DESCRIPTION

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

1.2 ABBREVIATIONS AND ACRONYMS

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

ECTC	Erosion Control Technology Council
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
ETC	Electrical Test Laboratories
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual System
HI	Hydraulic Institute
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code
ISA	Instrument Society of America
ISO	International Organization of Standardization
ITE	Institute of Traffic Engineers
LPI	Lightning Protection Institute
LRQA	Lloyd’s Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NISO	National Information Standards Organization
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PVC	Polyvinyl Chloride Pipe
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coating (formerly Steel Structure Painting Council)
SSPWC	Standard Specification for Public Works Construction
SS, SST	Stainless Steel Pipe
TPI	Truss Plate Institute
UDOT	Utah Department of Transportation
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
UPRR	Union Pacific Railroad
WCRSI	Western Concrete Reinforcing Steel Institute

WI	Woodwork Institute
WRI	Wire Reinforcements Institute, Inc.
WSP	Welded Steel Pipe
WWPA	Western Wood Products Association

All other abbreviations and acronyms are per ASME Y1.1.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.1 QUALITY ASSURANCE

A. TITLES OF SECTIONS AND PARAGRAPHS. Captions accompanying Specifications sections and paragraphs are for convenience of reference only, and do not form a part of the Specification.

B. APPLICABLE PUBLICATIONS. Whenever in these specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards or requirements of the respective issuing agencies which have been published as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. SPECIALISTS, ASSIGNMENTS. In certain instances, specifications test requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements and shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the work; also, they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.

B. Reference herein to "Building Code" or “Uniform Building Code” shall mean the International Building Code of the International Code Council. The latest edition of the code as approved and used by the local agency as of the date of award, as adopted by the agency having jurisdiction, shall apply to the work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, drawings and the other Contract Document, the most stringent requirements shall govern. All conflicts shall be brought to the attention of ENGINEER for clarification and directions prior to ordering or providing any materials or labor. CONTRACTOR shall bid the most stringent requirements.

D. APPLICABLE STANDARD SPECIFICATIONS. CONTRACTOR shall construct the work specified herein in accordance with the requirements of the Contract Documents

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

E. References in the Contract Documents to "Standard Specifications" shall mean the Contract Documents including all current supplements, addenda, and revisions thereof.

F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including changes and amendments thereto.

H. UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY. Wells, tanks, pumping stations and culinary water pipelines shall conform to the requirements of Utah Administrative Code Rule R 309. Water pipeline installation shall conform to the requirements of Utah Administrative Code Rule R 317-3-2.9 ”Protection of Water Supplies” for horizontal and vertical separation.

I. UTAH DEPARTMENT OF TRANSPORTATION (UDOT) REQUIREMENTS. CONTRACTOR's work on UDOT property or right-of-way shall conform to UDOT’s latest edition of Standard Specifications For Road and Bridge Construction.

J. U.S. ARMY CORPS OF ENGINEERS (COE) REQUIREMENTS. CONTRACTOR's work shall conform to C.O.E. Specifications in accordance with Section 404 of the Clean Water Act for excavation in wetlands.

K. Reference herein to APWA shall mean the latest edition of the ”Manual of Standard Specifications” and “Manual of Standard Plans” as prepared by the American Public Works Association and the Associated General Contractors of America.

L. All provisions of the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition both published by the Utah Chapter of the American Public Works Association are hereby made a part of the Contract Documents by reference. The publications may be purchased separately from the Utah Technology Transfer Center, Utah State University, 4111 Old Main Hill, Logan, UT 84322-4111. Any conflicts, between the technical specifications, drawings, and other provisions or documents contained in the Contract Form or Contract Documents versus provisions contained in the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition published by the Utah Chapter of the American Public Works Association, shall be resolved in favor of the most stringent of the criteria and conditions as determined by ENGINEER.

M. All provisions of JVWCD standards, and City standards for the various municipalities in which this project is located (i.e. Sandy City and Taylorsville City) are hereby made a part of the Contract Documents by reference. Any conflicts, between the technical specifications, drawings, and other provisions or documents contained in the Contract Form or Contract Documents versus provisions contained in JVWCD standards, or City standards, shall be resolved in favor of the most stringent of the criteria and conditions as determined by ENGINEER.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

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SECTION 01 45 00
QUALITY CONTROL AND MATERIALS TESTING

PART 1 GENERAL

1.1 SUMMARY

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

1.2 MATERIALS

A. All materials incorporated in the project shall be new and shall fully comply with the specifications. Unless otherwise clearly provided in the specifications, all workmanship, equipment, materials, and articles incorporated in the work covered by the contract are to be of the best available grade of their respective kinds. Whenever, in the specifications, any material, article, device, product, fixture, form, type of construction, or process indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired and shall be deemed to be followed by the words "or approved equal" and CONTRACTOR may in such case, upon receiving the ENGINEER's approval, purchase and use any item, type, or process which shall be substantially equal in every respect to that indicated or specified.

B. Materials and equipment may be used in the Work based upon receipt of a Supplier's certificate of compliance. Certificate must be in possession of CONTRACTOR and reviewed by ENGINEER prior to use.

C. Quality Assurance Testing by the OWNER and/or ENGINEER shall not relieve CONTRACTOR of responsibility to furnish materials and work in full compliance with Contract Documents.

1.3 MANUFACTURER'S INSTRUCTIONS

A. Should instructions conflict with Contract Documents, request clarification before proceeding.

B. When required in individual sections, submit manufacturer's instructions in the quantity required for product data, delivery, handling, storage, assembly, installation, start-up, adjusting, balancing, and finishing, as appropriate.

1.4 WORKMANSHIP

A. Maintain performance control and supervision over Subcontractors, Suppliers, manufacturers, products, services, workmanship, and site conditions, to produce work in accordance with Contract Documents.

B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

C. Provide suitable qualified personnel to produce specified quality.

D. Ensure finishes match approved samples.

1.5 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 TESTING AND INSPECTION SERVICES

A. Testing agency and testing for quality control and material testing shall be furnished by CONTRACTOR as part of the project. Results of testing shall be reported to CONTRACTOR and ENGINEER on site. Reports of the testing shall be transmitted directly to the ENGINEER.

B. Materials to be supplied under this contract will be tested and/or inspected either at their place of origin or at the site of the work by the testing agency. CONTRACTOR shall give ENGINEER written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin so ENGINEER may witness testing by the testing agency. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the material nor shall it preclude retesting or reinspection at the site of the work.

C. CONTRACTOR shall furnish such samples of materials as are requested by the ENGINEER, without charge. No material shall be used until reports from the testing agency have been reviewed and accepted by the ENGINEER. See Section 01 33 00, Submittal Procedures.

1.7 UNSATISFACTORY CONDITIONS

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

1.8 AUTHORITY AND DUTIES OF PROJECT REPRESENTATIVE

A. Refer to General Conditions, Article 9, paragraph 9.03 "Project Representation".

1.9 QUALITY CONTROL TESTING

A. ENGINEER’s failure to detect any defective Work or materials does not prevent later rejection when such defect is discovered, nor does it obligate ENGINEER for acceptance.

B. CONTRACTOR shall provide 24-hours minimum notice to ENGINEER for all testing required by these specifications so that ENGINEER may coordinate or be present during testing.

1.10 TESTING ACCEPTANCE AND FREQUENCY

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

B. Acceptance of Defective Work: As defined in Article 13.06 of the General Conditions.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

TABLE 01 45 00-1: QUALITY CONTROL TESTING FREQUENCY

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
PORTLAND CEMENT CONCRETE		
Section 03 30 00 Cast-in-Place Concrete	Slump	1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs and more frequently if batching appears inconsistent. Conduct with strength tests.
	Entrained air	1 test with slump test.
	Ambient and concrete tem-peratures	1 test with slump test.
	Water cement ratio.	To be verified and provided with batch tickets.
	Compressive strength	1 set of 4 cylinders every 100 c.y. or part thereof per day.
SUBGRADE AND BACKFILL MATERIALS		
Section 31 23 15 Excavation and Backfill for Buried Pipelines	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification and gradation.
Section 31 23 23 Excavation and Backfill for Structures	Field Density	1 test per 200 linear feet per 8 inches of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification and gradation.
Section 32 11 23 Road Base - Untreated Base Course	Field Density	Base course subgrade: 1 test per 2,000 square feet of area. Base course: 1 test per 2,000 square feet of area.
	Laboratory	Base course: 1 test for each material type which includes proctor, classification and gradation.
ASPHALT		
Section 32 12 16 Hot-Mix Asphalt Concrete Paving	Mix Design	Marshall Test Method: 1 test initially per each type of material and each change in target, and for each day of production thereafter. Specific Gravity: 1 per each Marshall Test Extraction: 1 test per each Marshall Test
	Field Density	Bituminous surfaces: 1 test per 2,000 square feet placed or part thereof.
	Asphalt Thickness and Core Density	Bituminous surfaces: 1 test sample every 300 linear feet of completed roadway.

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
STEEL PIPE		
Section 33 92 10 Steel Pipe, Specials, and Fittings	Field Welds	Weld tests for piping. Submit CWI certification that all field welds are complete joint penetration welds complying with AWS D1.1, WPS, and PQR.

NOTES:

1 Additional tests shall be conducted when variations occur due to the contractor's operations, weather conditions, site conditions, etc.

2 Classification, moisture content, Atterberg limits and specific gravity tests shall be conducted for each compaction test if applicable.

3 Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates.

4 Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement calculations.

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SECTION 01 45 23
TESTING AGENCY SERVICES

1.1 GENERAL

1.2 SUMMARY

A. CONTRACTOR shall be responsible for providing Construction Quality Control Testing of all soils, concrete, asphalt, welds, etc. as required by the various sections of these specifications. This section includes the following:

1. Use of independent testing agency
2. Control testing report submittal requirements
3. Responsibilities of testing agency

1.3 RELATED WORK

A. Related work specified in other sections:

1. Section 01 22 00 Measurement and Payment
2. Section 01 33 00 Submittal Procedures
3. Section 01 45 00 Quality Control and Materials Testing

1.4 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

B. AMERICAN WELDING SOCIETY (AWS) D1.1 (Welding Code for all field welding)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 3740: Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
2. ASTM D 4561 Standard Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
3. ASTM E 329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.5 DEFINITIONS

A. Independent Testing Agency: A testing agency NOT owned by CONTRACTOR, and an agency that does not have any preferential affiliation or association with CONTRACTOR, or any of CONTRACTOR's Subcontractors and Suppliers other than entering into a contract with CONTRACTOR to perform the duties defined in these Specifications.

B. Professional Engineer: An engineer who complies with Utah licensing law and is acceptable to the authority having jurisdiction.

1.6 QUALITY ASSURANCE

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

B. Concrete Technician: Approved by ENGINEER or ACI certified.

C. Person charged with engineering managerial responsibility.

D. Professional engineer on staff to review services.

E. Level of certification of technicians.

1.7 CONTRACTOR SUBMITTALS

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

B. If CONTRACTOR is employing and paying for an independent testing agency, prior to start of Work, submit testing agency's name, address, telephone number and the following:

1. Person charged with engineering managerial responsibility
2. Professional engineer on staff to review services
3. Level of certification of technicians

1.8 TESTING AGENCY SUBMITTALS

A. Field Test Report: Submit report no later than the end of the current day.

B. Laboratory Test Report: Submit original report within 48 hours after test results are determined.

C. Final Summary Report: Submit prior to final payment

D. On all reports include:

1. Project title, number and date of the report
2. Date, time and location of test
3. Name and address of material Supplier
4. Identification of product being tested and type of test performed
5. Identify whether test is initial test or retest
6. Results of testing and interpretation of results
7. Name of technician who performed the testing

1.9 RESPONSIBILITIES OF TESTING AGENCY

A. Calibrate testing equipment at least annually with devices with an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.

B. Provide sufficient personnel at site and cooperate with CONTRACTOR, ENGINEER and OWNER's Representative in performance of testing service.

C. Secure samples using procedures specified in the applicable testing code.

D. Perform testing of products in accordance with applicable sections of the Contract Documents.

E. Immediately report any compliance or noncompliance of materials and mixes to CONTRACTOR, ENGINEER, and OWNER's Representative.

F. When an out-of-tolerance condition exists, perform additional inspections and testing until the specified tolerance is attained, and identify retesting on test reports.

1.10 LIMITS ON TESTING AGENCY AUTHORITY

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

B. Agency may not suspend Work.

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

1.11 MEASUREMENT AND PAYMENT

A. Testing agency services shall be not be measured or paid as a separate item but shall be included as part of the work for which it relates.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

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SECTION 01 55 26
TRAFFIC CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall comply with all rules and regulations of the City, County, and State authorities regarding the closing of public streets or highways. If conditions justify, ENGINEER may authorize CONTRACTOR to conduct his work in specific areas and to specific tasks to avoid sporadic and unorganized work efforts.

B. See Drawings, Sheet G-3, for traffic control plans required by Taylorsville, Murray, Millcreek, and UDOT.

C. All work performed on or within the right-of-way of state roads shall have traffic control devices in place before work begins that meet the requirements of Utah Department of Transportation's "Specifications for Excavation on State Highways".

D. No road shall be closed by CONTRACTOR to the public except by express permission of the City in which the work is located and after obtaining the required permits. Where it is necessary to close a county or city road to thru traffic, the road shall be closed to thru traffic only - not local traffic. The road shall be closed for one block only, not over 700 feet. The road shall be barricaded at each point of public access with barricades meeting the Utah Department of Transportation's specifications.

E. Traffic must be kept open on those roads and streets where no detour is possible. CONTRACTOR shall, at all times, conduct his work so as to insure the least possible obstruction to traffic and normal commercial pursuits. All obstructions within traveled roadways shall be protected by approved signs, barricades, and lights where necessary for the safety of the traveling public. The convenience of the general public and residents, and the protection of persons and property are of prime importance and shall be provided for by CONTRACTOR in an adequate and satisfactory manner.

F. Excavations on project sites from which the public is excluded shall be marked or guarded in a manner appropriate for the hazard.

1.2 TRAFFIC CONTROL

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

B. If at any time the conditions indicate that CONTRACTOR's protective facilities and service are inadequate to assure the safety of the public or CONTRACTOR's workers, CONTRACTOR shall provide additional facilities or services as may be necessary to assure protection at no additional cost to the OWNER.

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

1.3 MEASUREMENT AND PAYMENT

A. Traffic Control shall be paid as a separate item for each vault site. See Bid Form.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.2 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.4 PRODUCT OPTIONS

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

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.5 PRODUCT SUBSTITUTION PROCEDURES

A. ENGINEER will consider requests for Substitutions only after Notice of Award.

B. Substitutions may be considered when a product becomes unavailable through no fault of CONTRACTOR.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that CONTRACTOR:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide the same warranty for a Substitution as for specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to OWNER.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse OWNER for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:

1. Submit the number of copies required in Section 01 33 00.
2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
3. ENGINEER may require CONTRACTOR to provide additional data about the proposed substitution.
4. ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and ENGINEER’s decision shall be final.
5. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
6. Acceptance by ENGINEER of a substitution proposed by CONTRACTOR shall not relieve CONTRACTOR of the responsibility for full compliance with the Contract Documents and for the adequacy of the substitution.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

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

- END OF SECTION –

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SECTION 01 71 13
MOBILIZATION

PART 1 GENERAL

1.1 DESCRIPTION

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

1.2 MOVING TO AND FROM THE JOB SITE

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

1.3 CLEAN-UP

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

1.4 TEMPORARY UTILITIES

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

1.5 PERFORMANCE BOND, PAYMENT BOND, AND INSURANCE

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

1.6 PERMITS

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

1.7 PRE-CONSTRUCTION VIDEO RECORDS

A. CONTRACTOR is required to produce a preconstruction video recording of areas where work is to be performed. The video record shall be of professional quality and the coverage shall be such, as to allow accurate determination of location, size, and conditions, etc. of existing features and improvements within the rights-of-way. The Contractor shall provide the Owner with a copy of the rights-of-way video in DVD format before construction begins.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 76 30
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

A. Any existing facilities disturbed, which are located in or adjacent to the Work (such as utilities, facilities, structures, paving, surfacing, curbs, gutters, walks, driveways, fences, etc), shall be cleaned up and restored in kind by CONTRACTOR and in accordance with the specifications contained herein governing the various types of services involved.

B. CONTRACTOR shall not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, fiber optic, television cable, or electric transmission line; any fence; or any structure, until authorization has been obtained from OWNER of the improvement. Provide OWNER of the improvement due notice of the beginning of the work, and remove, shore, support, or otherwise protect such improvement or replace the same.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 78 50 – Project Closeout

1.3 RESTORATION OF FENCES

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

1.4 UNDERGROUND SERVICE ALERT

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

1.5 INTERFERING STRUCTURES AND UTILITIES

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

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

B. All exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of the construction to avoid possible delays to CONTRACTOR's progress. Prepare a report identifying each utility by its size, elevation, station, and material of construction. Immediately notify ENGINEER and the utility in writing as to any utility discovered in a different position than as marked in the field or shown on the Drawings, or any utility which is not marked in the field or not shown on the Drawings.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility. Conform to local agency requirements for backfill and pavement repair subsequent to performing exploratory excavations.

D. Any damages to private property, either inside or outside the limits of the easements provided by OWNER, shall be the responsibility of CONTRACTOR. Any roads, structures, or utilities damaged by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at CONTRACTOR's expense without additional compensation from OWNER.

E. CONTRACTOR shall remove and replace small miscellaneous structures such as fences and culverts which are damaged by the construction activity at his own expense without additional compensation from OWNER. CONTRACTOR shall replace these structures in a condition as good as or better than their original condition.

F. At points where CONTRACTOR's operations are adjacent to or across properties of railway, fiber optic, telephone, irrigation canal, power, gas, water, or adjacent to other property (damage to which might result in considerable expense, loss, and inconvenience), no work shall be started until all arrangements necessary for the protection thereof have been made.

G. The locations of the major existing culinary water lines, sewer lines, storm water, gas pipes, underground electric, cable television, fiber optic communication, and telephone lines that are shown on the plans were taken from city maps, and maps supplied by the utility owner. No excavations were made to verify the locations shown for underground utilities, unless specifically stated on the Drawings. It should be expected that some location discrepancies will occur. Neither OWNER nor its officers or agents shall be

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

H. CONTRACTOR shall be solely and directly responsible to OWNERs and operators of such properties for any damage, injury, expense, loss or inconvenience, delay, suits, actions, or claims of any character brought because of an injury or damage which may result from the carrying out of the work to be done under the contract.

I. All utilities including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities encountered along the line of the work shall remain continuously in service during all operations under the Contract, unless other arrangements satisfactory to ENGINEER are made with OWNER of said utility.

J. In the event of interruption to either domestic or irrigation water, or to other utility services as a result of accidental breakage, or as a result of being exposed or unsupported, CONTRACTOR shall promptly notify the proper authority. CONTRACTOR shall cooperate with the authority in restoration of service as soon as possible and shall not allow interruption of any water or utility service outside working hours unless prior approval is received.

K. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of CONTRACTOR, be notified by OWNER to move such property within a specified reasonable time. When utility lines that are to be moved are encountered within the area of operations, CONTRACTOR shall notify ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

L. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to ENGINEER and OWNER of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

M. **Pothole by KCI. Nine pages of pothole summary sheets (prepared by KCI) are attached to the end of this section for Contractor information. These potholes are also located on plans.**

1.6 RIGHTS-OF-WAY

A. CONTRACTOR shall be required to confine construction operations within the dedicated rights-of-way for public thorough fares, or within areas for which construction easements have been obtained, or Owner properties noted for use on this project, unless they have made special arrangements with the affected property owners in advance. CONTRACTOR shall be required to protect stored materials, cultivated trees and crops, and other items adjacent to the proposed construction site.

B. CONTRACTOR shall submit for approval by ENGINEER the type and size of equipment used, and the methods for work performed on the rights-of-way across private properties, to avoid or minimize injury to trees, shrubs, gardens, lawns, fences, driveways, retaining walls, or other improvements within the rights-of-way.

C. The construction easement widths and access to private properties are as shown on the Drawings and as described in the easement documents; however, CONTRACTOR is to minimize impacts to surface improvements within the right-of-way. CONTRACTOR shall obtain a signed release from the property owner, approving restoration of work in the construction easements across or bordering private properties. See Project Closeout Section 01 78 50, 1.4.D.

D. Property owners affected by the construction shall be notified by CONTRACTOR at least 48 hours in advance of the time the construction begins. During all construction operations, CONTRACTOR shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to his property for a period exceeding 8 hours unless CONTRACTOR has made special arrangements with the affected persons. CONTRACTOR shall, daily or more frequently if necessary, grade all disturbed areas to be smooth for motor vehicle traffic.

1.7 PROTECTION OF SURVEY, STREET OR ROADWAY MARKERS

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

1.8 TREES OR SHRUBS WITHIN PROJECT LIMITS

A. Except where trees or shrubs are indicated to be removed, CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.

1. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.

2. CONTRACTOR shall immediately notify the jurisdictional agency and/or OWNER if any tree or shrub is damaged by CONTRACTOR's operations. If, in the opinion of said agency or OWNER, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub

shall be of a like size and variety as the one damaged, or, if of a smaller size, CONTRACTOR shall pay to OWNER of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height.

1.9 RESTORATION OF PAVEMENT

A. Pavement work shall meet the specifications for installation as noted in APWA Section 33 12 16 or in accordance with more stringent requirements of City, County, or State agencies where the project is located.

B. Concrete pavement restoration shall meet the specifications for installation as noted in APWA Plan 256.2 and APWA Section 32 01 19 or in accordance with more stringent requirements of City, County, or State agencies where the project is located.

C. All asphalt paved areas damaged during construction shall be replaced with similar materials of equal thickness plus 1 inch to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Pavements which are subject to partial removal shall be neatly sawcut in straight lines.

D. Wherever required by the local agency having jurisdiction, CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

1.10 CONCRETE WORK

A. Concrete work shall meet the specifications for installation as noted in APWA Section 32 16 13 - Driveway, Sidewalk, Curb and Gutter or UDOT specifications where applicable.

B. All flat work in streets tying into existing flatwork shall be doweled into the existing concrete. Dowels to be spaced at 12" O.C. and be No. 5 rebar x 14" for slabs up to 8 inches in thickness and No. 8 rebar x 18" for slabs over 8 inches.

1.11 LAWNS

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

1.12 FENCES

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

1.13 LANDSCAPING

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

1.14 OTHER SURFACE IMPROVEMENTS

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

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION –

SECTION 01 78 50
PROJECT CLOSEOUT

PART 1 GENERAL

1.1 FINAL CLEANUP

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

1.2 TOUCH-UP AND REPAIR

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

1.3 CLOSEOUT TIMETABLE

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

1.4 MAINTENANCE AND GUARANTEE

A. CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 13 of the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such required repair work shall be completed by CONTRACTOR at no cost to OWNER.

C. CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from OWNER. If CONTRACTOR fails to make such repairs or replacement promptly, OWNER reserves the right to do the work and CONTRACTOR and his surety shall be liable to OWNER for the cost thereof.

D. CONTRACTOR shall obtain a signed release from the property owner approving restoration of work in the construction easements across or bordering private property.

1.5 BOND

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

1.6 FINAL ACCEPTANCE

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

1.7 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction including:

1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements
2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work
3. Field changes of dimension and detail
4. Details not on original Contract drawings

G. Submit documents to Engineer with claim for final Application for Payment.

1.8 CONTRACT CLOSEOUT

A. As a condition precedent to final acceptance of the project, the Contractor shall complete the following forms and submit the original and 1 copy of each form to the Project Representative.

1. Contractor’s Certificate of Substantial Completion
2. Contractor’s Certificate of Final Completion
3. Contractor’s Final Waiver of Lien
4. Consent of Surety for Final Payment
5. Affidavit of Payment
6. Affidavit of Release of Liens by the Contractor

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

CONTRACTOR'S FINAL WAIVER OF LIEN

TO ALL WHOM IT MAY CONCERN:

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

_____

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

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

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

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

Title: _____

INSTRUCTION FOR FINAL WAIVER:

A. Project name.

B. Final Contract amount received (total amount of Contract as adjusted).

C. If the waiver is for a corporation, corporate name should be used, corporate seal affixed, and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself/herself as partner.

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

AFFIDAVIT OF RELEASE OF LIENS BY THE CONTRACTOR

TO ALL WHOM IT MAY CONCERN:

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

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

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

ATTACHMENTS:

1. Contractor s Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Release or Waiver of Liens from subcontractors and material suppliers.

{AFFIX CORPORATE}
{SEAL HERE}

_____
Contractor (Name of sole ownership, Corporation or partnership)

_____
(Signature of Authorized Representative)

Title: _____

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

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SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of designated piping and valves within the existing structures and removal of existing structures where designated on the drawings.

B. If demolition of electrical equipment is required, see the requirements in the Electrical Specifications.

1.2 RELATED WORK

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

1. Section 01 33 00 Submittal Procedures

1.3 SUBMITTALS

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

B. Shop Drawings and Schedule: Describe demolition, removal procedures, sequence and schedule.

1.4 CLOSEOUT SUBMITTALS

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

PART 2 PRODUCTS

2.1 MATERIALS

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

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Contact OWNER not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Provide, erect, and maintain temporary barriers and security devices.

C. Notify adjacent owners of work which may affect their property, potential noise or vibration, utility outage, or disruption seven days prior to the start of Work. Coordinate with Owner.

D. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

E. Protect existing structures indicated to remain.

3.3 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures.

B. Conduct operations with minimum interference to public or private accesses.

C. Maintain egress and access at all times. Do not close or obstruct roadways without permits.

D. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and debris rising and scattering in the area. CONTRACTOR shall comply with local, State, and Federal environmental regulations pertaining to environmental protection. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

E. Cease operations immediately when adjacent structures appear to be in danger. Notify OWNER and ENGINEER.

3.4 STRUCTURE DEMOLITION

A. Disconnect, remove as required, and cap designated utilities. Identify utilities at termination of demolition. Record termination or capped location on Record Documents.

B. Remove the existing piping as noted on the Drawings.

C. Remove existing structures as noted on the Drawings.

D. Demolish and remove components in an orderly and careful manner.

E. Protect all existing structures not to be removed.

3.5 CLEAN UP

A. Remove and properly dispose of demolished materials from site as work progresses.

B. Leave areas of work in clean condition.

C. Adjacent structures shall be cleaned of dust, dirt, and debris caused by the demolition, as requested by ENGINEER or directed by governing authorities, and adjacent areas shall be returned to pre-demolition conditions.

- END OF SECTION -

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

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

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

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

1.3 REFERENCES

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

1. American Concrete Institute (ACI) -ACI 347R- Guide to Formwork for Concrete
2. American Hardboard Association (AHA) -AHA A135.4- Basic Hardboard
3. Department of Commerce (DOC) -DOC PS 1- Structural Plywood
4. ACI 350R-01 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
5. NSF International (NSF) 61 - Drinking Water System Components - Health Effects

1.4 DESIGN

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

1.5 SUBMITTALS

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

B. The following shall be submitted:

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

3. Manufacturer's data including literature describing form materials, accessories, and form releasing agents.
4. Manufacturer's recommendation on method and rate of application of form releasing agent.

C. ENGINEER's review will not relieve CONTRACTOR from any responsibility as to the adequacy of the forming, shoring and bracing design. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. ENGINEER's review will not lessen or diminish CONTRACTOR's liability.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form surfaces shall be in "new and undamaged" condition and may be plywood, hard plastic finished plywood, overlaid waterproof particle board, and steel of sufficient strength and surface smoothness to produce the specified finish. CONTRACTOR shall verify that his types of form surfaces and panel sizes satisfy all requirements of these specifications.

B. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

2.2 FORM TIES

A. Form ties on exposed surfaces shall be located in a uniform pattern. Snap ties shall not be broken until the concrete has reached the design concrete strength. The use of tie wires as form ties will not be permitted. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. Form ties shall be **Plastic Cone Snap Tie by Dayton-Superior, Wrench Head Snap Tie by MASCO Mason Supply,** or approved equal.

B. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Taper ties shall be **Taper Tie by Dayton-Superior, Taper-Tie by MASCO Mason Supply**, or approved equal.

2.3 FORM RELEASING AGENTS

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

PART 3 EXECUTION

3.1 INSTALLATION

A. Forms shall be mortar tight, properly aligned and adequately supported to produce

concrete surfaces meeting the surface requirements specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar.

B. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight and smooth. All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.

C. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be thoroughly cleaned of mortar from previous concreting and of all other dirt and foreign matter before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

D. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms to avoid mortar seepage. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Contract Drawings. Unless these are specifically called for on the Contract Drawings, no chamfer strips shall be placed in the corners of vertical construction joints.

3.2 COATING

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

3.3 ALIGNMENT AND TOLERANCES

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

TABLE 03 10 00-1
TOLERANCES FOR FORMED SURFACES

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

3.4 FORM REMOVAL

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

B. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

- END OF SECTION -

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the steel reinforcement bars, wire fabric mats, rod mats, and couplers for use in reinforced cast-in-place.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

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

1.3 REFERENCES

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

B. AMERICAN CONCRETE INSTITUTE (ACI)

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

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

D. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

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

E. Wire Reinforcement Institute (WRI)

1. Manual of Standard Practice for Welded Wire Reinforcement

1.4 SUBMITTALS

A. CONTRACTOR shall submit the following in accordance with Section 01 33 00 - Submittal Procedures:

1. Drawings of Concrete Reinforcement System with details showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.
2. Reinforcing Steel with certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.
3. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

1.5 DELIVERY AND STORAGE

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

PART 2 PRODUCTS

2.1 DOWELS

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

2.2 FABRICATED BAR MATS

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

2.3 REINFORCING STEEL

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

2.4 WELDED WIRE FABRIC

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

2.5 WIRE TIES

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

2.6 MECHANICAL COUPLERS

A. Mechanical couplers shall only be provided where shown on the Contract Drawings. 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, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.

C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

D. Mechanical Couplers shall be **Lenton Form Saver by Erico Products, D51A DBR by Dayton Superior**, or approved equal.

2.7 SUPPORTS

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

B. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2-inch of concrete surface shall be plastic protected or shall be stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

C. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

D. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

2.8 EPOXY ANCHOR 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 anchor grout shall meet the requirements of Section 03 60 00 – Grout.

PART 3 EXECUTION

3.1 GENERAL

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

3.2 REINFORCEMENT

A. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.

B. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.

C. Placement:

1. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete.
2. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.
3. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks.
4. For concrete over formwork, CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
5. Limitations on the use of bar support materials shall be as follows.
   a. Concrete Dobies: permitted at all locations except where architectural finish is required.
   b. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
   c. Plastic Bar Supports: permitted at all locations except on grade.
6. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
7. Bars additional to those shown which may be found necessary or desirable by CONTRACTOR for the purpose of securing reinforcement in position shall be provided by CONTRACTOR at no additional cost to OWNER.

8. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
9. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Specially coated bar supports shall be used. CONTRACTOR shall repair all chips or cracks in the epoxy coating with a compatible epoxy repair material prior to placing concrete.
10. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

D. Splicing:

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

3.3 WELDED-WIRE FABRIC

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

3.4 DOWELS

A. Dowels shall be installed in slabs on grade at locations indicated and at right angles to the joint being doweled. Dowels shall be accurately aligned parallel to the finished concrete surface and rigidly supported during concrete placement. A PVC sleeve shall cover one end of dowels up to the joint location at the center of the bar. Grease to be placed at the back of the sleeve prior inserting dowel so that the grease will flow out, around, and fully encase the inserted bar. Grease the bar before insertion. Grease shall be semi-solid, inert lubricant, such as lithium grease.

3.5 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Dowel Epoxy Installation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or damaging any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.
7. Dowels shall be twisted during insertion into the partially filled hole to guarantee full wetting of the bar surface with epoxy. CONTRACTOR shall insert the bar slowly enough to avoid developing air pockets.

3.6 CLEANING AND PROTECTION

A. CONTRACTOR shall protect reinforcement steel from conditions conducive to corrosion until concrete is placed.

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

- END OF SECTION -

SECTION 03 25 00
EXPANSION JOINTS, CONSTRUCTION JOINTS AND WATERSTOPS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers the work necessary to furnish, install and complete expansion and construction joints, including waterstops.

B. All waterstops and sealants in contact with potable water including waterstops embedded in concrete floors and walls of potable water tanks shall be NSF 61 certified.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

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

1.3 REFERENCES

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

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 318 Building Code Requirements for Reinforced Concrete

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
3. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
4. ASTM D 570 Standard Test Method for Water Absorption of Plastics
5. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
6. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
7. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
8. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
10. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
11. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

12. ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness

D. FEDERAL SPECIFICATIONS (FS)

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

E. NSF International (NSF)

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

1.4 SUBMITTALS

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

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

1.5 OBSTRUCTIONS

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

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY AND STORAGE

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

PART 2 PRODUCTS

2.1 HORIZONTAL JOINT SEALANT

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

2.2 VERTICAL JOINT SEALANT

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

2.3 JOINT PRIMER

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

2.4 EXPANSION JOINTS

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

2.5 PVC WATERSTOPS

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

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

Tensile strength	2,000 psi min.	(ASTM D 638)
Ultimate elongation	300% min.	(ASTM D 638)
Shore A hardness	75 ± 5	(ASTM D 2240)
Specific gravity	1.38 max	(ASTM D 792)
Stiffness in flexure	600 psi min.	(ASTM D 747)
Cold brittleness	No Failure at -35°F	(ASTM D 746)
Water absorption: 48 hours	0.15% max	(ASTM D 570)
Tear Resistance	290 lb./in. min.	(ASTM D 624)

C. Manufacturer, or approved equal:

1. Vinylex Waterstop & Accessories
2. Greenstreak, Inc. (Sika Corporation)
3. Durajoint Concrete Accessories

D. Factory made waterstop joints shall have a tensile strength across the joint equal to at least 600 psi. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically controlled heating iron.

2.6 HYDROPHILIC WATERSTOP

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

B. The hydrophilic waterstop shall meet the following physical properties:

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

C. Manufacturer, or approved equal:

1. Conseal CS-231
2. Sika Hydrotite CJ-1020-2K

PART 3 EXECUTION

3.1 WATERSTOPS

A. Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. In horizontal joints, ensure that the areas below the water stop are completely filled with concrete.

B. Horizontal plastic waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches in such a manner that bending over one way, or another is prevented. A hog-ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.

C. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop and shall be watertight. Splices in waterstop shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross-sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.

D. Install hydrophilic waterstop in accordance with the manufacturer's written instructions. Adhesives used on hydrophilic waterstop shall be NSF 61 certified. Adhesives shall meet the requirements of ASTM C 920 and shall be **Manus Bond 75-AM Lot NSF61**, **DAP Premium Polyurethane Construction Adhesive**, or approved equal.

3.2 JOINTS

A. Joints shall be installed at locations indicated and as authorized. Joints shall be constructed to produce straight joints, and shall be vertical or horizontal, except where walls intersect sloping floors.

B. Construction Joints

1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted to not damage the waterstop, if waterstop is present. Where the joint is to receive a sealant, a recess 3/4-inch deep shall be formed along the joint using a dressed-and-oiled wood strip or other method approved by ENGINEER. The wood strip shall be removed after the concrete has set.

C. Expansion Joints

1. Expansion joint filler shall be used where required on the Contract Drawings. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.

D. Joint Sealant

1. The joint cavity shall be cleaned by sandblasting or power wire brushing and shall be blown clean of dust and sand with compressed air before the joint sealant may be applied. Joints must be frost-free, free of oils, grease, curing compound residues, and any other foreign matter that might prevent bond. A bond breaker tape shall be installed over the joint per manufacturer's instructions. After the joints have been prepared as described above, the joints shall be primed, and the sealant shall be applied in accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers cast-in-place concrete mix design and placement. It also applies to the precast concrete panels for vaults shown on Structural Sheets (S-1 trough S-4).

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

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Material Testing
3. Section 03 10 00 Concrete Forming and Accessories
4. Section 03 20 00 Concrete Reinforcement
5. Section 03 25 00 Expansion Joints, Construction Joints, and Waterstops
6. Section 09 90 00 Painting and Finishes
7. Section 31 23 23 Excavation and Backfill for Structures

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
3. ACI 301 Structural Concrete for Buildings
4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
5. ACI 305R Hot Weather Concreting
6. ACI 306R Cold Weather Concreting
7. ACI 318 Building Code Requirements for Structural Concrete and Commentary
8. ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
2. ASTM C 33 Standard Specification for Concrete Aggregates
3. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

4. ASTM C 42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5. ASTM C 78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
6. ASTM C 94 Standard Specification for Ready-Mixed Concrete
7. ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
8. ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
9. ASTM C 150 Standard Specification for Portland Cement
10. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete
11. ASTM C 172 Standard Specification for Sampling Freshly Mixed Concrete
12. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
13. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
14. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
15. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
16. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
17. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
18. ASTM C 595 Standard Specification for Blended Hydraulic Cements
19. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
20. ASTM C 1157 Standard Performance Specification for Hydraulic Cement

D. NSF INTERNATIONAL (NSF)

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

1.4 DEFINITIONS

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

B. Specified Strength (f_c'): The indicated strength.

1.5 SUBMITTALS

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

B. Provide catalog information for all products to be used as part of the submitted mix design.

C. The results of trial mix designs along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work

without additional tests to show that the quality of the concrete is satisfactory. Indicate whether mixes have been designed for pumping. Include in the report the following information:

1. Water-cement ratio.
2. Air entrainment.
3. Proportion of materials in the mix.
4. Source and type of cement.
5. Analysis of water to be used unless potable.
6. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times and strengths.
7. Slump, air content and temperature of samples.
8. Unit weight of fresh and dry light weight concrete.
9. Strength test data showing mix meets indicated strength requirements per ACI-301.

D. Preapproved Mix Design Data: If supplier has on record, an OWNER approved mix design, submit name and address of supplier for each mix design 1 day prior to using concrete mix.

E. Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials. Test reports shall meet the following requirements:

1. Date of mix design: No older than 365 days from the date of submission.
2. Physical properties of the aggregate: Test results shall not be older than 455 days from the date of submission. A new report will be required if the aggregate source is changed.

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

G. Submit catalog information on the curing compound and the proposed location(s) to be used.

1.6 QUALITY ASSURANCE

A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER'S approval.

B. In proportioning materials for mixing, use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.

C. Do not change the quantity of cement per cubic yard for approved mix design without written approval of ENGINEER.

D. Use of admixtures will not relax hot or cold weather placement requirements.

E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C-94 and the requirements in this Section.

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

1.7 PRODUCT STORAGE AND HANDLING

A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.

B. Stockpile aggregate to avoid segregation and prevent contamination.

C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

PART 2 PRODUCTS

2.1 ADMIXTURES

A. Admixtures shall be approved by ENGINEER prior to use. Any admixtures to be used shall be included in proposed concrete mix designs.

B. Air Entrainment: ASTM C 260.

C. Later Reducing and Set Retarding Agents: ASTM C494.

1. Type A: Set water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer).*
7. Type G: High range water reducing and set retarding.*

* The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides content (as Cl^-) expressed as a percent of the cement shall not exceed 0.1 percent by weight.

D. Calcium Chloride: None allowed.

E. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:

1. The maximum percentage of Portland cement replacement is:
   a. 15 percent, for concrete exposed to weather.
   b. 20 percent, for interior concrete.
2. Pozzolan should not exceed 25% by weight of the cement plus pozzolans.
3. The minimum cement content shall be used in the design formulas before replacement is made.
4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does not exceed 100 percent.
5. All other requirements of this section still apply.
6. Mix designs including trial batches are required for each aggregate source and for each concrete class.

F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied

by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

2.2 CEMENTITIOUS MATERIALS

A. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:

1. Cement: Use Portland cement, ASTM C 150, Type II, Type IIA, or Type V, low alkali, or ASTM C 595 and ASTM C 1157 IL(10)-A-MS, unless noted otherwise.
2. Portland - Pozzolan Cement: ASTM C 595, Type IP(20 Max)-A-MS. Do not use Pozzolan cement unless approved by ENGINEER.

B. Only one brand of cement from one manufacturing plant may be used.

2.3 AGGREGATES

A. Aggregates shall be natural aggregates, free from deleterious coatings, and shall conform to the requirements of ASTM C 33, except as modified herein. Aggregates shall not be potentially reactive as defined in Appendix XI of ASTM C 33. CONTRACTOR shall import nonreactive aggregates if local aggregates are reactive.

B. Fine Aggregates

1. Fine aggregate shall consist of clean, sharp, natural sand and shall conform to the requirements of ASTM C 33. Fine aggregate shall be graded as follows:

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

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

C. Coarse Aggregate

1. Coarse aggregate shall be washed gravel or crushed stone, or a combination of these materials, consisting of hard, tough, durable particles free from adherent coatings. It shall contain no more than 15 percent flat or elongated particles. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall not be used. Coarse aggregate shall be graded as follows (ASTM C 33):

COARSE AGGREGATES	
Sieve Size	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
½ inch	25-60
#4	0-10
#8	0-5

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

2.4 ACI MIX DESIGN

A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f'_c) shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.

B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03 30 00-A.

2.5 HAND MIXING

A. Do not hand mix batches exceeding 0.5 cubic yards.

B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.

C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.6 HEATING, WATER AND AGGREGATE

A. Do not allow products of fuel combustion to contact the aggregate.

B. Heat mixing water to maximum temperature of 150 degrees F. Heat aggregates uniformly.

C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees F.

2.7 WATER

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

2.8 PROPORTIONS OF MIX

A. Mixture Proportioning, Normal Weight Concrete: All concrete that must be watertight and resistant to freeze-thaw cycles and to naturally occurring or commonly used chemicals

should be air entrained. All materials should be proportioned to produce a well-graded mixture of high density and maximum workability with a minimum specified 28-day compressive strength of concrete classification. Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. In the case where ground iron blast-furnace slag is used, the weight of the slag will be substituted in the equations for the term P which is used to denote the weight of pozzolan. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength. Maximum water-cement or water-cement plus pozzolan Ratio: 0.45.

B. Average Strength: In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

TABLE NO. 03 30 00-A

CONCRETE MIX PROPERTIES (e)					
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION(S)				
	Class 5000	Class 4500	Class 4000	Class 3500	Class 3000
Specified Compressive Strength $f_{c'}$ at 28 days, min., psi	5,000	4,500	4,000	3,500 (d)	3,000 (d)
Compressive Strength at 7 days, min., psi (a)	3,350	3,015	2,680	2,345	2,010
Cement content (94 lb. sacks of cement per cubic yard of concrete), min. (b)	7.5	7.0	6.5	6.0	5.5
Entrained air content, (% by volume).	6±1	6±1	6±1	6±1	6±1
Slump Range, in. (c)	1 - 4 (f)	1 - 4 (f)	1 - 4 (f)	2 - 4	2 - 4
Maximum Water Cement Ratio	0.45	0.45	0.45	0.45	0.45

(a) Used for monitoring purposes only.

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

2.9 CURING MATERIALS

A. Normal Curing Compound

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

B. Dissipating Curing Compound

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

PART 3 EXECUTION

3.1 GENERAL

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

3.2 PREPARATION OF SURFACES

A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

B. Foundations: Earthwork shall be as specified. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semi porous subgrades for foundations and

footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.

C. Preparation of Previously Placed Concrete: Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

B. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown on the Contract Drawings. Proper placement and locations shall be the responsibility of CONTRACTOR.

3.4 BATCHING, MIXING AND TRANSPORTING CONCRETE

A. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and non-agitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-QC 3.

B. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quantity and quality of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by ENGINEER.

C. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the specified slump is 3 inches or less, or more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

D. Admixtures: Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing as recommended by manufacturer. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.

E. Control of Mixing Water: No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch. No water shall be added at the jobsite without the approval of ENGINEER.

3.5 SAMPLING AND TESTING

A. Sampling and Testing of the concrete will be as defined in Section 01 45 00 – Quality Control and Material Testing. If there are discrepancies between this Section and Section 01 45 00, the more stringent requirement shall apply.

1. Aggregates: Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33.
2. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.
    a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
    b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 100 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
    c. Temperature: Concrete and air temperatures shall be measured and recorded with each slump test or with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.
3. Evaluation and Acceptance of Concrete
    a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 3,000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent. Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.
    b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two (2) 6-inch diameter by 12-inch high cylinders made from the same sample of concrete and tested at 28 days or at another specified test age. If 4-inch diameter cylinders are used, the strength shall be the average of the strengths of three (3) 4-inch by 8-inch high cylinders.

c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.
d. Unless noted otherwise, make a minimum of five (5) 6-inch diameter by 12-inch high concrete cylinders or six (6) 4-inch diameter by 8-inch high cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders which must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.

B. Investigation of Low-Strength Test Results: When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by ENGINEER to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in a place that is considered potentially deficient. The location of cores shall be determined by ENGINEER to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by ENGINEER in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to ENGINEER. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by ENGINEER, at the expense of CONTRACTOR.

3.6 CONVEYING CONCRETE

A. Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph 3.7 CONCRETE PLACEMENT by methods which will prevent segregation or loss of ingredients. Conveying concrete shall be in accordance with the requirements of ACI 304.

1. Chutes: When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.
   a. Use metal or metal lined chutes with a maximum length of 20-feet.

b. The minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.

2. Buckets: Bucket design shall be such that concrete of the required slump can be readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.
3. Pumps: Concrete may be conveyed by positive displacement pumps when approved. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy-duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

3.7 CONCRETE PLACEMENT

A. Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by ENGINEER if the concrete is of such slump after the 1-1/2 hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.

1. Placing Operation: Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by CONTRACTOR prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 4 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Concrete should not be allowed to drop through a cage of reinforcing steel. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screened to the proper level to avoid excessive shimming or grouting.
   a. Additional requirements for depositing concrete in walls include, but are not limited to:
      1) Deposit concrete in a continuous operation until section is completed.
      2) Place concrete in approximately horizontal layers 2 ft maximum thickness.
      3) Each layer of concrete shall be plastic when covered with the following layer.
      4) Rate of vertical rise not more than 4 ft per hour.
      5) Pump concrete or use a tremie having varying lengths for placing concrete in columns and walls to prevent free fall of more than 4 ft.

6) Allow concrete to thoroughly settle before top is finished. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.

b. Additional requirements for depositing concrete in slabs include, but are not limited to:
   1) Deposit concrete in a continuous operation until section is completed.
   2) Concrete shall be deposited as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
   3) In sloping slabs, proceed uniformly from the bottom of the slab to the top for the full width of the placement.

2. Consolidation: Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8,000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

B. Cold Weather Requirements: Cold weather requirements shall conform to ACI 306 and this Specification. Special protection measures, approved by ENGINEER, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Provisions should be made to keep the concrete at a minimum temperature of 50 degrees F for 7 days. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 32 degrees F. No concrete shall be placed on frozen ground. The temperature of the concrete when placed shall be not less than 55 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used.

C. Hot Weather Requirements: Hot weather requirements shall conform to ACI 305 and this Specification. The temperature of the concrete placed during hot weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

3.8 CONSTRUCTION JOINTS

A. Construction joints shall be located as indicated on the Contract Drawings. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of ENGINEER. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through

construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph 3.2, PREPARATION OF SURFACES.

3.9 FINISHING CONCRETE

A. Formed Surfaces

1. Repair of Surface Defects: Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by ENGINEER and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed by ENGINEER.
2. Class A Finish: Where a Class A finish is indicated, fins shall be removed. A mortar mix consisting of one-part Portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be prepared. White cement shall be used to replace part of the job cement. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads until all visible grout film is removed. The rubbing pads shall have on their surfaces the same sand-cement mix specified above but without any mixing water. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and

48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas.

3. Class B Finish: Where a Class B finish is indicated, fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained using Grade B-B plywood forms.
4. Class C Finish: Where a Class C finish is indicated, fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.
5. Class D Finish: Where a Class D finish is indicated, fins exceeding 1/4 inch in height shall be chipped or rubbed off. Concrete surfaces shall be left with the texture imparted by the forms used.
6. See Specification Section 09 90 00 Painting and Finishes for required finishes.

B. Unformed Surfaces: In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F in accordance with ACI 306R. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 5/16-inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains.

1. Rough-Slab Finish: Slabs to receive fill or mortar setting beds shall be screened with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.
2. Float Finish: Slabs to receive a steel trowel finish and slabs where indicated shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float and left free of ridges and other projections. Float finish is normally specified for surfaces that will receive other treatment such as built-up roofing, nonslip surfacing material. Float Finish shall not be used on wearing surfaces.
3. Trowel Finish: Slabs where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Trowel finish shall be used on wearing surfaces and where a smooth finish is required.
4. Broom Finish: After floating, slabs where indicated, shall be lightly troweled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.
5. See Specification Section 09 90 00 Painting and Finishes for required finishes.

3.10 CURING AND PROTECTION

A. General: All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type II or IIA, or V, low alkali cement	7 days
Concrete with Type IP-A(MS) cement blended with pozzolan	10 days

B. Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.

C. Moist Curing: Concrete to be moist cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap, or saturated burlap. Once the moist curing has started the concrete surface must not be allowed to become surface dry for the entire curing period.

D. Membrane Curing:

1. Normal membrane curing compound shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. Use a Dissipating curing compound for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring.
2. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam.
3. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface.
4. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period.
5. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions.
6. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified.

7. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period.
8. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.11 QUALITY CONTROL TESTING

A. Quality Control Testing shall be in accordance with Section 01 45 00 – Quality Control and Material Testing.

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SECTION 03 31 05

CONTROLLED LOW STRENGTH MATERIAL

PART 1 GENERAL

1.1 REQUIREMENTS

A. CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.

B. Where “Rapid Set Flow Fill” (or rapid cure CLSM) is called for on plans, UDOT requires it. Rapid Set Flow Fill shall be compliant with Spec Section 03 57 00 (a UDOT Special provision), shall be approved by UDOT and also by Engineer. Place Rapid Set Flow Fill in two steps so it reaches initial set (locks in around pipe) before rest of trench is filled.

C. Normal CLSM shall be placed where indicated on plans. CLSM shall be, non-segregating consistency that readily flows and fills voids and difficult to reach places. Use it to fill abandoned pipes and vaults and to fill pipe zone and trench zone where called for on plans.

D. “Foundation CLSM” has high strength. It is not used on this project.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

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

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 33 Standard Specification for Concrete Aggregates
2. ASTM C 94 Standard Specification for Ready-Mixed Concrete
3. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete
4. ASTM C 150 Standard Specification for Portland Cement
5. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete.
6. ASTM C 403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
7. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
8. ASTM C 595 Standard Specification for Blended Hydraulic Cements
9. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
10. ASTM C 803 Standard Test Method for Penetration Resistance of Hardened Concrete

11. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
12. ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13. ASTM D 4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings:

1. CLSM mix designs which show the proportions and gradations of all materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
2. If Contractor proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to ENGINEER
3. In UDOT intersection lanes which require traffic to be quickly restored (ie in all traffic lanes in 11400S 700E intersection) - use **UDOT approved Rapid Set Flow Fill for both pipe zone and trench zone**. Slow cure CLSM may be used in all other areas requiring CLSM or flow fill, including these areas in UDOT rights of way: filling vaults and pipes to be abandoned (not exposed to traffic loads) and backfilling pipes (pipe zone and trench zone) and structures that are not in UDOT traffic lanes.

1.5 QUALITY ASSURANCE:

A. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.

B. If tests of the CLSM show non-compliance with the specifications, CONTRACTOR shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be CONTRACTOR's responsibility.

C. Correlation Tests

1. CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days.
2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the WORK. The proposed location shall be acceptable to ENGINEER.
3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. All tests shall be performed by a laboratory at CONTRACTOR's expense.
4. Testing shall be performed once each 2-hours during the first 8 hours, once each 8-hours during the first week, and once each 24-hours until the CLSM mix reaches the maximum design strength.
   a. Compression testing shall be in accordance with ASTM D 4832.
   b. Setting test shall be in accordance with ASTM C 403.
   c. Density tests shall be in accordance with ASTM C 138.

PART 2 PRODUCTS

2.1 CONTROLLED LOW STRENGTH MATERIAL

A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94.

B. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.

1. The actual mix proportions and flow characteristics shall be determined by the producer of the CLSM to meet requirements for compressive strength as specified for Normal CLSM or Foundation CLSM.
2. Entrained air content shall be between 15 percent minimum and 30 percent maximum.
3. Water reducing agent content as necessary.

C. Properties

1. Density shall be between 120 PCF minimum and 145 PCF maximum.
2. Slump shall be as required by CONTRACTOR methods, but shall not promote segregation, nor shall slump exceed 10 inches.
3. Compressive strength at 28 days:
   a. Normal CLSM: Between 50 psi minimum and 150 psi maximum. Unless specifically indicated otherwise, all CLSM shall be Normal CLSM.
   b. Foundation CLSM: 500 psi to 1,000 psi.

2.2 CEMENT

A. Cement shall be Type ll in accordance with ASTM C 150 or Type IP(10)-MS or Type IL(10)-MS per ASTM C 595 and ASTM C 1157.

2.3 POZZOLAN

A. Pozzolan shall be Type F or C in accordance with ASTM C 618. Pozzolan content, by weight, in Normal CLSM, shall not be greater than 90 percent.

2.4 AGGREGATE

A. Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8-inch. One hundred percent shall pass the 1 inch sieve; no more than 30 percent shall be retained on the 3/8-inch sieve; and no more than 12 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73 (liquid limit-20), when tested in accordance with ASTM D 4318. All aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

2.5 ADMIXTURES

A. Air entraining admixtures shall be in accordance with ASTM C 260.

B. Water reducing admixtures shall be in accordance with ASTM C 494.

2.6 WATER

A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 EXECUTION

3.1 PREPARATION

A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 23 15 Excavation and Backfill for Buried Pipelines.

3.2 BATCHING, MIXING AND DELIVERY

A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the ENGINEER and shall be delivered in standard transit mix trucks.

3.3 PLACEMENT

A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means acceptable to the ENGINEER. CLSM shall be directed in place by vibrator, shovel, or rod to fill all crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.

B. CLSM shall be continuously placed against fresh material unless otherwise approved by ENGINEER. When new material is placed against existing CLSM, the placement area shall be free from all loose and foreign material. The surface of the existing material shall be soaked a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.

C. CLSM placement for piping. Pipe shall be placed on soil pads and bedding placed under the pipe from one side and vibrated, as necessary, so that the CLSM flows to the opposite side. CLSM shall then be added to both sides of the pipe and vibrated until it fills the space between the pipe and the excavated trench bottom. CLSM shall be deposited in such a manner as to avoid uplift and deposited in its final position to avoid disturbing the pipe trench causing foreign material to mix with the cement slurry.

D. Pipe zone backfill shall not be placed or compacted until the CLSM has reached initial set. Pipes placed on steep slopes may require a stiffer mix to prevent CLSM from flowing down the trench. Vibration may be required to ensure that the CLSM fills all voids.

E. Temperature of the CLSM shall be between 50 and 90 degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

3.4 FINISHING

A. The finish surface shall be smooth and to the grade indicated or directed by the ENGINEER. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.5 CURING

A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.

3.6 PROTECTION

A. CLSM shall be protected from freezing for 72 hours after placement.

B. No fill or loading shall be placed on Foundation CLSM until probe penetration resistance, as measured in accordance with ASTM C 803 exceeds 650 psi

C. Do not compact on other CLSM until strength exceeds 30 psi.

D. CLSM shall be protected from running water, rain, and other damage until the Material has been accepted and final fill completed.

- END OF SECTION –

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June 14, 2017

UDOT SPECIAL PROVISION

SECTION 03 57 50
RAPID SETTING FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rapid Setting Flowable Fill

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 194: Chemical Admixtures for Concrete

B. ASTM C1600: Standard Specification for Rapid Setting Hydraulic Cement

C. ASTM D 4832: Preparation and Testing of Controlled Low Strength Material (CLSM) Test

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Batch Proportions
   1. Seven days before placement.

B. Trial Batch
   1. Certified test results or conduct laboratory trial batch to verify strength before placement.
   2. Combine materials to meet the requirements for strength and constructability as required.
      a. Minimum strength – 50 psi at 2 hours.
      b. Maximum strength – 200 psi at 28 days.

C. If volumetric mixers are used, provide daily production data in electronic or printed media at the end of each production shift, including the following:
   1. Weight of cement per revolution count
   2. Weight of each aggregate size per revolution count
   3. Gate openings for each aggregate size.
   4. Weight of water added to the concrete per revolution count
   5. Moisture content of each aggregate size
   6. Individual volume of admixtures per revolution count

7. Time of Day
8. Day of week
9. Production start and stop times
10. Volumetric mixer identification
11. Specific type of concrete being produced
12. Source of the individual aggregate sizes
13. Source, brand, and type of cement
14. Source, brand, and type of individual admixtures
15. Name and signature of the operator.

D. Mixer Calibration
   1. If volumetric mixers are used Calibrate mixer in the presence of the Engineer.
      a. Measure weight of each of three consecutive batches of 125 lb of aggregate using the mixer and a certified scale. Repeat until three consecutive weights are within 2 percent.
      b. Measure weight of each of three consecutive batches of 20 lb of cement using the mixer and a certified scale. Repeat until three consecutive weights are within 2 percent.
   2. Calibrate before production for the first application.

1.6 ACCEPTANCE NOT USED

PART 2 PRODUCTS

2.1 MATERIALS AND SUPPLIERS

A. Cement – Rapid hardening hydraulic cement meeting the requirements of ASTM C1600.

B. Sand

C. Coarse aggregate – Determine a suitable aggregate size and gradation for the intended application.

D. Admixtures: Water reducers and set accelerators

E. Suppliers: Staker Parsons, or equal.

PART 3 EXECUTION

3.1 CURE AND PROTECT

A. Protect surface until walking on the surface leaves no footprints.

END OF SECTION

SECTION 03 60 00
GROUT

PART 1 GENERAL

1.1 REQUIREMENTS

A. CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.

B. Unless indicated otherwise, grout shall be provided as listed in this Section whether indicated on the Contract Drawings or not.

C. The following types of grouts are covered in this Section:

1. Cement Grout
2. Non-Shrink Grout – Class I (cement based)
3. Non-Shrink Grout – Class II (cement based)
4. Non-Shrink Epoxy Grout
5. Epoxy Anchor Grout for Adhesive Anchors
6. Topping Grout and Concrete/Grout Fill

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 60 00 Product Requirements
3. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

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

B. American Society for Testing Materials (ASTM)

1. ASTM C 33 Standard Specification for Concrete Aggregates
2. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C 150 Standard Specification for Portland Cement
4. ASTM C 307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
5. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
6. ASTM C 496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
7. ASTM C 531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
8. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

9. ASTM C 580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
10. ASTM C 595 Standard Specification for Blended Hydraulic Cements
11. ASTM C 827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
12. ASTM C 881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
13. ASTM C 882 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
14. ASTM C 939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
15. ASTM C 942 Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
16. ASTM C 1090 Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
17. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
18. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
19. ASTM C 1339 Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
20. ASTM D 648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
21. ASTM D 695 Standard Test Method for Compressive Properties of Rigid Plastics

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.

B. Provide the following submittals for each type of grout used on the project:

1. Test reports accompanied by a manufacturer's statement that previously tested material is of similar type, quality, and manufacture as that which is proposed for use on this project shall be submitted for:

    a. Cement
    b. Aggregates
    c. Retardants
    d. Bonding compounds
    e. Epoxy Resin

2. Certifications that grout used on the project contain no chlorides or other chemicals that cause corrosion.
3. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.
4. Manufacturer's certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
5. Submit manufacturer's written warranty as indicated herein.

6. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grout.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Grout and grout materials shall be stored in a dry shelter, protected from moisture, and for prepackaged grout, maintained in accordance with the manufacturer's recommendations.

1.6 QUALITY ASSURANCE

A. The work shall be subject to inspection at all times by OWNER and ENGINEER for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.

B. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.

C. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by ENGINEER.
2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 30 00 - Cast-in-Place Concrete, at intervals during construction selected by ENGINEER.
4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579, Method B, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.

D. Construction tolerances shall be as indicated in Section 03 30 00 Cast-in-Place Concrete unless noted otherwise.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: Portland cement shall be Type II or Type V per ASTM C 150 or Type IL(10)-MS or HS per ASTM C 595 and ASTM C 1157.

B. Aggregate:

1. General: Aggregate shall be non-reactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the material from the new source prior to commencing grout work.
2. Fine Aggregate: Fine aggregate shall be sand or crush stone conforming to ASTM C 33 as modified herein. When tested in accordance with ASTM C 136, gradation shall be such that 100 percent by weight passes a No. 8 sieve and not less than 45 percent by weight passes a standard No. 40 sieve. Variation from the specified gradation in individual tests will be accepted if the average of three consecutive tests is within the following variation:

Standard Sieve	Permissible Variation in Individual Test
No. 30 or coarser	2% by weight
No. 50 or finer	0.5% by weight

C. Admixtures

1. General: Admixtures shall be compatible with the grout and shall comply with the manufacturer's recommendations. Admixtures shall be added to the grout mix separately.
2. Water Reducing Retarder: Water reducing retarder shall comply with ASTM C 494, Type D and shall be **Master Builders (BASF) MasterSet R 300, Sika Corporation Plastiment**, or approved equal.
3. Lubricant: Lubricant additive for cement pressure grouting shall be **Sika Intraplast**, or approved equal.

D. Water:

1. Water for washing aggregate, for mixing and for curing shall be potable, shall not contain more than 1,000 mg/L of chlorides as Cl, nor more than 1,300 mg/L of sulfates as SO_4, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

2.2 CEMENT GROUT

A. Application: Surface repairs of concrete.

B. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.

C. Cement grout materials shall be as indicated in Section 03 30 00 Cast-in-Place Concrete.

2.3 NON-SHRINK GROUT

A. General

1. Non-shrink cementitious grout shall be a flowable, prepackaged, inorganic, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. The manufacturer shall

have at least 10 years' experience in the manufacture of cement based grouts. The manufacturer shall provide technical services and provide a representative at the jobsite for product training prior to product installation.

2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the application.
3. Grout shall not contain chlorides or additives that may contribute to corrosion.
4. Grout shall be formulated to be used at any consistency from fluid to plastic.
5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
   a. Minimum tensile splitting strength of 500 psi per ASTM C 496.
   b. Minimum flexural strength of 1,000 psi per ASTM C 580.
   c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882.
   d. Grout shall be certified for use in freeze/thaw environments.

B. Class I Non-Shrink Grout

1. Application: Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas; Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension; Storage tanks and other non-motorized equipment and machinery under 30 horsepower; Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.; Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material; and any other location not specifically listed in this Section or on the Contract Drawings.
2. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
3. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
4. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.
6. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
7. Class I Non-Shrink Grout shall be **Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, CB-G PG by Hilti**, or equal.

C. Class II Non-Shrink Grout

1. Application: Column base plates (greater than 2 story or larger than 16-inches in the least dimension); under precast concrete elements; and repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials.
2. Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
3. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827.
4. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.

5. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
6. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
7. The grout when tested shall not bleed or segregate at maximum allowed water content.
8. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
9. Class II non-shrink grout shall be **Five Star Fluid Grout 100 by Five Star Products**, **Crystex by L&M Construction Chemicals**, or equal.

2.4 EPOXY ANCHOR GROUT

A. Application: Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.

B. Epoxy anchor grout shall conform to ASTM C 881, Type IV, Class A, B, and C, Grade 3 with the exception of gel time.

C. Heat deflection temperature shall be a minimum of 139 °F per ASTM D 648.

D. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 °F.

E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

F. Epoxy anchor grout shall be capable of being used in submersed applications once cured.

G. Minimum compressive strength shall be 12,000 psi per ASTM D 695.

H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.

I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.

J. Epoxy anchor grout shall be **Epcon C6+ by ITW Ramset/Red Head, Power-Fast Epoxy Injection Gel by Powers Fasteners, RE 500 by Hilti**, or equal.

2.5 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Where fill is thicker than 3-inches, structural concrete as indicated in Section 03 30 00 - Cast-in-Place Concrete, may be used when accepted by ENGINEER.

B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 30 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.

C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00 - Cast-in-Place Concrete.

F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 – Cast-in-Place Concrete.

G. **Strength:** Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 4,000 psi.

2.6 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

B. Rough concrete lightly, but not enough to interfere with placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level, and maintain final positioning of components to be grouted.

3.2 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by ENGINEER.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by ENGINEER, alternate grouting methods shall be submitted for acceptance by ENGINEER.
3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Drilled Anchors and Reinforcing Bars

1. General
   a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.
   b. CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
2. Epoxy Adhesive Anchors
   a. Grout shall be proportioned and mixed with automatic equipment.
   b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
   c. Holes required for grouting shall be blown or vacuumed clean and are to be free of dust and standing water. Horizontal holes for grouting are to be drilled at a slight downward angle and with the inserted dowel or bolt bent to match.
3. Cement Based Non-Shrink Grout
   a. In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I.
   b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
   c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one-inch, the hole diameter should be at least twice the bolt diameter.
   d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
   e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

D. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.4 CONSOLIDATION

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

3.5 CURING

A. Cement based grouts shall be cured per 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION –

SECTION 05 45 00

MECHANICAL METAL SUPPORTS (PIPE SUPPORTS)

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers materials and installation of mechanical metal supports, pipe supports, hangers, guides, anchors and appurtenances as specified and indicated.

B. CONTRACTOR shall provide mechanical metal supports in accordance with this Section whether shown on the Contract Drawings or not.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 33 00 Submittal Procedures
2. Section 05 50 00 Miscellaneous Metals
3. Section 09 90 00 Painting and Finishes
4. Section 33 05 05 Ductile Iron Pipe
5. Section 33 05 07.1 PVC Pressure Pipe (ASMT 1785)
6. Section 33 12 00 Mechanical Appurtenances

1.3 REFERENCES

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

B. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY (MSS)

1. MSS SP-58 Pipe Hangers and Supports – Materials Design and Manufacture
2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
4. MSS SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

1. ASME B 31.1 Power Piping

D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 36 Standard Specification for Carbon Structural Steel
2. ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings
3. ASTM A 48 Standard Specification for Gray Iron Castings
4. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and

Steel Hardware

6. ASTM A 575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
7. ASTM A 576 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

1.4 SUBMITTALS

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

B. CONTRACTOR shall submit complete shop drawings of mechanical supports, pipe supports, hangers and guides. Provide scaled shop drawings showing locations of the supports and detailed drawings for each support. Identify each type of hanger or support by the manufacturer's part number of figure on the drawing.

C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support.

D. Provide structural calculations for special supports and anchors, stamped and signed by a professional engineer registered in the State of Utah.

PART 2 MATERIALS

2.1 GENERAL

A. All pipe hanger and supports shall be manufactured to comply with MSS-SP-58, MSS-SP-569, MSS-SP-89 except as modified herein. Where applicable, design and manufacture must also conform to ANSI/ASME B31.1. Supports for plumbing or fire piping shall be in accordance with the latest edition of the applicable plumbing or fire code and the requirements of the local jurisdiction.

B. Hangers, supports, anchors and restraints must be designed in accordance with MSS-SP-127 to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. Piping supports and equipment must be considered as a total system and appropriate balance calculations made to determine load forces at critical stress points. Loading conditions to be considered may include, but are not limited to:

1. The total load of pipe, fittings, valves, insulation and any expected contents of the pipe.
2. Thermal expansion and contraction
3. Stress from cycling of equipment or process.
4. Vibration transmitted to or from equipment or terminal connection.
5. Wind, snow or ice loading on outdoor piping
6. Loading due to seismic forces

C. Static and dynamic forces at points of attachments must be considered to help ensure structural integrity of buildings or equipment. Hanger and supports must be selected so as to minimize the effect of piping system loading on the structure.

D. In general, piping shall be supported from structural members, such as walls, beams, columns and slabs, using approved structural attachments. In situations where approved attachments cannot be used, alternative attachments or substructure assemblies must

receive approval by ENGINEER prior to installation. Prior approval by ENGINEER must be given before any cutting or drilling of building structural steel. Damage to the structure through welding, cutting or drilling will not be permitted if it reduces the structures strength below the established safety factor for the structure. Any additional structural steel required to properly support piping or equipment shall be furnished and installed by CONTRACTOR at no additional cost to OWNER.

2.2 SUPPORT MATERIALS

A. Pipe supports, hangers, guides, etc. shall be hot-dip galvanized carbon steel, unless noted otherwise on the Drawings. Steel shall be in accordance with ASTM A 36, ASTM A 575, or ASTM A 576. Hot-dip galvanizing shall be in accordance with ASTM A 123 or ASTM A 153. Bases, rollers, and anchors shall be steel as described above or may be cast iron conforming to ASTM A 48. Pipe clamps shall be steel as described above or may be malleable iron conforming to ASTM A 47.

B. Submerged supports, as well as piping in hydraulic structures within 24 inches of the high water level, shall have supports, including hardware and anchors constructed of Type 316 stainless steel, unless noted otherwise on the Drawings.

C. Piping in chemical or corrosive areas shall have supports, including hardware and anchors constructed of Type 316 stainless steel or fiberglass reinforced plastic (FRP), unless noted otherwise on the Drawings.

D. Supports fabricated from other materials specified on the Drawings shall have a protective coating in accordance with the requirements of Section 09 90 00 – Painting and Finishes.

2.3 FLOOR MOUNTED SUPPORTS

A. Floor mounted pipe supports shall include the manufacturer's recommended pipe stanchion and base plate. Base plates shall be anchored to the floor with bolts and provided with a 1-inch thick grout pad.

2.4 SPRING-TYPE HANGERS

A. Spring-type hangers shall be provided for piping subject to vibration or vertical expansion/contraction such as engine exhaust piping. Design the spring-type hangers per the manufacturer's recommendations.

2.5 CONCENTRATED LOADS

A. Concentrated loads, such as meters, valves, and equipment, on PVC piping systems shall have supports on each side of the concentrated load.

2.6 CONCRETE ANCHORS

A. Anchors shall be in accordance with Section 05 50 00 – Miscellaneous Metals.

2.7 MANUFACTURERS

A. Mechanical Metal Support (pipe support) manufacturers shall be **Anvil International Inc., B-Line by Eaton (Cooper Industries), Utility Coatings & Fabrication,** or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Mechanical metal supports, pipe supports, hangers, guides, etc. shall be installed per the manufacturer's instructions and ASME B31.1 – Power Piping.

B. Pipe supports shall be positioned in order to produce an orderly, neat piping system. Hanger rods shall be vertical without offsets.

C. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting as close to ceilings or roods as possible and without interference with other work.

D. Hangers shall be installed in a manner to prevent obstructing ladders, manhole covers, and access hatches.

E. Set embedded inserts accurately in position and support them rigidly before concrete is placed and prevent displacement during and after placement of concrete.

F. Provide separate hangers or supports at valves, meters, elbows, tees, and other equipment. Provide separate hangers on each both sides of each non-rigid joint or flexible coupling.

G. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, or other pipe to which the pipe is connected.

H. Hangers and supports for rigid plastic pipe shall be provided with a support shield to spread the load bearing surface.

I. Use of wire hangers, perforated strap, hanging from unreinforced metal deck and cellular roof deck are not permitted.

J. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.

K. Galvanizing Field Repairs

1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

3.2 SUPPORT LOCATION AND SPACING

A. Supports for horizontal piping shall be spaced to prevent excessive sag, bending and stresses in the piping. Spacing shall not exceed the maximum indicated spans.

B. Maximum spans indicated in the tables below are for ambient temperatures or the temperatures listed for the materials and pipe wall thicknesses shown. Adjust the span spacing for different temperatures and/or pipe wall thicknesses per the manufacturer's recommendations.

C. Install pipe supports on horizontal and vertical runs at the spacing shown or detailed on the Drawings. If no spacing or rod sizes are given on the Drawings or in the specifications for a particular piping system, use the following tables or the recommendations of the support or pipe manufacturer.

1. Support Spacing for Steel Pipe:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Hanger Rod Size (inches)
3/8 and smaller	4	5	3/8
1/2 through 1	6	8	3/8
1-1/4 through 2	8	10	3/8
2-1/2 through 3	10	14	1/2
3-1/2 through 4	10	15	5/8
6	12	20	3/4
8	12	24	3/4
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.			

2. Support Spacing for PVC Pipe (Section 33 05 07.1 – Polyvinyl Chloride Pipe) Schedule 40 and Schedule 80. The table below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				Maximum Span Schedule 80 (feet)			
	60°F	80°F	100°F	120°F	60°F	80°F	100°F	120°F
1/2	4.5	4.5	4	2.5	5	4.5	4.5	3
3/4	5	4.5	4	2.5	5.5	5	4.5	3
1	5.5	5	4.5	3	6	5.5	5	3.5
1-1/4	5.5	5.5	5	3	6	6	5.5	3.5
1-1/2	6	5.5	5	3.5	6.5	6	5.5	3.5
2	6	5.5	5	3.5	7	6.5	6	4
2-1/2	7	6.5	6	4	7.5	7.5	6.5	4.5
3	7	7	6	4	8	7.5	7	4.5
4	7.5	7	6.5	4.5	9	8.5	7.5	5
6	8.5	8	7.5	5	10	9.5	9	6
8	9	8.5	8	5	11	10.5	9.5	6.5
10	10	9	8.5	5.5	12	11	10	7
12	11.5	10.5	9.5	6.5	13	12	10.5	7.5
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.								
Data taken from Anvil International, Inc. Catalog PH-2006, page PH-213 and is based on continuous span and for un-insulated line carrying fluids of specific gravity up to 1.00.								

3. Supports for Ductile Iron Pipe (Section 33 05 05 – Ductile Iron Pipe) should be installed

in locations shown on the Drawings with a minimum of one support per 20-foot length of pipe. If longer spans are required, the supports should be designed in accordance with DIPRA – Design of Ductile Iron Pipe on Supports and the pipe manufacturer's recommendations. Supports should be cradle type with a saddle angle of 120 degrees. The table below shows the recommended maximum spans per US Pipe – Long Span and Bridge Crossing Pipe guidelines.

Pipe Size (inches)	Maximum Span Water Service (feet)
6	28
8	30
10	30
12	35
14	35
16	40
18	42
20 to 64	45
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.	

4. Support spacing for other pipe materials shall be based on recommendations from the pipe manufacturer.
5. Provide sway bracing for hangers where shown on the Drawings. If no bracing is shown, provide bracing at 10 foot maximum center-to-center intervals.

- END OF SECTION -

SECTION 05 50 00
MISCELLANEOUS METALS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers materials, fabrication, and installation of miscellaneous metals and appurtenances as specified and indicated.

1.2 RELATED SPECIFICATIONS

A. Fabrication and erection of the platforms, ladders and stairs shall be in accordance with the Specification for the Design, Fabrication and Creation of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 1910.27 of the latest edition of the OSHA standards, except as specified herein.

1.3 REFERENCES

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

B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

1. Manual of Steel Construction

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 36 Standard Specification for Carbon Structural Steel
2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASMT A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
7. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
8. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
9. ASTM F 594 Standard Specification for Stainless Steel Nuts

1.4 RELATED WORK

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

1. Section 01 33 00 Submittal Procedures
2. Section 09 90 00 Painting and Finishes

1.5 SUBMITTALS

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

B. CONTRACTOR shall submit complete shop drawings of fabricated items, such as vents, ladders, stairs, platforms, beams, pipe supports, and miscellaneous metals for approval to Engineer.

C. Shop drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the work.

D. Shop drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

E. Submit manufacturer's catalog data and dimensional drawings for lifting eyebolts and inserts; ladder safety posts, manhole covers and frames, and anchor bolts.

F. Submit ICC ES Evaluation Reports for adhesive and wedge anchors and installer qualifications and procedures.

PART 2 MATERIALS

2.1 CARBON STEEL

A. Materials for bolted or welded steel construction shall conform to ASTM A 36.

2.2 BOLTS

A. Steel anchor and connection bolts for non-corrosive service shall conform to ASTM A 307, Grade A or B, unless otherwise noted. Bolts shall be hot-dip galvanized and provided with self-locking nuts or lock washers and plain nuts.

B. Steel anchor and connection bolts for corrosive service shall be fabricated from stainless steel, unless indicated otherwise in the specifications or on the Drawings. Corrosive service locations are as listed below.

1. Buried locations
2. Submerged locations
3. Locations subject to occasional flooding
4. Inside hydraulic structures
5. Chemical handling areas
6. Inside buried manholes, vaults, and structures that do not have a gravity drain or sump pump
7. Inside trenches, containment walls, and curbed areas.

2.3 STEEL PIPE

A. Pipe for vault vents shall be Schedule 40 conforming to ASTM A 53 and shall be hot-dip galvanized.

2.4 STAINLESS STEEL

A. All bolts, expansion bolts, nuts, washers, and expansion sleeve inserts used to attach metal supports shall be stainless steel Type 304.

B. All ladders, wall conduits, louvers, and other items required shall be stainless steel unless noted otherwise.

2.5 HOT-DIP GALVANIZED

A. Zinc coating for plates, bolts, anchor bolts, and threaded parts shall in in accordance with ASTM A 153. Structural steel shall be zinc coated in accordance with ASTM A 123.

2.6 COVERS AND FRAMES

A. Manhole covers and frames shall be cast iron and designed for AASHTO HS-20 loading, unless otherwise indicated. Castings shall be smooth, clean and free from blisters, blowholes, and shrinkage. Covers shall seat firmly into the frames without rocking. Covers and frames shall fit together evenly such that the cover fits flush with the surrounding finished surface.

2.7 VAULT VENTS

A. Fabricate vault vents as shown on the Drawings. Vault vents shall be welded steel construction and hot-dip galvanized after fabrication. Coating shall be in accordance with Section 09 90 00 – Painting and Finishes.

2.8 ADHESIVE ANCHORS

A. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered without an ICC ES Report verifying strength and material equivalency. Anchors used inside potable water reservoirs shall be ANSI/NSF 61 certified.

B. Adhesive anchors shall be a two-component system consisting of an all threaded anchor rod with nut and washer, and the adhesive capsule. Anchor rods shall be Type 304 stainless steel conforming to ASTM F 593 with nuts conforming to ASTM F 594. The adhesive capsules shall contain a polyvinyl or urethane methacrylate-based resin and accelerator within a sealed dual chamber foil capsule. Adhesive anchors shall be **Hilti HVA Capsule Adhesive Anchoring System**, or approved equal.

2.9 WEDGE ANCHORS

A. Wedge type anchors shall be used only where indicated on the Drawings. Wedge anchors shall be a stud type expansion anchor, torque controlled, with impact section to prevent thread damage. Stud and wedge shall be Type 304 or Type 316 stainless steel conforming to ASTM A 276. Nut shall be Type 304 or Type 316 stainless steel conforming to ASTM F 594 with washer of similar material. Wedge anchor bolts shall be **Hilti Kwik Bolt 3,** or approved equal. Anchors installed in non-submerged or non-corrosive environments may be carbon steel and be **Simpson Strong-Tie Strong Bolt**, or approved equal.

2.10 LADDERS

A. All Ladders shall be fabricated entirely of Type 304 stainless steel; including ladder, ladder hardware and supports. Do not use pre-fabricated steps shop (or field) cast into walls of vaults or manholes.

B. All ladders without a permanently mounted exterior ladder extension shall be provided with a telescoping safety post. The post shall be fabricated of steel with telescoping tubular section that locks automatically when fully extended. The upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. The telescoping safety post shall be fabricated from the same material and finish as the ladder. The telescoping posts shall be **LadderUP Safety Post by Bilco**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Except as otherwise shown, the design, fabrication, and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

B. Install miscellaneous metals as indicated on the drawings or as recommended by the manufacturer.

C. Store materials above ground on platforms, skids or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

D. Clean surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign matter before placing concrete.

E. Set embedded metalwork accurately in position and support it rigidly before concrete is placed and prevent displacement during and after placement of concrete.

F. Repair or replace metal items damaged during installation. Follow the manufacturer’s procedures for repairing damaged surfaces.

G. Welding shall be performed by metal-arc method or shielded metal arc method as per the American Welding Society’s (AWS) “Welding Handbook”. During welding component parts shall be adequately clamped or supported. Avoid irregular surface, non-uniform bead pattern, and high crown. Upon completion of welding, remove weld splatter, flux, slag, and burrs. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.

H. Adhesive Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer’s instructions. Do not load the anchor until the adhesive has reached its indicated strength in accordance with the manufacturer’s instructions.

I. Wedge Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer’s instructions.

J. Galvanizing Field Repairs

1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

- END OF SECTION –

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SECTION 09 90 00
PAINTING AND FINISHES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers furnishing, surface preparation, and applying paints and coatings, complete and in place, to all specified surfaces including exposed valves, piping or fittings.

B. Definitions

1. The term “paint”, “coatings”, or “finishes” as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
2. The term “DFT” means minimum dry film thickness, without any negative tolerance.
3. The term “mil” means thousandths of an inch.
4. The term “SSPC” means The Society for Protective Coatings.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Contract Drawings.
2. Stainless steel
3. Machined surfaces
4. Grease fittings
5. Glass
6. Equipment nameplates
7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The protective coatings applicator (Applicator) shall possess a valid state license as required for the performance of the painting and coating work called for in this specification and shall provide 5 references which show the Applicator has previous successful experience with the indicated of comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Applicator provided the protective coating.

1.2 RELATED WORK

A. Related Work in other Sections includes, but is not limit to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 30 00 Cast-in-Place Concrete
3. Section 05 45 00 Mechanical Meal Supports
4. Section 05 50 00 Miscellaneous Metals
5. Section 33 05 05 Ductile Iron Pipe
6. Section 33 12 00 Mechanical Appurtenances
7. Section 33 92 10 Steel Pipe, Specials, and Fittings

1.3 REFERENCES AND STANDARDS

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

1. OSHA — Occupation Safety and Health Act: State of Utah and Federal
2. ICRI — International Concrete Repair Institute Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI A 13.1 — Standard for Scheme for the Identification of Piping Systems
2. ANSI Z 535 — Standard for Safety Colors

C. AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

1. ASTM C 309 — Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
2. ASTM D 520 — Standard Specification for Zinc Dust Pigment
3. ASTM D 521 — Standard Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
4. ASTM D 6943 — Standard Practice for Immersion Testing of Industrial Protective Coatings Linings
5. ASTM D 1653 — Standard Test Methods for Water Vapor Transmission of Organic Coating Films
6. ASTM D 2370 — Standard Test Method for Tensile Properties of Organic Coatings
7. ASTM D 2794 — Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
8. ASTM D 4263 — Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
9. ASTM D 4414 — Standard Practice for Measurement of Wet Film Thickness by Notch Gages
10. ASTM D 4417 — Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
11. ASTM D 7234 — Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
12. ASTM D 7682 — Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
13. ASTM E 96 — Standard Test Methods for Water Vapor Transmission of Materials
14. ASTM F 1869 — Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
15. ASTM F 2170 — Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 210 — Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

2. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

E. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301 Specifications for Structural Concrete

F. NACE International (NACE)

1. NACE RP0287 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
2. NACE SP0188 Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
3. NACE SP0892 Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
4. NACE No. 1/SSPC-SP 5 White Metal Blast Cleaning
5. NACE No. 2/SSPC-SP10 Near White Metal Blast Cleaning
6. NACE No. 3/SSPC-SP6 Commercial Blast Cleaning
7. NACE No. 6/SSPC-SP13 Surface Preparation of Concrete

G. SSPC: The Society for Protective Coatings (SSPC)

1. SSPC PA1 - Shop, Field, and Maintenance Painting of Steel
2. SSPC-PA2 – Paint Application Specification No. 2: Measurement of Dry Coating Thickness with Magnetic Gages.
3. SSPC-PA11 - Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
4. SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning.
5. SSPC-SP10/NACE 2 - Near White Metal Blast Cleaning
6. SSPC-SP16 – Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
7. SSPC-VIS 1 - Guide to Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

1.4 SUBMITTALS

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

B. CONTRACTOR shall supply shop drawings for approval on all paint materials at least 30 days prior to installation. Submittals shall include the following data sheets:

1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.

C. Where ANSI/NSF 61 approval is required, submit ANSI/NSF 61 certification letter for each coating in the system indicating the product application limits on size of tank or piping, dry film thickness, number of coats, specific product tests, colors certified, and approved additives.

D. Quality Control Submittals:

1. Furnish a list of references for the Applicator substantiating the requirements as specified.
2. Manufacturer's certification stating factory applied coating systems meets or exceeds requirements specified herein.
3. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.

1.5 PAINT DELIVERY, STORAGE, AND HANDLING

A. Deliver paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.

B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the manufacturer.

1.6 QUALITY ASSURANCE

A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.

B. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.

C. Observations by OWNER or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.7 MANUFACTURER'S SERVICES

A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

1.8 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. An inspection may be conducted during the eleventh month following completion of coating work. CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective work shall be repaired in accordance with these specifications and to the satisfaction of OWNER. OWNER may, by written notice to CONTRACTOR, reschedule the inspection to another date within the one-year correction period or may cancel the inspection altogether. CONTRACTOR is not relieved of its responsibilities to correct defects whether or not the inspection is conducted.

PART 2 PRODUCTS

2.1 GENERAL

A. CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

B. Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Colors and shades of colors of coatings shall be as indicated or selected by ENGINEER. Each coat shall be of a slightly different shade to facilitate observation of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by OWNER.

E. Substitute or “Or-Equal” Products

1. Basis of Design: The Coating Systems listed below in paragraph 2.3 are based on products from Tnemec Company Incorporated, except where indicated below.
2. Product Substitution: To establish equality under Section 01 60 00 – Product Requirements, the specified coating systems are the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of ENGINEER. Requests for material substitutions shall be in accordance with requirements of the project specification.
3. Product Requirements: CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or equal" product that the material meets the indicated requirements and is equivalent or better in the following properties: Quality, Durability, Resistance to abrasion and physical damage, Life expectancy, Ability to recoat in the future, Solids content by volume, Dry film thickness per coat, Compatibility with other coatings, Suitability to chemical attack, Temperature limitations during application and in service, Type and quality of recommended undercoats or topcoats, Ease of repairing damaged areas, and stability of colors.
4. Manufacturers of “or equal” products shall provide direct performance comparison with the materials specified, in addition to complying with all other requirements of these Specifications. “Or equal” products shall employ the same generic type materials and system components as the specified coating systems.
5. Requests for product substitution shall be made and approved at least 10 days prior to bid date.
6. CONTRACTOR shall bear any additional costs, if a proposed substitution requires changes or additional work.

2.2 COLORS

A. Provide colors as selected by OWNER or ENGINEER.

B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply color matches.

D. Equipment colors;

1. Equipment shall mean the machinery or vessel itself plus the structural supports and fasteners.
2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as indicated below:

   a. Dangerous parts of equipment and machinery: OSHA Orange
   b. Fire protection equipment and apparatus: OSHA Red
   c. Radiation hazards: OSHA Purple
   d. Physical hazards in normal operating area: OSHA Yellow

3. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.

E. Piping color coding shall be in accordance with ANSI A13.1, Division of Drinking Water R-309-525, and International Plumbing Code.

1. Color code non-submerged metal piping except electrical conduit. Paint fittings and valves the same color as the pipe unless otherwise specified.
2. Pipe supports: If pipe supports are not galvanized or stainless steel, supports shall be painted ANSI No. 70 light gray as specified in ANSI Z535.
3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, unless noted otherwise on the Contract Drawings.

2.3 COATING SYSTEMS

A. System No. 1 Steel – Immersion Potable Water NSF 61 Certification

1. Materials

Type	Epoxy conforming to AWWA C 210 and D 102 (for steel tanks).
VOC content, max, g/L	311
Volume Solids, min, %	67
Demonstrated Suitable for	Long term immersion in water, resistant to corrosion, good color retention
Certification	NSF 61 if in contact with potable water

2. Surface preparation and Coating System

Surface Preparation	**Products**	**Total System** (mils)
SSPC-SP10 Near-White Blast Cleaning with minimum angular profile of 1.5 mils	<u>6" -16" Pipes</u> Primer: Tnemec Series 1220 (White) Intermediate: N/A Finish: Tnemec Series 1220 (White) Max thinner: 15%, Recoat cure time 6 hrs @ 75-deg F, Final cure time 7 days @ 75-deg F, Mix ratio 2:1 (A:B by volume), Series 44-700 Accelerator may be added up to 1 fl. oz./gal	<u>6" – 16" Pipes (Tnemec Only)</u> Primer: 6-8 DFT Finish: 6-8 DFT <u>18" and Greater</u> Primer: 3-5 DFT Intermediate: 4-6 DFT Finish: 4-6 DFT
	<u>18" and Greater</u> Primer: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Intermediate: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Finish: Tnemec N140 Pota-Pox Plus (00WH White or 15BL Tank White) Max thinner: 5% No. 60 by volume, Recoat cure time 9 hrs @ 75-deg F (5 hrs @ 75-deg F with accelerator), Final cure time 30 days @ 75-deg F; Mix ratio 1:1 (A:B by volume), Series 44-700 Accelerator may be added to Part A in the field and may be added at up to 4 fluid ounces per two mixed gallons of parts A and B.	
	Primer: Sherwin Williams Tank Clad HS Intermediate: Sherwin Williams Tank Clad HS Finish: Sherwin Williams Tank Clad HS	
	Primer: Carboline Carboguard 891 VOC Intermediate: Carboline Carboguard 891 VOC Finish: Carboline Carboguard 891 VOC (For AWWA C210 only)	

3. Application
   a. For use on lining of pipes, valves, pumps, equipment in potable water service including items under submerged conditions, such as wall pipes, pipes, pipe sleeves, and the following specific surfaces unless noted otherwise:

B. Systems 2 & 3 – Not Used.

C. System No. 4 – for Steel and Ductile Iron and Cast Iron – Interior and Exterior Exposed

1. Materials

Type	3-Coat Moisture Cured Urethane System. Zinc-Rich primer with Polyamidoamine Epoxy (intermediate coat), and Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	340 Zinc Primer 250 Intermediate and Finish Coats
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering
Certification	None

2. Surface preparation and Coating System

Surface Preparation	**Products**	**Total System** (mils)
Steel: Abrasive blast to SSPC-SP10 to min angular anchor profile of 1.5 mils. Ductile & Cast Iron: Prep all surfaces per NAPF 500-03 and Abrasive blast all surfaces to an NAPF 500-03-04 angular profile of 1.5 mil min	Primer: Wasser MC-Moizinc100 (also known as MC-Zinc) Intermediate: Wasser MC-CR100 (also known as Ferrox B) Finish: Wasser MC Ferrox A100 (also known as Ferrox A)	Primer: 3-5 DFT Inter.:5-7 DFT Finish: 2-4 DFT

3. Application
   a. Coat all exposed steel and ductile iron surfaces located inside and outside of structures (except galvanized pipes outside structures). The exterior of all steel and ductile iron pipes inside vaults, including galvanized vent pipes.
   b. Middle and topcoat with Ferrox B & A (respectively) all piping in vaults that is already shop coated with another coating, including epoxy coated valves, dismantling joints, couplings, steel and ductile iron pipe (coat over tar coating), and other ferric piping appurtenances.
4. Special Requirements
   a. Surface preparation (sandblast) and zinc primer coat shall be shop applied to all surfaces (prior to field installation).
   b. Finish coats (Ferrox B and Ferrox A) may be applied in shop and field touched up, or alternately, they may be applied to zinc primed pipe exterior surfaces after piping has been assembled in vault (or building).

D. System No. 5 Buried Steel Pipe. Not Used

E. System 6 – Not used.

F. System No. 7 Galvanized Steel – Exterior Exposed

1. Materials

Type	Polyamide Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering

2. Surface preparation and Coating System

Surface Preparation	**Products**	**Total System** (mils)
Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 3-5 DFT Finish: 2.5-4 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	
	Primer: Carboline Carboguard 890 Finish: Carboline Carbothane 133LV(Satin) or 134VOC(Gloss)	

3. Application
   a. Exposed galvanized located outside of pipe and metals requiring painting.

G. Systems 8, 9, 10, 11, 12, 13, 14, 15 – Not Used.

2.4 SPECIAL COATING SYSTEMS

A. System 202 – **Polyethylene Encasement is required for buried ductile iron pipe**. It shall be in accordance with ANSI/AWWA C105 using Method C. Provide polyethylene encasement where indicated on the Contract Drawings or per Section 30 05 05 – Ductile Iron Pipe.

B. System 204 – **Provide for all Ductile or Cast-Iron, Valves and Gates** (Immersion in Water and Wastewater)

1. Materials

Type	High Solids Epoxy
VOC content, max, g/L	285
Demonstrated Suitable for	Ductile or Cast-Iron immersion in water or wastewater
Certification	NSF 61 if used for immersion in potable water

2. Surface preparation and Coating System

Surface Preparation	**Products**	**Total System** (mils)
Prepare all surfaces by uniformly abrasive blasting the entire exterior surface to ensure cleanliness and to create a minimum angular anchor profile of 2.0 mils.	Primer: Tnemec Hi-Build Epoxoline II Series N69* Intermed:Tnemec Hi-Build EpoxolineII SeriesN69* Finish: Tnemec Hi-Build Epoxoline II Series N69* * For NSF 61 potable water use (instead): Tnemec Pota-Pox Plus Series N140.	Primer: 3 - 5 DFT Intermediate: 4 - 6 DFT Finish: 4 - 6 DFT
	Primer: Ameron Amerlock 400 Intermediate: Ameron Amerlock 400 Finish: Ameron Amerlock 400	
	Primer: International Interseal 670 HS Intermediate: International Interseal 670 HS Finish: International Interseal 670 HS	
	Wastewater: Primer: Carboline Phenoline 1205 Finish: Carboline Phenoline 1205 NSF61: Prime: Carboline Carboguard 635VOC Intermediate: Carboline Carboguard 635VOC Finish: Carboline Carboguard 635VOC	

3. Application
   a. Ductile or Cast-Iron Slide Gate Covers and Frames

2.5 CONCRETE FINISHES

A. Exterior Above Grade Concrete: Concrete surfaces exposed to view outside the building and including 6 inches below finished grade on the building or structure should be finished with a “Class B” finish. Products for the “Class B” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

B. Interior Exposed Above Floor Concrete: Interior above grade concrete shall be finished with a “Class B” finish. Products for the “Class B” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

C. Interior Concrete Floors: Interior concrete floors shall be finished with a “Trowel” finish. Products for the “Trowel” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

D. Exterior Concrete Flat Surfaces: Exterior concrete flat surfaces shall be finished with a “Broom” finish. Products for the “Broom” finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

PART 3 EXECUTION

3.1 GENERAL

A. The intention of this specification is for all new, interior and exterior, masonry, concrete, and metal, whether atmospheric or submerged exposure surfaces to be painted whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive a prime coat only unless modified herein.

B. Surface preparation and coating application shall be in accordance with these specifications and the coating manufacturer’s written product data sheets and written recommendations of the manufacturer’s technical representative. Where conflict occurs between the manufacturer’s recommendations and these specifications, the more stringent of the two shall apply unless approved by ENGINEER.

C. For immersion coatings, obtain full cure for completed system before immersing or allowing exposure to water of condensation for more than 12 hours.

3.2 REGULATORY REQUIREMENTS

A. Meet federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposures.

B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application, and dust prevention including but not limited to the following Acts, Regulations, Standards, and Guidelines:

1. Clean Air Act
2. National Ambient Air Quality Standard
3. Resource Conservation and Recovery Act (RCRA)
4. SSPC Guide 6

C. Comply with applicable federal, state, and local regulations for confined space entry.

D. Provide and operate equipment that meets explosion proof requirements.

3.3 ENVIRONMENTAL CONDITIONS

A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather. The Applicator shall adhere to the manufacturer’s recommendations regarding environmental conditions. The Applicator shall monitor humidity, air temperature, and surface temperature with properly calibrated instruments.

B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer’s recommendations.

C. Surface preparation power tools and blast equipment shall contain dust collection devices that will prevent discharge of dust particles into the atmosphere around electrical or mechanical equipment unless otherwise permitted by ENGINEER.

D. Where weather conditions or project requirement dictate, the Applicator shall provide and operate dehumidification equipment to maintain environmental conditions suitable for abrasive blasting and coating application as specified.

3.4 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating work.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the work shall be cleaned, repaired, and refinished to original condition.

3.5 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.6 SURFACE PREPARATION

A. All surfaces which receive paint or other coatings shall be prepared in accordance with the recommendations of the manufacturer of the material being used. The Applicator shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application.

B. Perform sandblasting for piping and any other items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, and procedures shall meet requirements of the Society for Protective Coatings (formerly the Steel Structures Painting Council).

3.7 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Surfaces that are not to receive coatings shall be protected during surface preparation, cleaning, and coating operations.

B. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

C. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

D. Protect working parts or mechanical and electrical equipment and motors from damage.

E. Care shall be exercised not to damage adjacent work during blasting operations. Spraying shall be conducted under carefully controlled conditions. CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blasting or coating operations.

3.8 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the the Society for Protective Coatings shall form a part of this specification:

1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. Surface Preparation of Concrete (SSPC-SP13): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.
9. Surface Preparation (SSPC-SP16): Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

3.9 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.

C. Round or chamfer all sharp edges and grind smooth burrs and surface defects and weld splatter prior to blast cleaning.

D. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

E. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

F. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

G. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 may be used as per manufacturers recommendations.

H. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning has been started.

I. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

J. Exposed ductile iron pipe shall be given a shop coat of rust-inhibitive primer conforming to these specifications. Abrasive blasting of the asphaltic coating on ductile iron pipe will not be allowed.

3.10 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by blast cleaning per SSPC SP16.

B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.11 CAST-IN-PLACE CONCRETE SURFACE PREPARATION

A. Concrete surfaces to receive protective coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise

finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.

B. All surfaces must be clean, dry and free of oil, grease and other contaminants, prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the corrosion protection lining system.

C. Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers, existing coatings, and other contaminants and to provide the recommended ICRI-CSP Profile.

D. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of sharp edges, ridges, form fins, and other concrete protrusions.

E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires topcoating within a specific period of time, the equipment shall be finish coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

D. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

E. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.

F. CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

3.13 APPLICATION

A. General

1. Schedule inspection with ENGINEER in advance for cleaned surfaces and all coats prior to each succeeding coat.
2. Apply coatings in accordance with the paint manufacturer’s recommendations and these specifications, whichever is more stringent. Allow sufficient time between coats to assure thorough drying of previously applied paint.
3. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
4. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
5. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
6. Non-buried steel piping shall be abrasive blast cleaned and primed before installation.
7. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.14 CURING OF COATINGS

A. CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air, if necessary, may be required until the coatings have fully cured.

3.15 SHOP AND FIELD OBSERVATION AND TESTING

A. CONTRACTOR shall give ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Observation by ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.

C. CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for ENGINEER's use while coating is being done, until final acceptance of such coatings. CONTRACTOR shall furnish the services of

a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of ENGINEER.

D. CONTRACTOR shall test for continuity (holiday test) all coated surfaces inside reservoirs, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturers' printed instructions and then be retested.

   1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
   2. Coatings with thickness of 20-mils or less total DFT: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.

E. On ferrous and non-ferrous the dry film coating thickness shall be measured in accordance with the SSPC PA 2 using a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

F. Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from SSPC and NACE, such as using NACE standards TM-01-70 and TM-01-75.

G. Visually inspect concrete, nonferrous metal, plastic, drywall, and wood surfaces to ensure proper and complete coverage has been attained.

3.16 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.

B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.

C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

D. Damages due to overspray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of CONTRACTOR.

3.17 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.

- END OF SECTION –

SECTION 09 98 10
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall apply external coating and internal lining on steel pipe, field coating of joints, and field repair of coating damage, complete and in place, in accordance with the specifications.

B. Buried steel pipe shall be mortar lined and dielectrically coated with mortar top coat. Use tape dielectric coating for pipe and specials except that on special, tees, wyes, and outlets, where dielectric coating shall be polyurethane.

C. Exposed steel pipe will be coated in accordance with Section 09 90 00 – Painting and Finishes, unless noted otherwise.

1.2 RELATED WORK

A. Related Work in other sections includes, but is not limit to:

1. Section 01 33 00 Submittal Procedures
2. Section 09 90 00 Painting and Finishes
3. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)
4. Section 33 12 00 Miscellaneous Appurtenances

1.3 REFERENCES AND STANDARDS

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

B. Occupation Safety and Health Act: State of Utah and Federal

C. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.
2. AWWA C209 Cold-Applied Tape Coating Systems for the Exterior of Special Sections, Connection, and Fittings for Steel Water Pipelines
3. AWWA C214 Tape Coating Systems for the Exterior of Steel Water Pipelines
4. AWWA C216 Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
5. AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
6. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

D. NATIONAL ASSOCIATION OF CORROSION ENGINEERS INTERNATIONAL (NACE)

1. NACE RP 274 High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

E. SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1. SSPC-SP-1 Solvent Cleaning Surface Preparation
2. SSPC-SP-2 Hand Tool Cleaning Surface Preparation
3. SSPC-SP-3 Power Tool Cleaning Surface Preparation
4. SSPC-SP-5 White Metal Abrasive Blast Surface Preparation
5. SSPC-SP-6 Commercial Abrasive Blast Surface Preparation
6. SSPC-SP-10 Near White Metal Abrasive Blast Surface Preparation
7. SSPC-SP-11 Power Tool to Bare Metal

1.4 SUBMITTALS

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

B. Submit catalog cuts and other manufacturer's performance information for products proposed that demonstrate compliance with the Specifications herein described. Provide a copy of approved coating system submittals to the coating applicator. Provide Paint System Data Sheets (PSDS) and/or Material Safety Data Sheets (MSDS) for coating and lining materials.

C. Quality Control Submittals: Applicator's experience with list of references substantiating compliance.

D. If the manufacturer of field-applied coating differs from that of the shop-applied primer, furnish written confirmation from both manufacturers that the 2 coating materials are compatible

1.5 QUALITY ASSURANCE

A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.

B. Coating applicator shall have a minimum of 2 years experience applying the specified coating system and the application supervisor (Certified Applicator) for the coating application personnel shall have a minimum of 5 years practical experience in application of the indicated products.

C. Coating and/or lining manufacturer technical representative shall be present for a minimum of 3 days to furnish technical assistance and instruction at the start of coating and/or lining operations within the shop and at the Site. During these visits, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

D. Coating and/or lining manufacturer shall furnish 8 hours per month of field or shop coating technical support if requested by ENGINEER.

E. Technical representative shall provide a written report to ENGINEER for each visit. Report shall include copies of test data collected, description of observations, and recommended corrective actions. Report shall be submitted within 10 working days after the visit. When deemed necessary by ENGINEER, work will not be permitted to proceed until the recommended corrective actions have been implemented. After corrective recommendations have been implemented; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.

F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance and to determine compliance with manufacturer's instructions, and as may be necessary, to resolve problems attributable to or associated with, manufacturer's products furnished for this project.

G. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.

H. CONTRACTOR shall notify OWNER and minimum of 14 days prior to the commencement of any work. CONTRACTOR shall provide the OWNER and/or ENGINEER with full access to facilities and application documentation. Observation by OWNER and/or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.6 DEFINITIONS

A. Manufacturer's Representative: Employee of coating manufacturer who is factory trained and knowledgeable in technical aspects of manufacturer's products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacturer is furnished stating the sales representative has full authority to act on behalf of the coating manufacturer.

1.7 ABBREVIATIONS

A. ANSI American National Standards Institute

B. AWWA American Water Works Association

C. MDFT Minimum Dry Film Thickness

D. Mil Thousandths of an Inch

E. OSHA Occupation Safety and Health Act

F. SSPC Society for Protective Coatings

1.8 SPECIAL WARRANTY REQUIREMENT

A. CONTRACTOR and coating applicator shall warrant the work under this Section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the pipeline.

B. This warrantee shall be in addition to the prime CONTRACTOR's warrantee that covers repair of all defective work, including linings and coatings.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather.

B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GENERAL

A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturers, and this Section, whichever is more stringent.

B. Pipeline coating or lining materials shall be the products of a single manufacturer. Product substitutions during the project will not be considered or permitted.

C. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.

D. Coatings and linings will be stored, handled and applied per the manufacturer's written directions.

2.2 SHOP-APPLIED (EXTERIOR) COATINGS

A. General. Buried steel pipe dielectric tape coatings shall comply with AWWA C214, and specials with outlets with AWWA C222. Mortar linings and coatings shall comply with AWWA C205 and mortar coatings shall be 1-inch thick. Extend dielectrically coatings 2-inches into vaults. End mortar coatings 3" outside vaults walls.

B. Polyethylene Tape Wrap

1. Steel pipe shall be coated with the following 80-mil (nominal) tape-coating system applied in accordance with AWWA C214 and this Section.

2. **Polyken YGIII** Tape Coating System:

a. Primer: **Polyken 1019, 1027, 1029**, or as recommended by the coating manufacturer.
b. Weld Stripe Tape: **Polyken 931** without 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.

3. Weld Preparation: Provide weld stripe tape or grind welds at pipe fabricator's option.

4. Steel Surface Preparation: SSPC-SP5, White Metal blast, 2.5-mils blast profile, minimum.

5. Tape Coating Requirements

    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 any time during the pipe fabrication, tape quality becomes inconsistent with a wider tape, OWNER may require the remainder of the pipe to be coated using the maximum indicated tape width.

C. Cement Mortar "Rock Shield" Top Coat:

1. Apply cement mortar "rock shield" coat over a tape wrap coating system on steel pipe and fittings in accordance with AWWA C205, except as modified herein.

2. Cement: Conform to ASTM C150, Type II or V.

3. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.

4. Cement mortar mixture shall consist of 1 part cement to not more than 3 parts aggregate.

5. 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.

6. Cement mortar coating: Nominal 1 inch thick coating with permitted tolerance of ±1/4 inch.

D. Plural Component Polyurethane may be used for pipes with outlets

1. General: Plural component, polyurethane coating system (referred to as a polyurethane system) shall be applied in accordance with AWWA C222 and as required herein.
2. Surface Preparation: SSPC-SP5, White Metal blast, 3.0-mil profile, minimum, or as required by the manufacturer, whichever is greater.
3. Coating: Self-priming, plural component, 100 percent solids, non-extended polyurethane, suitable for burial or immersion, and shall be one of the following products, or approved equal:

a. **Protec II by Futura Coatings**
b. **Durashield 210 by Lifelast, Inc.**
c. **Chemthane 2660 by Chemline, Inc**

4. Thickness: One coat, 35-mils total dry film thickness, minimum, or as required to meet the holiday and coating defects limits of this Section.
5. Holidays: Not to exceed an average of 1.5 holidays per 100 square feet of surface area per 100 square feet of surface area per joint of pipe. Two or more holidays separated by not more than 4 inches center to center will be counted as a single holiday.

E. Exterior Coating for Exposed Coating or Overcoat

1. All atmospherically exposed or vault piping shall be shop primed with the coating system as specified in Section 09 90 00 – Painting and Finishes.
2. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer as specified in Section 09 90 00 – Painting and Finishes. OWNER approval of a coating system with two or more coating manufacturer's will required written approval from all coating manufacturer's as to compatibility and acceptance under warranty.

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 shall conform to ASTM C150, Type II.
3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

2.4 SPECIALS, FITTINGS, AND CONNECTIONS

A. Coating and lining application for special sections, connections, and fittings shall conform to coating system and application requirements in this Section. Polyurethane is the only external coating system allowed for specials, fittings and pipes with outlets. Internal Mortar lining shall be applied to all specials, fittings and pipes with outlets. All specials, fittings and pipes with outlets shall also be shop-coated with a cement mortar "rock shield" coat.

B. Specials, fittings, and pipes with outlets shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes that require special fabrication that prevents mechanical production application of the indicated coating system from end to end of pipe joint as defined herein.

C. In addition to the items listed above as specials, the following items shall also be considered as specials: Pipe joints with pass through holes.

D. Hand-applied tape coatings will not be permitted on any specials, fittings, connections, pipes with outlets and elbow fittings.

E. Specials, fittings, connections and pipes with outlets shall be externally coated with the polyurethane coating system, applied from end to end of pipe joint.

2.5 FIELD JOINT (EXTERIOR) COATING

A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, except as modified herein.

B. Field joint coating shall be compatible with the shop-applied coating system and be provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.

C. Field joint coating materials shall be as follows or an equal.

1. Heat Shrink Sleeves
   a. Filler Material: Provide filler material for push-on, flange, and coupling type joints. Filler material shall adhere to pipe and heat shrink sleeves and shall not melt under joint welding temperatures. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.
   b. Joint Coating: Heat shrink, cross-linked polyolefin wrap or sleeve with an adhesive, backing and sleeve with a total of, 200-mils minimum thickness, suitable for pipeline operating temperature, as recommended by the manufacturer.
   c. Provide standard recovery sleeve for girth weld or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints, coupling style joints, and ductile iron pipe joints.
   d. 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.
   e. Consider sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of 2 or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without OWNER approval.
   f. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
2. Hand Applied Tape Wrap – Not Allowed.
3. Wax Tape Coating
   a. Wax tape coatings shall be limited to field application on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink or hand-applied tape wrap coating systems.
   b. Apply coating in accordance with AWWA C217, except as modified herein.
   c. Provide filler material to fill and smooth irregular surfaces, such that no tenting or voids remain under the applied wax tape.
   d. Protect coating from damage and provide special sand backfill to protect wax coating from damage.
   e. Coating System

1) Surface Preparation: SP3 Power Tool or SP11 Power Tool to Bare Metal.
2) Primer: Petroleum or petrolatum wax.
3) Filler Material: Filled petroleum or petrolatum wax.
4) Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40-mils thick.
5) Outer Wrap: PVC or tape suitable for application to inner tape.

f. Wax tape coating system shall be as manufactured by, or approved equal:
1) **Petrolatum Tapes by Denso North American**
2) **Wax-Tape by Trenton**

2.6 FIELD MORTAR LINING OF JOINTS

A. Surface preparation and field lining of pipe joints shall be with the same coating system as the shop-applied lining. Field application shall be performed by qualified personnel trained on the proper application of the coating system. Field coating application requirements shall be the same as the shop-applied coating requirements. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

B. Field mortar line joints after welding in accordance with AWWA C205, and the following.

C. Where larger pipe diameter allows, field mortar line joints by manually troweling joint from within pipe. Engineer may require video inspection of mortar lined joints if he can't manually inspect.

D. Where joints can't be manually troweled from inside pipe, line joints by ball swab as follows. At pipe laying startup, field demonstrate to Engineer, by video or inspection, at least one successful mortar lined joint before lining other joints.

1. Submit joint dimension showing limits of shop and field mortar linings. Field mark on spigot end the stab depth per shop drawings.
2. Mix "stiff" mortar: 1-part cement (Type II or Type V, per ASTM C150) to two parts sand with water to make a stiff mix of dry pack consistency.
3. Insert a tight-fitting ball swab or squeegee into spigot end of pipe in trench, and feed swab draw rope through the pipe to be laid.
4. Mortar line bell end of pipe (to be laid) with enough mortar to line the joint.
5. Place mortar lined bell over spigot. Tack weld top of bell to spigot at marked stab depth, then lower pipe into trench.
6. Draw ball swab through pipe removing excess mortar, then weld joint.
7. Let weld cool and apply shrink wrap coating.

E. Butt Strap Closures. Provide 6-inch diameter (shop mortar lined) flanged outlets on butt straps to field mortar line butt strap closures after welding.

1. Inspect lined butt strap and outlet and allow Engineer verify 3/8" min thick mortar lining covers all steel piping.
2. Shrink warp coat over butt straps field welds, then wax tape coat over 6-inch blind flange and butt strap until all field coatings overlap at least 4-inches (butt strap, outlet, flange, bolts, etc).

2.7 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. Major repairs on tape wrapped or Polyurethane coatings shall be repaired using heat shrink sleeves as indicated for field joint coating in accordance with AWWA C216, except as modified herein.
3. Minor repairs on tape wrapped pipe shall be with heat applied patches.
4. Coating repairs for polyurethane coating shall be as indicated herein.

B. Coating Repair Materials

1. Heat Shrink Sleeves (major repair)
   a. Filler Mastic: Provide mastic filler to fill tape void as required.
   b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness minimum, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a minimum of 3-inches overlap onto intact pipe coating.
   c. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
2. Heat-Applied Patches (minor repair)
   a. Heat applied adhesive, polyolefin-backed, mastic coated tape, 12-inches maximum size.
   b. Patch shall provide a minimum of 2-inches overlap onto intact pipe coating.
   c. Manufacturers: **CRP patch by Canusa, PERP patch Berry CPG**, or approved equal.

C. Polyurethane Coating

1. Polyurethane coating system repair shall be in accordance with the coating manufacturer's recommended procedures.
2. Pinhole holidays or adhesion test coating repairs shall be with same coating material as for minor repairs or melt stick repairs such as **3M Reactive Adhesive** or **Canusa Melt Stick**.
3. Coating material for minor repairs shall be single use kits using syringes or other mix ratio controlled packages of slow set polyurethane coating material similar to the existing coating
4. Major repairs will be completed using the same coating material as used for the coating. Surface and adjacent coating shall be abrasively blasted to meet the original coating specifications and to properly roughen the adjacent coating. Coating shall be reapplied using plural component spray equipment by a manufacturer-certified coating applicator.

D. Exposed Pipe Coating System

1. Touch-up repair all damage to primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 90 00 – Painting and Finishes.

PART 3 EXECUTION

3.1 ENVIRONMENTAL LIMITATIONS

A. General

1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
4. Do not apply coatings when:
   a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications.
   b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
   c. When it is expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
   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 indicated and in accordance with the manufacturer's coating application recommendations.
6. Work activities may be restricted until adequate temperature and humidity controls are in place and functioning within the environmental limits given.
7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test, and other parameters applicable to the type of coating.

B. Temperature Control

1. In cold weather or if moisture collects on the pipe, if the temperature of the pipe is less than 45 deg F, preheat the pipe to a temperature of 50 deg F or 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturer's recommended application temperatures, CONTRACTOR shall provide temperature controls as necessary to permit the work to proceed within the manufacturer’s temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect propane fired heaters that do not increase humidity levels within the working area. Heaters shall be sized for the area to be heated.

C. Dehumidification

1. CONTRACTOR shall provide dehumidification equipment when necessary for shop or field environmental control during surface preparation and/or coating application. Dehumidification equipment shall be properly sized to maintain dew point temperature 5 degrees or more below surface temperature of metal surfaces to be cleaned and coated.
2. Cleaned metal surfaces shall be prevented from flash rusting throughout the project duration; condensation or icing shall be prevented throughout surface preparation and coating application.
3. Equipment size and power requirements shall be designed by personnel trained in the operation and setup of dehumidification equipment based on project requirements and anticipated weather conditions.
4. Dehumidification equipment shall operate 24 hours per day and continuously throughout surface preparation and coating application.
5. CONTRACTOR shall use personnel properly trained in the operation and maintenance of the dehumidification equipment or provided adequate training by the dehumidification equipment supplier.
6. Daily maintenance requirements of the equipment shall be documented in writing and posted near the equipment for review if required by ENGINEER.
7. Re-blasting of flash rusted metal surfaces or removal of damaged coatings because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of CONTRACTOR.

3.2 OBSERVATION OF WORK

A. CONTRACTOR shall give ENGINEER a minimum of 14 days advance notice of the start of any coating work to allow scheduling for shop or field observation. Notify ENGINEER a minimum 3 days in advance of actual start of surface preparation and coating application Work.

1. Provisions shall be made to allow ENGINEER full access to facilities and appropriate documentation regarding coating application.
2. Observation by ENGINEER or the waiver of observation of any particular portion of the coating work shall not be construed to relieve CONTRACTOR of responsibility to perform the coating in accordance with these Specifications.
3. Materials shall be subject to observation for suitability as ENGINEER may determine, prior to or during incorporation into the work.

3.3 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
4. Protect prepared pipe from humidity, moisture, and rain. Flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.
5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

1. Application
   a. Spray applied coating systems do not require weld grinding.
   b. Grind welds on tape wrap coated pipe or apply weld stripe tape over the weld, at the pipe fabricator's option, unless otherwise indicated.
2. Weld Grinding: Under the weld grinding option, welds taller than 3/32-inch above pipe surface shall be ground to a tolerance of +3/32-inch to zero-inches above the pipe surface as measured on the highest side of the weld.
3. Weld Stripe Tape
   a. Weld stripe tape shall be applied to primed metal.
   b. Tape shall either have no polyethylene backing or be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.
   c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
   d. Adhesion of the weld stripe tape shall be the same as for the coating system.

C. Steel Surface Preparation

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness appropriate to the coating system to be applied.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion required.

3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
4. Preparation of the steel pipe for the Polyurethane coating system shall have a sharp angular surface profile of the minimum depth indicated.
5. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
6. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the required metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at ENGINEER'S sole discretion.

3.4 SHOP-APPLIED COATING SYSTEMS

A. Tape Wrap Coating

1. Applicator shall use 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 to; pipe temperature, line speed, primer and tape roll body temperature, and tape tension.
   a. Pipe surface temperature shall be between 45 and 120 degrees and 5 degrees above dew point, whichever is greater.
   b. 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.
2. 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.

3. If welds are not ground flush, apply a weld stripe tape to longitudinal or spiral pipe welds prior to application of the inner wrap.
4. 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.
    a. 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.
5. Tape coating adhesion testing shall be performed on the pipe per this Section.
6. Holidays testing shall be conducted on the inner layer tape prior to proceeding with subsequent tape layers. Holidays shall be primed and patched using coating repair procedures herein.
7. Perform coating and lining repairs per this Section.

B. Polyurethane Coating or Lining

1. Applicator Qualifications
    a. Equipment shall 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 coating manufacturer and 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 2 years. The application supervisor (certified applicator) shall be present during all coating application Work and shall have responsibility for controlling all aspects of the coating application.
2. Coating manufacturer shall provide to 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 rejecting the applied coating. Rejected coating shall be removed to bare metal and reapplied using proper application methods in accordance with the quality assurance manual and this Section.
3. Pipe surface temperature shall be between 50 and 100 degrees and 5 degrees above dew point, whichever is greater.
4. 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.
5. Coating applied under improper environmental conditions will be rejected. Such coatings shall be removed to bare metal and reapplied under proper environmental conditions.
6. Coating adhesion and holidays testing shall be tested per this Section.
7. Perform coating and lining repairs per this Section.

C. Cement Mortar and Overcoat Coatings

1. Steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
2. Dielectrically coated steel pipe, when specifically required, shall have a cement overcoat (rock shield) applied over the dielectric pipe coating in accordance with AWWA C205, except as modified herein.
3. Cement Mortar Coating:
    a. Reinforcement:
        1) For pipe and specials smaller than 48-inches in diameter, reinforce coating with spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
        2) For pipe and specials 48-inches in diameter and larger, reinforce coating with 2 layers of spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
        3) Lap ends of reinforcement strips 4-inches and tie or loop free ends to assure continuity of reinforcement.
        4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electric isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
    b. Specials Fittings:
        1) Special fittings shall be polyurethane coated as specified.
    c. Coating Defects:
        1) Coating defects shall be repaired as specified in AWWA C205, except as modified herein.
4. 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. Holdback shall be increased with extruded polyethylene coating as required to maintain the minimum overlap specified for joint coating application, where specifically required to be cement mortar overcoated.
    c. Coating Defects:
        1) Cracking in the mortar “rock shield” coating 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 AWWA C205.

3.5 EXTERIOR COATING HOLDBACK

A. Coating holdbacks shall be straight and cut through the full thickness of the coating.

B. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer’s recommendations and these requirements.

C. Holdbacks shall be as required for proper jointing of pipe, considering joint welding requirements, and be as follows:

Tape wrap coating	
Push-on joint, spigot	4-inches, minimum
Push-on, bell	Flush with bell end
Welded, spigot	3-inches, minimum
Welded, Bell	4-inches, minimum
Polyurethane coating	
Push-on joint, spigot	Flush with spigot end
Push-on, bell	Flush with bell end
Welded, spigot	3-inches, minimum
Welded, Bell	4-inches, minimum

D. Holdback Corrosion Protection

1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the joint coating system, shall prevent corrosion of prepared pipe ends for duration of storage and construction, and be recommended for buried exposures.
2. Primer shall be compatible with welding operations and shall not result in running or melting of the coating during welding operations.
3. Application and thickness of holding primer shall be in accordance with the primer manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
4. Any corroding holdback areas shall be abrasively blasted to SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.6 PIPE LINING APPLICATION

A. Shop-Applied Cement Mortar Lining

1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	Lining Thickness, Inches	Tolerances, Inches
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
   a. Steel plate specials larger than 16-inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gauge welded steel wire mesh.
   b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
   c. Tightly close ends of pipe and fittings with plastic sheet caps within 30 minutes of lining application. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
   d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications.
   e. Other requirements of mortar lining materials and processes are in AWWA C205.

B. Field Mortar Lining of Steel Pipe Joints (Shop lined Steel Pipe)

1. Comply with all project specifications, AWWA C 205, and the following.
2. For steel pipe that is shop mortar lined: Field trowel on mortar from inside pipe if diameter allows (i.e., for pipes 24-inch and larger). ENGINEER may require a video inspection on 24-inch diameter steel pipe if it can't be manually inspected.
3. For 24-inch and smaller steel pipe: video inspect (by robotic camera) mortar lined joints not inspected manually. Video inspect pipes every 500 feet (and within reach limit of robotic camera) and obtain ENGINEER acceptance before continuing pipe assembly.
4. For 24-inch and smaller steel pipe, field mortar line joints by ball swab as follows. At startup, field demonstrate to ENGINEER, by video or inspection, at least one successful mortar lined joint before lining other joints.
   a. Submit steel pipe with shop mortar lining extending to butt end of spigot.
   b. Mix "Stiff Mortar": One-part cement (Type II or Type V, per ASTMC150) to two parts sand with water to make a stiff mix of dry pack consistency.
   c. Insert a tight-fitting ball swab or squeegee in spigot end of pipe in trench.
   d. Mortar line butt end of shop mortar on spigot and bell ends of the two pipes being joined. Use enough mortar to fill the space between pipes.
   e. Install next pipe joint with 2-inch min joint lap. Tack weld bell end to pipe spigot in trench. Lower and secure the next pipe in place, then draw the ball swab (or squeegee) through the pipe layed to remove excess mortar. Do not move pipe after pulling ball swab.

f. For pipes with field welded joints, let mortar cure 4 hours min, then weld the outside of bell to spigot. During welding, limit heat input to minimize cracking of mortar lining. Note when water is introduced into the finished pipe, that mortar linings swell and weld cracks heal.
g. Then apply joint coatings.

5. Mortar line butt straps (i.e., closure joints) for pipes under 24-inch diameter. Show ENGINEER one successful mortar lined threaded port (on a butt strap) before mortar lining other ports. Use tack welded project pipe to demonstrate threaded port lining.
   a. Provide butt strap with one or two "weldable" 5-inch threaded ports to allow arm-troweling mortar lining of butt strap.
   b. Weld butt strap.
   c. Trowel line with "stiff mortar" (described above) butt strap interior except for 5-inch port(s).
   d. Mix "sticky mortar": One-part cement (Type II or Type V, per ASTM C150) to one-part sand (ie double cement content) and enough water to make a sticky mix that holds shape for a few minutes in a 3/4-inch cantilevered ring.
   e. Apply sticky mortar 3/4-inch thick to back of 5-inch threaded plug.
   f. Build "lips" of sticky mortar 3/4-inch into all sides of threaded port.
   g. Thread on the plug; visually checking that sticky mortar on port and plug contact each other as the threading begins.
   h. Allow 4 hours to cure, then 1/4-inch seal weld (fillet or groove) full perimeter of threaded port/plug. Then apply joint coatings.

3.7 FIELD COATING JOINTS

A. General

1. Remove oil or grease contamination by solvent wiping the pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
2. Clean pipe surface and adjacent coating of mud, rust, and other foreign contaminates in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasively field blast joints in accordance with SSPC-SP10, near white blast, that exhibit any surface rust. Clean the full circumference of the pipe and a minimum of 6-inches onto the existing coating.
3. Remove loose or damaged pipe coating at joint and either repair the coating or increase the length of the joint coating, where reasonable and practical.
4. On non-welded joints, including buried connections to valves and couplings, complete joint bonding (where shown) of pipe joints before application of joint coating. Joint bonds shall be installed per Section 26 42 10 – Galvanic Cathodic Protection. Joint bonds shall be low profile bonds, and gaps and crevices around the bonds shall be filled with mastic sealant.
5. CONTRACTOR shall electrically test completed joint coating for holidays with high voltage spark tester.

B. Post-Welding of Joints:

1. Post-welded joints are defined as welded pipe joints that are coated prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:
   a. Joint coating shall be heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.

b. Provide 6-inch wide non-shrinking layer centered over the interior weld location, such as **CRP patch by Canusa or PERP by Berry CPG** patch materials. Heat resistant tape will not be acceptable.
c. Finished external joint coatings shall be fully buried with a minimum of 12-inches of soil cover, prior to any interior welding.

3. CONTRACTOR shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first 2 post-welded joints for inspection of the coating condition. Up to 3 additional post-welded joints for excavation by CONTRACTOR will be selected for inspection of joint coating condition.
4. Any damage to the external joint coating system will require CONTRACTOR to modify welding methods and or coating materials until a non-damaged system is attainable. All weld damaged joint coatings shall be removed and replaced with the new suitable system.

C. Heat Shrink Sleeve Joint Coating

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.
2. Store sleeves in shipping box until use. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees F as recommended by the sleeve manufacturer.
3. Metal pipe surface shall be free of dirt, dust, and flash rusting prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations. At a minimum, surfaces shall be prepared by abrasive blasting to SSPC-SP10 or by power tool cleaning to bare metal in accordance with SSPC-SP11.
4. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
5. Fill cracks, crevices, gaps, and step-downs greater than 1/4- inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.
6. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees F and while maintaining the pipe temperature above the preheat temperature above. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2 inch overlap onto the existing pipe coating.
7. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no wrinkling or excessive burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated. Minor coating repairs may be made using heat applied patch material indicated.

8. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.
9. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.
10. 10. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and CONTRACTOR shall remove and recoat the joint.

D. Cement Mortar Coating

1. If pipe zone is CLSM or UDOT Rapid Set Flow Fill, then no cement mortar coating is required over dieletric coated pipe joints (ie shrink sleeve or wax tape coated joints).
2. Field repair cement mortar coating in accordance with AWWA C205.
3. Joint Diapers
   a. Polyethylene Foam:
      1) Cut into strips wide enough to match uncoated field joint area.
      2) Slit to thickness of 1/4-inch that will expose a hollow or open cell surface on one side.
      3) Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
      4) Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
      5) Splices to provide continuity of material will be permitted.
      6) Protect polyethylene foam material from direct sunlight.

3.8 REPAIR OF COATING AND LININGS

A. General

1. Areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
2. Maximum defects allowable shall be as indicated for the coating system.

B. Tape Wrap Coating Repairs

1. General
   a. No more than 5 repairs per joint of pipe will be permitted with tape wrap coating, excluding adhesion test damage. The coating on any pipe with more than 5 coating repairs or with more than 2 areas of coating damage greater than 5 square feet will be rejected.
   b. Pipes exceeding the maximum number or size of coating defects shall be stripped, reblasted, and recoated at the CONTRACTOR's expense.
   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 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 are 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 - repairs that are less than 6-inches in the greatest dimension, measured after cutout of damaged tape layers. Damage to the inner tape layer will be considered minor only if repairs are made using heat-applied patch materials.
   b. Major repairs - repairs that exceed 6-inches in the greatest dimension or where damage to the inner tape layer has occurred.
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 one-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 one-inch or more of the underlying tape layer for the circumference of the repair.

4. Major Repairs
   a. Coating repairs shall be with heat shrink sleeves as indicated 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 holidays and retest for holidays.
   d. Cut middle and outer layers in stepped fashion to expose one-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.

C. Polyurethane Coating or Lining Repairs

1. General
   a. Complete coating repairs in accordance with the coating manufacturer's written instructions and these Specifications, whichever is stricter.
   b. Major repairs shall not exceed 2 per pipe joint and the combined area shall not be greater than 50 percent of the pipe.
   c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated at the CONTRACTOR’s expense.
   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 CONTRACTOR’s expense.
2. Defect Size
   a. Minor repairs - repairs that are less than 4-inches in the greatest dimension.
   b. Major repairs - repairs that exceed 4-inches in the greatest dimension.
3. Maximum Quantity of Defects Allowed:
   a. Minor coating 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 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 shall be repaired using coating repair kits.
   a. 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.

b. Shop Repairs
    1) Slow setting parent material polyurethane coating material in syringes or other single use packaging that controls mix ratio.
    2) Coating manufacturer's polyurethane coating repair products subject to ENGINEER'S approval.
c. Field Repairs
    1) Melt stick coating repair (not acceptable for repairs greater than one-inch diameter); **Scotchkote P206, Canusa Melt Stick**, or approved equal.
    2) Heat-applied coating materials; **CRP Patch by Canusa; PERP Patch by Berry CPG, Tyco Adhesives**, or approved equal.
    3) Coating manufacturer's polyurethane coating repair products subject to ENGINEER'S approval.
    4) Apply a single coat of the patch coating material at the indicated coating thickness.
    5) Repairs adhesion shall be at least 50 percent of the indicated coating adhesion.
d. Major Repairs:
    1) Surface Preparation: The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or equal in cleanliness and profile as the original surface. Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.
    2) Shop Repairs: Same material as the pipeline coating and shall be applied by using plural component spray equipment.
    3) Field Repairs: Same material as the pipeline coating and shall be applied by using plural component spray equipment, Heat shrink sleeves as for pipeline joints. The metal surface and surrounding coating shall be re-blasted to equal cleanliness and profile as the original surface preparation. Existing coating shall be feathered and roughened to the equivalent of coarse sandpaper by abrasive blasting.
e. One coat of the original coating material shall be applied over the repaired surface at the indicated thickness.
f. Repair adhesion shall be equal to the indicated coating adhesion.

D. Cement Mortar Coating

1. Cement mortar coating that is cracked or disbanded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
2. Disbonded mortar coating shall be removed and patched.
3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
4. Cracks in mortar coating shall be repaired in accordance with AWWA C205.

3.9 INSPECTION AND TESTING

A. Inspection

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this Specification.

3. CONTRACTOR will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining.

B. Adhesion Testing, General

1. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of CONTRACTOR.
2. A minimum of 2 pipes will be tested for adhesion from each lot of pipe coated up to 4,000 square feet of pipe. An additional adhesion test will be conducted on every increment up to 3,000 square feet of pipe coated in excess of the first 4,000 square feet of pipe. (i.e., if one workday of production is 8,000 square feet of pipe, 4 adhesion tests will be conducted on the pipe lot.

3. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.
4. The pipe coating applicator shall repair coating damage from adhesion testing.
5. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criterion and the test was requested by the pipe fabricator.
6. Pipe will be randomly selected for adhesion testing.
7. If any pipe tested fails the adhesion test, all pipes within the lot will be rejected. Each pipe within the rejected pipe lot will then be individually tested for adhesion and accepted or rejected on a pipe-by-pipe basis.
8. Rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.

C. Adhesion Testing, Tape Wrap

1. Inner tape coating shall have an adhesion of 20 pounds per inch width on steel pipe or 15 pounds per inch width on ductile iron pipe, minimum, when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
2. Adhesion tests shall be conducted at temperatures above 60 degrees F and less than 80 degrees F.
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. The pull tension shall be recorded for each inch of pull. The 2 highest and 2 lowest readings shall be discarded and the remaining values averaged. Pull speed shall be not less than 5 seconds per inch nor greater than 10 seconds per inch. If elongation of the tape backing occurs, pull speeds may be exceed 10 seconds per inch provided the minimum adhesion rating can still be achieved.
5. 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. Intermittent skip failures will be counted as zero pounds of adhesion and included in the calculations for average coating adhesion. Adhesive failure, defined as separation of the adhesive from the metal substrate, will be rejected.
6. Pipe that fails the test by delamination will be retested on 2 other pipes within the same lot of coated pipe. Failure of any 2 pipes within the lot will result in rejection of all pipes coated with the rejected tape lot.

D. Adhesion Testing, Polyurethane

1. Polyurethane coatings shall have an adhesion to steel of 1,750 pounds per square inch, minimum.
2. Polyurethane coating adhesion to steel substrates shall be tested using pneumatic pull off equipment in accordance with ASTM D 4541 and AWWA C222, except as modified in this Section.
3. Adhesion testing records shall include pipe identification, surface tested (interior or exterior), surface temperature, coating thickness, tensile force applied, mode of failure, and percentage of substrate failure relative of dolly surface.
4. Dollies for adhesion testing shall be glued to the coating surface and allowed to cure for a minimum of 12 hours. Because of high cohesive strength, polyurethane coatings shall be scored around the dolly prior to conducting the adhesion test.

5. Failure shall be by adhesive and cohesive failure only. Adhesive failure is defined as separation of the coating from the steel substrate. Cohesive failure is defined as failure within the coating, resulting in coating remaining both on the steel substrate and dolly.
6. Partial substrate and glue failures will be retested if the substrate failure is less than 50 percent relative of the dolly surface area and the applied tension was less than the adhesion criterion. Pipes that have partial substrate failures greater than 50 percent and less than the required adhesion will be rejected as a substrate adhesion failure.
7. Glue failures in excess of the minimum required tensile adhesion would be accepted as meeting the adhesion requirements.
8. Adhesion tests will be conducted all polyurethane pipe coating.
9. 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 indicated for the type of repair.

E. 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 tests on polyurethane coatings shall be conducted on the completed coating after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE Standard RP 0274 and these specifications.
3. Coating thickness used for holiday testing shall be the minimum coating thickness.
4. Dry Film Thickness Testing

    a. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
    b. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

3.10 HANDLING, TRANSPORTATION, AND STORAGE

A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.

B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.

C. During coating application, storage, loading, and transportation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have load-bearing surfaces padded with suitable material. Lift pipe with web slings a minimum of 12-inches wide and of a type that will not damage the coating. Metal chains, cables, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12-inches wide, minimum. Pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the Site and from the storage yard to the point of installation.

E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at contact points.

F. Pipe shall be inspected by CONTRACTOR at the Site for damage. Any damage to the pipe, lining, or coating shall be repaired if a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense of CONTRACTOR.

G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workers shall not be permitted to walk on the coating except when absolutely necessary. When required, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.

H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for length of above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required shall depend on the project location, laying schedule, anticipated length of exposure, and type of outer wrap. Coating manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of CONTRACTOR.

I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and to remain firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.

J. Bracing

1. The manufacturer shall install adequate bracing or strutting to keep the pipe from becoming deformed or damage from occurring to the coating or linings. Strut-type bracing shall be installed as soon as possible after application of lining. Struts shall remain in place during handling, storage, transportation, and installation of pipe and fittings until after the pipe zone material is compacted. Adequate strutting shall be provided by pipe manufacturer, so that after completion of backfilling, pipe deflection

or elongation shall not exceed one percent of the nominal inside diameter of cement-mortar-lined pipe.

2. The minimum bracing shall consist of crossed struts (horizontal and vertical). The maximum spacing along the pipe shall be near each end and at the one-third points for each 48-foot section of pipe, with a minimum of 4 sets of struts per 48-foot section of pipe. Random lengths of pipe shall have an equivalent number of sets of struts, with a minimum of one set of struts in a 10-foot section of pipe
3. The struts shall be installed with pads and wedges in such a manner that the pipe lining will not be damaged and the struts will not be dislodged during shipping and handling of the pipe. If struts are welded, they shall be installed and removed in such a manner to prevent damage to the steel cylinder, lining, or coatings. Damage shall be repaired to the satisfaction of ENGINEER.

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SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. It is the intent of this part of the Contract Documents to cover all Work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified.

1.2 GENERAL PROVISIONS

A. Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the Work.

B. All Work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.

C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of ENGINEER for a decision.

D. The alignment of equipment and conduit shall be varied due to architectural changes, or to avoid work of other trades, without extra expense to OWNER.

E. CONTRACTOR shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.

F. All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted Shop Drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

G. CONTRACTOR shall lay out and install electrical work prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.

H. CONTRACTOR shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, etc. are improperly placed or installed, CONTRACTOR shall do all necessary work, at his own expense, to rectify the errors.

I. All electrical equipment shall be capable of operating successfully at full-rated load,

without failure, at an ambient air temperature of 40 degrees C, and specifically rated for an altitude of 4500 feet.

J. CONTRACTOR shall submit Shop Drawings, data and details to ENGINEER on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.

K. All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacture, and of highest grade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

1.3 REGULATIONS AND CODES

A. Electrical Work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of each of the following as well as all State and local codes.

1. NATIONAL ELECTRICAL CODE (NEC)
2. NATIONAL ELECTRICAL SAFETY CODE (NESC)
3. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
4. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
5. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
6. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
7. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
8. NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
9. FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
10. UNDERWRITERS' LABORATORIES, INC. (UL).

1.4 COORDINATION OF THE ELECTRICAL SYSTEM

A. CONTRACTOR shall verify all actual equipment and motor full-load and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If CONTRACTOR furnishes equipment of different ratings, CONTRACTOR shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full-load and rated voltage.

1.5 TEST

A. The electrical Work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness

of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans or accepted Drawings shall be corrected and indicated on the Plans.

1.6 CONFORMS TO RECORD DOCUMENTS DRAWINGS

A. Prior to completion of the Contract, CONTRACTOR shall furnish ENGINEER with a set of Electrical Plans marked with any changes, deviations or additions to any part of the electrical work.

B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the Record Documents Drawings to enable rapid and accurate circuit tracing by maintenance personnel.

1.7 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Where indicated on the Plans and where required by applicable codes, CONTRACTOR shall furnish and install nameplates which shall be black lamicoid with white letters. The nameplates shall be fastened to the various devices with round head stainless steel screws. Each disconnect means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose. All nameplates shall have 3/8-inch high lettering.

PART 3 EXECUTION - Not Used

- END OF SECTION -

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SECTION 26 05 05
ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes general electrical equipment used to complete the electrical system.

1.2 RELATED WORK

A. Related Work specified in other Sections:

1. Section 01 33 00 Submittal Procedures
2. Section 26 05 00 Electrical General Requirements
3. Section 26 05 13 Conductors and Cables
4. Section 26 05 33 Raceway

1.3 SUBMITTALS

A. Submittals will be required for all electrical equipment and shall be made in accordance with Section 01 33 00 Submittal Procedures.

PART 2 MATERIALS

2.1 LIGHTING SWITCHES

A. Manufacturers:

1. Hubbell 1221I (ivory), 1221W (white)
2. P&S 20AC1I (ivory), 20AC1W (white)
3. Leviton 1221-2I (ivory), 1221-2W (white)
4. Or approved equal

B. Industrial Extra Heavy-Duty Specification Grade: Snap switches shall have the number of poles as indicated on the Drawings, [ivory] [white], rated at 20 ampere.

C. Device Cover Plates:
1. Vault Areas: Stainless steel cover plates shall be utilized.

2.2 RECEPTACLES

A. Manufacturers:

1. Hubbell No. IG5352I (ivory), IG5352W (white)
2. P&S No. 5362-I (ivory), 5352-W (white)
3. Leviton No. 8300-I (ivory), 8300-W (white)
4. Or approved equal

B. Special receptacles, covers, etc. shall be as specified herein or as indicated on the Plans.

C. Device Cover Plates:
   1. Vault: Stainless steel cover plates shall be utilized.

D. Ground Fault Interrupter Receptacles (GFI): GFI outlets shall be duplex ivory GFI receptacles, 2-pole, 3-wire grounded, 125 volts AC, rated at 20 amperes.

   1. Manufacturers:
      a. Hubbell No. GF5262I
      b. General Electric
      c. P&S 2091-I
      d. Leviton 5362-IGI
      e. Or approved equal.

2.3 ENCLOSURES

A. Manufacturers:

   1. Hammond
   2. Hoffman
   3. Rittal
   4. Or approved equal.

B. This Specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. For Vault, contractor shall provide NEMA 4X fiberglass enclosure with hinged cover and quick release latches. Enclosure shall be supplied with internal panel.

C. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.

D. PILOT DEVICES:

   1. Manufacturers:
      a. Allen-Bradley, Bulletin 800T, 30 mm
      b. C3 Controls
      c. Eaton
      d. General Electric
      e. Square D, Type K, 30 mm - Class 9001
      f. Or equal.
   2. Indicating lights, pushbuttons and selector switches shall be miniature oiltight units. Contact blocks in control circuits shall be NEMA ICS, B150, rated 5 amperes inductive at 120 volts AC. Contact blocks for signal circuits shall be rated 0.06 amperes at 30 volts AC or DC and shall

be hermetically sealed and reed switches. Pilot lights for 120 volt AC circuits shall be LED type. Pilot lights for 24 volt circuits shall be rated 28 volts. Where group lamp test circuits are not specified, individual pilot light assemblies shall be "push-to-test" type. Pilot lights shall be capable of being changed from the front of the panel without special tools.

E. TERMINAL BLOCKS:

1. Manufacturers:
   a. Allen-Bradley
   b. Buchanan
   c. Eaton
   d. Entrelec (ABB) M4/6
   e. Phoenix Contact
   f. Square D Co.
   g. Weidmuller, Z Series
   h. Or equal.
2. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.
3. Provide only screw type terminals.

F. CIRCUIT BREAKERS:

1. Manufacturer/Model
   a. Phoenix Contact TMC Series
   b. Eaton FAZ Series
   c. Approved equal
2. Provide DIN rail mounted circuit breakers. Ratings shall be determined by contractor as required or as shown on the drawings.

G. FUSE BLOCKS:

1. Manufacturers:
   a. Entrelec (ABB), M10/13.SF2
   b. Or approved equal.
2. DIN rail mounted.
3. Terminals shall accommodate 22-10 AWG solid or stranded wires.
4. Provide terminals rated for 600 VAC/VDC and 15 amperes.
5. Device shall be UL listed.

H. 24 HOUR TIME SWITCH:

1. Manufacturer/Model
   a. Tork/800 Series, 8009A
   b. No equal.
2. Description: Many daily on/off operations per day.
3. Electrical: Input Supply - 120 VAC, 60 Hz., 3 watts
4. Output Contacts: SPDT
5. Scheduling:
   a. Minimum ON setting 15 minutes

b. Minimum OFF setting 15 minutes.
c. Dial has 96 captive tabs.

6. Duty Cycle: ½, 1, 2, 3, 4, 6, 12 and 24 hours.
7. Environmental:
   a. Operating Temperature: -40-deg F to 165-deg F
   b. Enclosure: lockable hasp.

2.4 LIGHTING

A. Lighting fixtures shall be as described below and as indicated on the Plans.

B. Fixtures shall include lamps, ballasts, poles, mounting hardware, etc. to provide complete operating units.

C. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens shall be submitted to the ENGINEER for review and acceptance for all fixtures before fixtures are manufactured. Substitutions will be permitted only if acceptable to the ENGINEER.

D. Light Emitting Diode(LED) Lighting

1. The LED Fixture shall consist of a LED Luminaire Assembly, LED Driver and mounting hardware.
2. LED Fixture requirements are as described below:
   a. The input to the LED Lighting Fixture shall be 120 to 277VAC (±10%), 60HZ or as indicated in the Contract Document.
   b. Correlated Color Temperature (CCT) shall be minimum 4000K or as indicated in the Contract Document.
   c. Color Rendering Index (CRI) shall be 70.
   d. A minimum of 50,000 operating hours before reaching the L70 lumen output degradations point without catastrophic failure, or as indicated in the Contract Document.
   e. Conform with UL 8750.
   f. Compliance to FCC CFR Section 15.
3. LED Luminaire Assembly
   a. Definition: Luminaire Assembly is the LED assembly without LED driver.
   b. Input voltage shall be 24VDC, 36VDC or as indicated in the Contract Document.
   c. CCT, CRI, Minimum life and UL conformity requirements are as defined in above.
4. LED Driver
   a. Must operate input voltage between 120VAC to 277VAC (±10%).
   b. Operating frequency must be 60Hz.
   c. Must be rated to operate between -40ºC to +50ºC.
   d. Must have a minimum efficiency of 85%.
   e. Self protected including short circuit protection.
   f. Compliance to FCC CFR Section 15.
   g. Driver must have a Power Factor (PF) of 0.90.

E. Types and ratings: As shown on "Lighting Fixture Schedule" on Drawings.

2.5 CONTROL PANELS

A. ENCLOSURES

1. Manufacturers:
   a. Hammond Manufacturing
   b. Hoffman
   c. Rittal
   d. Saginaw Control & Engineering (SCE)
   e. Or approved equal.
2. This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 4X for outdoor installations.
3. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be stainless steel.
4. Enclosures shall be from fiberglass. Doors shall have fiberglass hinges with quick opening latches.

2.6 PROCESS SWITCHES

A. LEVEL SWITCH - FLOAT

1. Manufacturer/Model:
   a. IMO Industries, Inc. Gems Sensors Division, LS-270.
   b. Or approved equal.
2. Stem: 316 Stainless steel
3. Float: Buna N
4. Operating Temperature:
   a. Water: to 180-degrees F.
5. Minimum Liquid Specific Gravity: .65
6. Pressure (MAX): 150 PSI
7. Switch Rating: 20 VA
8. Electrical Termination: No. 22 AWG, 24-inches long, Polymeric Lead Wires.
9. Selectable Normally Open (NO) or Normally Closed (NC) by inverting float on unit stem.

PART 3 INSTALLATION

A. Installation shall be as per manufacturers specifications.

- END OF SECTION -

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SECTION 26 05 13
CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of wires or cables required for power distribution, service, feeders, and branch circuits.

1.2 RELATED WORK

A. Related Work specified in other Sections:

1. Section 26 05 05 Electrical Equipment
2. Section 26 05 33 Raceway
3. Section 25 05 34 Electrical Boxes and Fittings
4. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

A. NFPA 70: National Electrical Code.

B. UL: Underwriters' Laboratories, Inc.

1.4 SUBMITTALS

A. Field Test Data: Submit megohmmeter test data for circuits under 600 volts.

PART 2 PRODUCTS

2.1 MATERIALS

A. Building Conductors: Copper, 600 Volt insulation, THW.

B. Branch Circuit Conductors and All Conductors #3 AWG and Smaller: Copper conductor, with TW, THHN, or THWN insulation #10 AWG and smaller, and THW larger than #10 AWG, where ambient temperature conditions exceed 140 degrees F.

1. Size all conductors per NFPA 70.
2. Minimum size to be #12 AWG.
3. All conductors shall be stranded.
4. For outlets to fixtures, and in fixture channels (in dry areas); THHN insulated conductor.
5. In damp locations, under slabs, on exterior provide THWN.

C. Provide permanent plastic name-tag indicating load feed.

D. Use type XHHW conductors for water pumping and vaults.

E. Cable Supports: OZ cable supports for vertical risers, type as required by application.

2.2 COLOR AND CODING OF CONDUCTORS

A. 120/240 volt.

1. A-Phase - Black
2. B-Phase - Red
3. Neutral - White
4. Ground - Green

B. 208Y/120 volt.

1. A-Phase - Black
2. B-Phase - Red
3. C-Phase - Blue
4. Neutral - White
5. Ground - Green

PART 3 EXECUTION

3.1 INSTALLATION

A. Make conductor length for parallel feeders identical.

B. Lace or clip groups of feeder conductors at distribution center, pull-boxes, and wireway. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.

C. Provide copper grounding conductors and straps.

D. Install wire and cable in code conforming raceway.

E. Use non-detrimental wire pulling lubricant for pulling No. 4 AWG and larger wire.

F. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.

G. Color code conductors to designate neutral conductor and phase.

H. Furnish necessary reels, reel jacks, and other pulling aids required to prevent damage to wires and cable.

I. Splicing:

1. Install wires and cables continuous without splices from sources of supply to distribution equipment and from source of supply to motor, lighting, or power outlet.

2. Do not use pull boxes for making splices.
3. Do not install splices in conduits.

J. Install all wiring per NFPA 70.

K. Use of cable with more conductors then specified; CONTRACTOR's option. When done, tape off and labeled extra conductors as spares.

3.2 CONDUCTOR CONNECTIONS

A. Use approved pressure type solderless connectors and lugs for service entrance, feeder, equipment connections and terminal posts.

B. Use connectors of a type compatible to conductors, locations, and load.

C. Make neutral connection and taps individually in order to prevent the possibility of an "open-neutral".

D. Make branch circuit connections with UL approved solderless connectors. Do not depend solely upon a single insulating material to secure connection as well as to insulate it.

E. After first either silverplating the bars or applying suitable non-oxidizing agents, bolt buss bar connections with adequate nonferrous bolts, washers, and lockwashers.

F. Insulate joints and taps with patented or molded plastic insulators. Use tapes compatible with conductor jackets, temperature, and other conditions.

3.3 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW

A. Prior to energization, test cable and wire for continuity of circuit for short circuits. Megger all circuit of 100 amp and greater rating.

B. Correct malfunctions.

C. Submit record of megohmmeter readings to ENGINEER.

3.4 IDENTIFICATION OF FEEDERS

A. Affix a marker stamped or embossed on each cable at each entry to and exit for each manhole, pullhole, pullbox, cable tray switchgear and switch, identifying circuit; i.e. "MCCI", "PANEL L" "NO 1" etc.

B. Identification letters to be 1/8 inch size minimum.

C. Markers to be rigid, noncorrosive, attached to feeder cables with feeder identification.

D. Nylon straps to be used to tie the markers.

- END OF SECTION -

SECTION 26 05 33
RACEWAY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible or rigid conduits. couplings. supports, and nonmetallic ducts.

1.2 RELATED WORK

A. Related Work specified in other Sections:

1. Section 26 05 13 Conductors
2. Section 33 23 15 Excavation and Backfill for Buried Pipelines.
3. Section 33 12 16 Hot-Mix Asphalt Concrete Paving

1.3 REFERENCES

A. ANSI C80.1: Rigid Steel Conduit - Zinc-Coated.

B. ANSI C80.3: Electrical Metallic Tubing - Zinc-Coated.

C. FS W-F-406: Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.

D. FS WW-C-566: Conduit, Metal, Flexible.

E. NEMA TC6: PVC and ABS Plastic Utilities Duct for Underground Installation.

F. NEMA TC9: Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

G. NFPA 70: National Electric Code.

H. UL: Underwriters' Laboratories, Inc.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit. tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4 inch.

B. Rigid Metal Conduit (RMC): ANSI C80.1.

C. Intermediate Metal Conduit (IMC): ANSI C80.1.

D. Rigid and Intermediate Steel Conduit Fittings: Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at conduit termination, use OZ Type B

bushings on conduits 1-1/4 inch and larger.

E. Electrical Metallic Tubing (EMT): ANSI C80. 3.

F. EMT Fittings: Provide insulated throat non-indenter type malleable steel fittings; concrete tight where required by application. Install OZ Type B bushings on conduits 1-1/4 inches and larger.

G. Flexible Metal Conduit (FMC): FS WW-C-566, Zinc-coated steel.

H. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, Style A.

I. Liquid Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).

J. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type1, Class 3, Style G.

K. Expansion Fittings: OZ Type AX, or equivalent to suit application.

L. PVC Coated RGS Conduit:

1. Requirements of article “Rigid Metal Conduit - Steel (RGS)” shall apply.
2. Coating: Apply minimum 40-mil, gray polyvinyl chloride (PVC) coating over exterior and apply urethane coating uniform and consistent to interior of conduit. Internal coating shall be nominal 2 mil thickness. Conduit having areas with thin or no coating, not acceptable. Protect conduit threads by urethane coating. PVC coating shall have been investigated by UL as providing primary corrosion protection for rigid metal conduit.

2.2 NON-METALLIC CONDUIT AND DUCTS

A. General: Minimum trade size: 3/4 inch.

B. Underground PVC Plastic Utilities Duct: NEMA TC6, Type I for encased burial in concrete, Type II for direct burial.

C. Duct Fittings: NEMA TC9, match to duct type and material.

2.3 CONDUIT, TUBING, AND DUCT ACCESSORIES

A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 LOCKNUTS, BUSHINGS, CONNECTORS, COUPLINGS, AND SUPPORTS

A. General: Provide malleable bushings, except that plastic bushings may be used in lieu of phenolic-lined malleable bushings where "insulating bushings" are required.

B. Provide "double-locknut" system (2 locknuts) throughout, each being tightened wrench tight as to effectively bond outlet box or cabinet to conduit.

C. Sealing Bushing: OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

D. Provide insulated-through type ground bushing of the malleable type.

E. Provide connectors or couplings that are proper for the conduit they are used with. Make watertight when required.

F. Provide cadmium plated or galvanized fittings.

G. Provide fittings with die-cut threads unless approved otherwise.

H. EMT connectors used with #4 and larger cable shall have throat liners of suitable plastic insulation.

2.5 CONDUIT OUTLET BOXES

A. Refer to Section 26 05 34 Electrical Boxes and Fittings.

2.6 SCHEDULE OF LOCATIONS

A. Galvanized steel conduit in concrete and exposed in vault.

B. For underground conduit use rigid, threaded, galvanized steel conduit, or solvent welded PVC Schedule 40 conduit

C. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid tight connectors. Provide 1/2 inch minimum size for motor connections.

D. Provide flexible conduit for fixture and control wiring with sufficient length of flexible conduit to avoid transmission of vibration.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavate; Section 31 23 16 Excavation and Backfill for Buried Pipelines.

3.2 INSTALLATION

A. Install conduit concealed in all areas, excluding mechanical and electrical rooms, connections to motors, and connections to surface cabinets.

B. For exposed runs attach surface-mounted conduit with clamps.

C. Coordinate installation of conduit in masonry work.

D. Unless indicated otherwise, do not install conduit larger than 2-1/2 inches in concrete slabs. Provide a minimum concrete cover around conduits of 2-inches.

E. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt and moisture.

F. Clean out conduit before installation of conductor.

G. Alter conduit routing to avoid structural obstructions, minimizing crossovers.

H. Fill end of conduit with fiberglass where conduits leave heated area and enters unheated area.

I. Provide flashing and pitchpockets, making watertight joints where conduits pass through roof or waterproofing membranes.

J. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended buildings.

K. Route all exposed conduits parallel or perpendicular to building lines.

L. Make interconnections between difference types of raceways with manufactured fittings approved by UL.

M. Size raceways per NFPA 70 tables. Do not reduce from any sized indicated.

N. Do not exceed sizes permitted in slabs or walls.

O. Do not exceed number of bends allowed in conduit by NFPA 70.

P. Make joints wrench tight or otherwise with minimum resistance tothe flow of fault currents.

Q. Use furred spaces and chases to an advantage in concealing conduits.

R. Make field bends only where needed and then carefully to minimize wire pulling tensions and for best appearance in exposed runs.

S. Test conduit runs with lignum vitale ball (mandrel) of 85-percent of conduit diameter.

T. Cut conduit with hacksaw or other approved pipe cutting tool and ream ends to clean out all burrs before connecting.

U. Keep conduits at least 6-inches away from steam or hot water pipes, breaching, and boilers, but in no case permit conductors to reach higher than rated temperatures. Avoid traps in runs and slope conduit to drain.

V. Fasten raceways securely in place. Firmly fasten conduit within 3-feet of each outlet, junction box, cabinet, or fitting. Support metallic conduit, rigid (heavy wall) and EMT at least every 10-feet. Support rigid nonmetallic conduit in strict accordance with NFPA70. Use raceway fasteners designed for the purpose.

3.3 SPECIAL CONDUIT FITTINGS

A. Use special conduit fittings as required or indicated. Use UL approved fittings suitable for location and usage made.

B. At expansion joints use special fittings if cast in concrete slabs.

C. Building Expansion Joints: Where surface conduits, raceways, panels, or light fixtures, span building expansion joints, make satisfactory arrangements to provide the movement provided for in building structure plus or minus nominal joint width.

3.4 PULL BOXES, WIREWAYS, AND GUTTERS

A. Furnish as indicated, plus any such items required to assemble conduits and other raceways. Provide Section 26 35 34 Electrical Boxes and Fittings as dictated by wire pulling requirements. Unless indicated otherwise face into secondary or unfinished rooms.

B. Construction: Code gage galvanized sheet steel and sized strictly inconformance with NFPA 70 requirements.

C. Finish: Free of burrs, sharp edges, unreamed holes, and sharp-pointed screw or bolts. Paint both inside and out.

D. Coating: When mounted direct to concrete or masonry walls that are below grade or where there will be sweating or other moisture present on wall surface, coat backs of boxes with a heavy coat of black asphalt paint before mounting.

E. Protection: Adequate provisions for preventing damage to conductors either during pulling in or from weights and tensions when in place.

F. Weatherproof, rain-tight, or special type when indicated or when required by NFPA 70.

3.5 ANCHORS, FASTENERS, AND MISCELLANEOUS SUPPORTS

A. Use compatible anchors in roof or ceiling slabs of concrete from which a load is suspended and anchors used to fasten heavy equipment without lead in their construction.

B. Make exposed conduit fastenings with one-piece, malleable conduit clamps. Two hole, galvanized sheet metal pipe straps may be used on all concealed installations.

C. Use companion bases or backs with conduit clamps when conduit isexposed to weather or continuous moisture.

D. Use ring type hangers on individual runs of conduit 3-inches and larger if suspended, complete with threaded rods. Use adjustable turnbuckles when specified or otherwise as an option.

E. Support multiple runs of suspended conduits from trapeze style hangers suspended with rigid threaded steel rods and with suitable conduit clamps or straps of the same make as cross channels used.

F. Mount multiple runs of conduit on ceiling or wall surfaces.

G. Do not hang or support electrical equipment and materials from roof decks.

- END OF SECTION -

SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Types of electrical boxes and electrical fitting work.

1.2 RELATED WORK

A. Related Work specified in other Sections:

1. Section 26 05 05 Electrical Equipment
2. Section 26 05 33 Raceway
3. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

A. NEMA OS 1: Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

B. NEMA OS 2: Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. NFPA 70: National Electric Code.

D. UL: Underwriters' Laboratories, Inc.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70 as applicable for installation of electrical boxes and fittings.

B. Comply with NEMA OS 1 and NEMA OS 2 as applicable for outlet boxes, device boxes, covers and box supports.

C. Provide electrical boxes and fittings which have been UL-listed and labeled.

PART 2 PRODUCTS

2.1 INTERIOR OUTLET BOXES

A. One piece, galvanized cast iron or cast aluminum outlet wiring boxes, of types shapes and sizes, including box depths, to suit each respective location and installation. If of aluminum, essentially "copper free". Do not use on conduits of dissimilar metals, except with written permission.

B. Minimum depth 1-1/4 inches or 2-1/8 inch depth for boxes with 3 or more conduit entries.

C. Use in combination with factory or field bends when indicated or advised. Complete outlet bodies with mounting brackets, hangers, extension rings, fixture studs, cable

clamps, metal straps, gaskets, cover, hubs, reducers, and other accessories.

2.2 WEATHERPROOF OUTLET BOX

A. Corrosion-resistant cast-metal of types, shapes and sizes (including depth) required.

B. Threaded conduit ends, cast-metal face plates with spring hinged waterproof caps suitably configured for each application, with faceplate gaskets and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES

A. Building Structure Type: Code-gage sheet steel with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with galvanized steel bolts, screws and washers.

B. Buried Type: Plastic body and cover, or pre-cast concrete with screw-on traffic rated cast iron covers; of types, shapes and sizes to suit each respective location and installation; equipped with stainless steel Nuts and Accessories.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

B. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 INSTALLATION

A. A. Install where indicated, complying with manufacturer's written instruction, applicable requirements of NFPA 70 and NEMA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install coverplates for all boxes; weatherproof outlets for interior and exterior locations exposed to weather or moisture.

C. Install boxes and fittings to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.

D. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum l0-inches of conduit between them.

- END OF SECTION -

SECTION 26 21 16
ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes arrangement with Utility Company for permanent electric service; payment of Utility Company charges for service as outlined in Paragraph 1.7 “Coordination”; service provisions; and utility metering equipment.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Concrete pads.

1.2 REFERENCES

A. National Electrical Contractors Association

1. NECA Standard of Installation.

B. American National Standards Institute

1. NFPA 70 - National Electrical Code.
2. NFPA 72 - National Electrical Safety Code.

C. National Electrical Manufacturers Association

1. Pub/No. AB 1: Molded Case Circuit Breakers
2. Stds Pub/No. AB 3: Molded Case Circuit Breakers and Their Application.
3. Stds Pub/No. KS 1: Enclosed Switches
4. Stds Pub/No. PB 2: Deadfront Distribution Switchboards.
5. Stds Pub/No. PB 2.2: Application Guide for Ground fault Protective Devices for Equipment.
6. Stds Pub/No. SG 3: Low-Voltage Power Circuit Breakers.
7. Stds Pub/No. SG 4: Alternating-Current High-Voltage Circuit Breakers.
8. Stds Pub/No. SG 5: Power Switchgear Assemblies.

1.3 SYSTEM DESCRIPTION

A. Utility Company: Rocky Mountain Power

B. System Characteristics: 100 Amps 240/120 volts, one-phase, three wire, 60 Hertz.

C. Service Entrance: Underground.

D. Underground Service Provisions:

1. Utility Raceway Connection: Utility Company's terminal pole.

2. Utility Service-Entrance Conductor Connection: Utility Company's pad-vault mounted transformer.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal procedures.

B. Submit Utility Company prepared drawings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Utility Company written requirements.

B. Maintain one copy of each document on site.

1.6 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings. Coordinate with Power Company for final location of equipment.

1.7 COORDINATION

A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be relocated, include costs in this contract.

B. Contact utility company regarding charges related to service installation. Include utility charges in this contract.

C. Utility charges for service installation will be paid by Owner and are not part of this contract.

PART 2 PRODUCTS

2.1 UTILITY METER

A. Furnished by Utility Company.

2.2 UTILITY METER BASE

A. Manufacturers:

1. **Milbank.**
2. Approved equal.

B. Product Description: Meter base ring type, EUSERC approved, with a space for utility provided test switch. Meter base shall comply with Rocky Mountain Power regulations.

2.3 TRANSFORMER PAD

A. Fiberglass, provided and installed by the utility company.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify service equipment is ready to be connected and energized.

3.2 INSTALLATION

A. Install service entrance conduits to building service entrance equipment. Utility Company will connect service lateral conductors to service entrance conductors

B. Install concrete pad for transformer, in accordance with Rocky Mountain Power regulations.

- END OF SECTION -

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SECTION 26 42 10
GALVANIC CATHODIC PROTECTION

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install galvanic cathodic protection and joint bonding for electrical continuity on all buried metallic piping and appurtenances associated with the vault improvements water piping as shown on the Drawings and specified herein, complete.

B. The quantity and location of the specified galvanic anodes are provided on the Drawings. Anode material has been selected based on the soil conditions of the installation location.

C. Galvanic anode installations include anodes directly connected to the pipe/appurtenance and anodes connected to the pipe through Type A test stations.

D. All buried metallic pipe and appurtenances shall be coated with a bonded dielectric coating, as shown on the Drawings and specified herein, complete.

1.02 DEFINITIONS

A. Ferrous Metal Pipe: Pipe made of steel or iron, or pipe containing steel or iron as a principal structural material, except reinforced concrete pipe.

B. Foreign-Owned: Buried pipe or cable not specifically owned or operated by the OWNER.

C. Lead, Lead Wire, Joint Bonds, Pipe Connecting Wires, Cable: Insulated copper conductor; the same as wire.

D. 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 bond resistance for each joint as specified in this section.

1.03 REFERENCES

A. The Association for Materials Protection and Performance (AMPP)

B. National Association of Corrosion Engineers (NACE) International.

1.04 STANDARDS:

A. The following standards are included by reference:
   1. AMPP/NACE International
      a. NACE SP-0169
      b. NACE SP-0177

1.05 SUBMITTALS

A. Shop Drawings: Catalog cuts, laboratory report, and other information for products proposed for use.

B. Quality Assurance Submittals:

1. Manufacturers' Certificates of Compliance.
2. Field Test Reports.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials provided hereunder shall be the product of one manufacturer to achieve standardization for appearance, maintenance, and replacement.

B. The use of a manufacturer's name and model or catalog number is for establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

C. Materials and workmanship as specified in this section shall be installed concurrently with pipe installation. Coordinate all work specified herein with related sections.

2.02 SUPPLIERS

A. Alternate suppliers will be considered, subject to approval of the ENGINEER. Location provided is that of the general office; contact these offices for information regarding the location of their representative nearest the project site.

1. Corrpro, Houston, TX.
2. Farwest Corrosion Control, Downey, CA.
3. Mesa Products, Tulsa, OK.

2.03 GALVANIC ANODES

A. **High-Potential** Magnesium Alloy (Prepackaged-Backfill Supplied):

1. Composition:
   a. Aluminum: 0.01 percent maximum.
   b. Manganese: 0.5 to 1.3 percent.
   c. Zinc: 0.
   d. Silicon: 0.
   e. Copper: 0.02 percent maximum.
   f. Nickel: 0.001 percent maximum.
   g. Iron: 0.03 percent maximum.
   h. Total Others: 0.05 percent each or 0.3 percent maximum, total.
   i. Magnesium: Remainder.
2. Dimensions:
   a. Bare Weight: 32 pounds or as shown on the Drawings.
3. Manufacturers and Products:

a. Dow; Galvomag.
b. Amax; Maxmag.
c. Approved equal.

B. Backfill:

1. Composition:
   a. Ground Hydrated Gypsum: 75 percent.
   b. Powdered Wyoming Bentonite: 20 percent.
   c. Anhydrous Sodium Sulfate: 5 percent.
2. Grain Size: 100 percent passing through a 20-mesh screen and 50 percent retained by a 100-mesh screen.
3. Mixture: Thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration.
4. The quantity of backfill shall be sufficient to cover surfaces of the anode to a depth of 1 inch.

2.04 CATHODIC PROTECTION TEST STATIONS:

A. Flush Mounted:

1. Test Box: Concrete body cast with a cast iron ring, with a minimum weight of 55 pounds and minimum dimensions of 8 inch inside diameter and 12 inches long. Furnish extensions as required to penetrate concrete surfaces by 4 inches minimum. Furnish with a 12-pound cast iron lid with the letters "TS" or words "Test Station" cast into the lid.
2. Manufacturer and Products: Brooks; Models 1RT or equal.
3. Flush Mount Test Station Terminal Board:
   a. Test boards for terminating pipeline test leads and other test leads inside test boxes: Plastic or glass reinforced 6-inch by 10-inch by 1/4-inch-thick laminate.
   b. Furnish terminal block with five stainless steel studs, washers, and lock washers.
   c. Shop fabricated as shown on the Drawings with engrave labels on terminal board.

B. Post Mounted (hot-dipped Galvanized Steel Post):

1. Test Station Head: Type A, T, I, and F: Testox series 700 or 1000 series test head.
2. Terminal Block: Plastic with minimum seven terminals. 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. Terminal studs, washers, and nuts shall be stainless steel.
3. Mounting Post: 3-inch diameter by 6 foot long hot-dipped galvanized steel post.
4. Mounting Hardware: Conduit, straps, nipple, reducer, and hardware for mounting test station to the post as specified under CONDUIT, LOCKNUTS, AND STRAPS.
5. Manufacturers and Products: Testox 700 and 1000 series test station as manufactured by Gerome Manufacturing, Uniontown, PA.

C. Test Station Wires:

1. General: Conform to applicable requirements of NEMA WC 3-80, WC 5-73, and WC 7-88.
2. Single-conductor, No. 10 AWG stranded copper with 600-volt TW, THWN, or THHN insulation.
3. Galvanic Anode Header Wire: Single-conductor, No. 8 AWG, stranded copper with 600-volt HMWPE insulation.

4. Insulation Color/Identification: Wire insulation color shall indicate the function of each wire and shall be as follows:
    a. Anodes/Header Cable: Black
    b. Pipelines: White
    c. Stationary Reference Cell: Yellow
    d. Foreign Pipeline: Red (gas), Blue (water)
    e. Insulated Joints: Green (insulated side), White (protected side)

D. Stationary Reference Electrodes:

1. Prepackaged Copper-Copper Sulfate Reference Electrodes:
2. Material: High impact ABS, ceramic with Moisture Retention Membrane.
3. Dimensions: 1.5” by 10.5” or 1” by 8”.
4. Wire: Minimum 14 AWG stranded copper wire with yellow, 600-volt TW, THWN, or THHN insulation. The wire shall be attached to the electrode and insulated with the manufacturer's standard connection. Connection shall be stronger than the wire.
5. Packaging: Furnish electrode packaged in a plastic or heavy paper bag of sufficient thickness to protect the electrode, backfill, and cloth bag during normal shipping and handling.
6. Manufacturers:
    a. Borin Manufacturing, Stelth 2 Series
    b. MC Miller, IonX Permanent Reference Electrode

2.05 JOINT BONDS

A. Ductile or Cast Iron Pipe:

1. Single-conductor, stranded copper wire with 600-volt HMWPE insulation. Supply joint bonds complete with a formed copper sleeve on each end of the wire.
2. No. 2 AWG wires, 18 inches long.

B. Flexible Coupling, Flanged Coupling Adapter, and Other Non-standard Joints:

1. Ductile Iron Pipe: No. 2 AWG wires, 24 inches long, HMWPE insulation, with 12-inch long THHN insulated No. 12 AWG wire pigtails, as manufactured by Erico Products Inc. (Cadweld), Cleveland, OH.

C. Insulated Flexible Coupling Joints:

1. Ductile Iron Pipe: No. 8 AWG HMWPE wire, 18-inch long, with one 12-inch long THHN or HMWPE insulated No. 12 AWG wire pigtail.
2. Steel Pipe: 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. Weld bonds to pipe with the thermite weld mold recommended by the bond manufacturer. Strap bond shall be as manufactured by Erico Products, Continental Industries, or approved equal.

2.06 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.

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: 32 grams, **maximum**, XF-19 Alloy, specifically for use on cast iron and ductile iron.

E. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
No. 4 AWG Wire & Smaller		
Steel	HA, VS, HC	25 gm
Ductile or Cast Iron	HB, VH, HE	32 gm
No. 2 AWG Wire Joint Bonds		
Steel	FS	32 gm
Ductile or Cast Iron	FC	45 gm

F. Welding Materials Manufacturers:

1. nVent/Erico Products Inc. (Cadweld), Cleveland, OH.
2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.

2.07 COATING REPAIR MATERIAL FOR PIPE AND FITTINGS

A. General:

1. Complete coating repairs in accordance with recommendations of the pipe or fitting manufacturer.

2. Coat steel pipe with epoxy coating repair as specified.
3. Coat thermite weld connections to ductile or cast iron pipe with fast cure epoxy OR petrolatum wax tape, as specified under Wax Tape Coating System.

B. Epoxy Coating:

1. 100 percent solids, fast curing epoxy suitable for submerged or buried conditions.
2. Acceptable products and manufacturers or equal:
   a. Protal 7125, 7200, or 7300 Denso North American, Houston, TX.
   b. TC 7010, Tapecoat, Evanston, IL.
   c. 3M; ScotchKote 323.
   d. Aquata-poxy, American Chemical Corp., East Lake, OH.
   e. "Or-equal."

C. Wax Tape Coating:

1. Buried thermite welds shall be coated in accordance with AWWA C217.
2. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
3. All components of the wax tape coating system shall be from a single manufacturer as manufactured by Denso North American, Trenton, or equal.

2.08 COATING MATERIAL FOR METALLIC PIPE AND FITTINGS

A. General:

1. All metallic fittings, valves, and metallic hardware (nuts, bolts, etc.) associated with non-metallic pipe construction shall be dielectrically coated with a bonded coating.
2. Prepare surface of items to be coated in accordance with coating manufacturer's requirements and as specified herein.

B. Dielectric Coating Systems for Metallic Pipe, Fittings, and Appurtenances

1. Wax Tape Coating System
   a. Metallic piping, fittings, and appurtenances shall be coated in accordance with AWWA C217.
   b. Apply coating system to all buried metallic pipe appurtenances, including joints, fittings, bolts, and irregularly shaped surfaces.
   c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
   d. Provide wax tape coating system filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
   e. Use sand backfill to protect wax coating from damage.
   f. Coating System:
      (1) Surface Preparation: As required by coating manufacturer. Remove all dirt and debris from pipe surface. Pipe surface shall be completely dry before application of wax tape components.
      (2) Primer: petroleum or petrolatum wax.
      (3) Filler Material: petroleum or petrolatum wax sealer/filler with closed cell plastic filler.

(4) Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick.
(5) Protective Outerwrap (for burial in native soil, not required for sand backfill).
(a) Provide fiber mesh fabric outerwrap over wax tape resin coated, woven fiber-mesh fabric that is .005 inches. Protect coating from damage and use sand backfill to protect wax coating from damage.

g. All components of the wax tape coating system shall be from a single manufacturer as manufactured by Denso North American, Trenton, or equal.

2. Epoxy Coating System
a. Fusion Bonded Epoxy
(1) Prepare surface and apply coating in accordance with C213 and coating manufacturer's guidelines.
(2) Apply minimum dry film thickness of 12 mils.
b. Polyamide Epoxy
(1) Prepare surface as required by coating manufacturer and apply coating in accordance with C210 and coating manufacturer's guidelines.
(2) Apply minimum of two coats at a total minimum dry film thickness of 12 mils.

2.09 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. Complete assembly shall have an ANSI rating of 150 pounds, minimum, or equal to or higher than that of the joint and pipeline.
2. Gasket materials shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline.
3. Gaskets: Full-face Type E with O-ring seal.
4. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA G 10 grade).
5. Insulating Washers: Fiberglass reinforced epoxy (NEMA G 10 grade).]
6. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.
a. Provide two washers per bolt for flange diameters equal to or less than 36-inch diameter.
b. Provide four washers bolt for flange diameters larger than 36-inch diameter.
7. Manufacturers:
a. GPT, Denver, CO.
b. Central Plastics Co., Shawnee, OK.
c. Advance Products and Systems, Scott, LA
d. Approved Equal.

8. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body.
a. Manufacturer:
(1) Central Plastics Co., Shawnee, OK.
(2) Or approved equal.

2.10 ANCILLARY MATERIALS

A. Wire Connectors: One-piece, tin-plated crimp-on ring tongue connector as manufactured by Burndy Co. or Thomas and Betts.

B. Compression Connectors:

1. For in-line, tap, and multi-splice, furnish "C" taps made of conductive wrought copper, sized to fit the wires being spliced.
2. Provide crimp tool and dies as recommended by the manufacturer for the wire and connector size.
3. Manufacturer and Product: Burndy; Type YC, or equal.

C. 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 EXECUTION

3.01 GENERAL

A. Install galvanic anodes for cathodic protection of ancillary metallic pipe and appurtenances where shown on the Drawings.

B. Installation of anodes to be performed in conjunction with pipeline trenching and as specified in other sections.

C. All materials and equipment associated with joint bonding, cathodic protection, and coatings, as shown and specified herein, shall be furnished and installed by the Contractor. Any changes in design or method of installation of an item as specified shall be reviewed by the Engineer.

D. The Contractor shall coordinate the installation of the specified items with the General Contractor or other subcontractors on the project such that installation of the items herein specified can be completed concurrently with pipeline installation. Items not installed before backfilling of the pipe shall be installed at the Contractor's sole expense.

E. Whenever the requirements of the Specifications or Drawings exceed those of the codes or manufacturer's instructions, the requirements of the Specifications or Drawings shall prevail. Where a larger size or better grade of material or a higher standard of workmanship is required, the most stringent requirement shall apply.

3.02 STORAGE AND HANDLING

A. Store all packaged anodes, anode backfill, and associated materials off the ground and keep them dry at all times.

B. Protect materials against weather, condensation, and mechanical damage. Immediately remove from site all damaged anodes.

C. Anode backfill material that has become wet will not be acceptable.

3.03 GALVANIC ANODE INSTALLATION

A. General: Install galvanic anodes as shown on the Drawings.

B. Remove anode packaging materials prior to installing anode.

C. Provide a minimum anode spacing of 2 feet from the protected structure, other unprotected pipelines, thrust blocks, or adjacent structures. Anode depth shall be at or below the pipe depth, and not less than 4 feet below the finished grade.

D. Connect anode lead wire directly to the pipe / fitting or route to test station as specified on the Drawings.

E. After installation, flood each anode with a minimum of 5 gallons of water.

F. Thoroughly compact backfill around each anode to a point 1 foot above the anode.

3.04 PIPE JOINT BONDING

A. To form an electrically continuous pipeline and associated appurtenances, the joints of all buried steel and iron pipe, vault and manhole piping, fittings, and restrained joints shall be provided with joint bonds as specified herein, except joints specified to be threaded, welded, or insulated.

B. Mechanical pipe connections are not considered to provide electrical continuity and require joint bonds, except where specified or approved by Engineer. All metallic components associated with appurtenances and fittings, including follower rings and retainer glands shall be electrically bonded to the piping system.

C. Contractor shall consider options for thermite welding to follower rings and retainer glands to aid in welding to surfaces with limited space and to avoid potential damage from discharged thermite weld metal. Options could include completing thermite welds on the follower rings and retainer glands prior to installation on pipe or utilizing alternate welding method.

D. Quantity of joint bonds for fittings and appurtenances shall be as shown on the Drawings.

E. Electrical connection of all wires to pipe and fittings shall be by the thermite weld process.

F. Each bonded joint shall be tested as specified under ELECTRICAL CONTINUITY TESTING, this section.

3.05 TEST STATION INSTALLATION:

A. Location, type, and style of test stations shall be as shown on the Schedules on Drawings. Final field location shall be determined based on actual site conditions and as approved by the ENGINEER.

B. Locate test stations where shown on the Schedules on Drawings.
   1. Install test stations as appropriate at 1,000-foot intervals or less.

2. Install Type F test stations where any ferrous metal pipe crosses a foreign owned pipeline under cathodic protection.

C. Wires to foreign-owned pipelines will be attached by pipeline owner, unless permission is granted to Contractor in writing by owner of foreign pipeline. Coordinate this Work with owner of foreign pipeline before pipe is excavated.

D. Attach all test wires to the pipe by the thermite weld method unless approved otherwise.

E. The wires from the test stations shall be buried a minimum of 36 inches below finished grade. Provide 12-inch loop in wires at pipe and beneath test station to prevent them from being stressed or broken during backfilling operations.

F. Test wires within paved roadways and with less than 36 inches of ground cover shall be installed in rigid PVC-coated steel conduit, except when located under concrete floor slabs.

G. Make wire connections to test station terminals with crimp-on ring tongue terminals, except where solid wire is specified.

H. Wire Labels:
1. Install labels on conductors in test stations.
2. Position markers in boxes so they do not interfere with operation and maintenance.

3.06 WIRE CONNECTIONS

A. Thermite Weld:

1. Use thermite weld method for electrical connection of copper wire to steel, ductile, and cast iron surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation recommended by the welder manufacturer. Assure that the pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the integrity of the pipe or fitting wall or protective lining.
2. After the weld connection has cooled, remove slag, visually inspect, and physically test wire connection by tapping with a hammer; remove and replace any defective connections.
3. On pipe and fittings with dielectric linings, make the weld connection on the shop tab provided or on a thick metal section to minimize damage to the lining and coating. After the weld is made, coat the weld with coating repair material.
4. Coat each completed wire connection as specified, this section.
5. If the lining is damaged by welding, repair in accordance with the lining applicator's recommendations.

3.07 WIRE INSULATION REPAIR

A. Splicing of wire will not be permitted except where specifically shown on the drawings and approved by the Engineer.

B. Splices or damage to the wire insulation shall be required by spirally wrapping with two coats of high-voltage rubber splicing tap and two layers of vinyl electrical tape.

C. Make wire splices with suitable sized compression connectors or mechanically secure and solder with rosin cored 50/50 solder.

3.08 INSULATED JOINTS:

A. Install insulated joints to electrically isolate the pipeline from vault piping, electrically grounded facilities, and where shown on the Drawings.

B. Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.

C. After assembly of insulated flanges, prepare cement-mortar surface in accordance with paint manufacturer's instructions and apply a 20-mil minimum thickness of EPA potable water approved, 100 percent solids water or air curing epoxy coating to the interior of the pipeline. Apply coating for a minimum of two pipe diameter lengths from the insulating flange in both directions. Apply and cure coating in accordance with the manufacturer's recommendations. Do not apply coating where it will interfere with operation of pipeline valves or other pipeline assemblies.

D. 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.

3.09 TESTS AND INSPECTION

A. Electrical Continuity Testing:

1. General
    a. Furnish all necessary equipment and materials and make all electrical connections to the pipe as required to test continuity of bonded joints.
    b. Conduct a continuity test on all buried joints that are required to be bonded. Test the electrical continuity of joint bonds after the bonds are installed but before backfilling of the pipe.
    c. The Contractor shall test completed joint bonds for electrical continuity using digital low resistance ohmmeter or by the Calculated Resistance Test Method at the Contractor's option. The equipment and test procedures for the two methods are described herein.
2. Digital Low Resistance Ohmmeter Method:
    a. Equipment and Materials:
        (1) One Biddle Model 247001 digital low resistance ohmmeter or equal.
        (2) One set of duplex helical current and potential handspikes, Biddle Model No. 241001, cable length as required.
    b. Test Procedure: Measure the resistance of joint bonds with the low resistance ohmmeter in accordance with the manufacturer's written instructions. 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. Record the measured joint bond resistance on the test form described herein. 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 in Table 1.

Table 1			
	Max. Allowable Resistance (Ohms)		
Joint Type	One Bond/Joint	Two Bonds/Joint	Three Bonds/Joint
No. 2 AWG wire Bonds	0.000325	0.000162	0.000081
Flexible Coupling	0.000425	0.000212	0.000115

b. The Contractor shall replace any joint bond that exceeds the allowable resistance. Replacement joint bonds shall be retested for compliance with the specified bond resistance.
c. Any defective joint bond discovered during energizing and testing 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. Test current and voltage drop across each joint and calculated bond resistance (Calculated Resistance Method only).
   f. Measured joint bond resistance (Digital Low Resistance Ohmmeter method only).

B. Insulated Joint Testing:

1. 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. Conduct test before burial and coating of buried insulating flanges.

2. CONTRACTOR to replace damaged or defective insulation parts identified during 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 Standard Practice SP0169.

4. CONTRACTOR shall conduct additional insulating joint tests as required to assure that insulating flanges are not electrically shorted by other equipment or incidental contact with concrete reinforcement or other equipment during energizing and testing.

END OF SECTION

SECTION 31 11 00
CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.1 SUMMARY

A. This work shall consist of removing and disposing of all trees; shrubs; brush; stumps; windfalls; roots; and other vegetation, including dead and decayed matter; and debris that exist within the designated construction limits, borrow areas, and soil stockpile areas and which are not specifically designated to remain.

1.2 DEFINITIONS

A. Clearing: Clearing operations shall consist of cutting, removing and disposing of trees, shrubs, bushes, windfalls and other vegetation within the construction limits, borrow areas, and soil stockpile areas. All brush shall be cut off within six inches of the ground surface.

B. Grubbing: Grubbing operations shall consist of removing and disposing of stumps, roots, debris deleterious materials, and other remains (such as organic and metallic materials) which if left in place would interfere with proper performance or completion of the contemplated work, would impair its subsequent use or form obstructions therein. Organic material from clearing or grubbing operations shall not be incorporated in fill or backfill.

C. Stripping: Stripping operations shall consist of removing all soil material containing sod, grass, or other vegetation and topsoil to a minimum depth of six (6) inches from all areas that will receive fill or over all trenches in field or yard areas.

1.3 MEASUREMENT AND PAYMENT

A. Measurement and payment for clearing, grubbing and stripping shall not be paid as a unit item, but considered as included in the contract unit or lump sum prices for the various items of the contract to which it relates.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 CLEARING

A. All trees, stumps, shrubs, bushes, windfalls and other vegetation (except such trees and vegetation as may be indicated or directed by ENGINEER to be left standing) shall be cut off to within six inches of the ground surface and shall be removed from the construction limits. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by such means as the circumstances require.

3.2 GRUBBING

A. All stumps, roots, debris, deleterious and other organic or metallic materials not suitable for foundations shall be removed completely from the construction limits, borrow areas and soil stockpile areas. Unless otherwise permitted by ENGINEER, stumps shall be removed completely. If any stumps are permitted to remain, they shall be cut off not more

than six inches above the ground.

3.3 STRIPPING

A. Soil material containing sod, grass, or other vegetation and topsoil shall be removed to a minimum depth of six (6) inches from all areas to receive fill from the area within lines 5 feet outside all foundation walls, over all trenches, and from beneath pavement and curb and gutter areas. The stripped material shall be deposited in such locations as are acceptable to ENGINEER. Topsoil shall be placed over designated areas to be landscaped, and over all trench areas (outside of paved areas).

B. All areas to be sodded shall have a minimum thickness of 3 inches (or thicker if required elsewhere in these documents or on the drawings) of topsoil.

3.4 DISPOSAL

A. No open burning of combustible materials will be allowed.

B. All trees, timber, stumps, roots, debris, shrubs, bushes, and other vegetation removed during the clearing and grubbing operations shall be removed from the project site and disposed of by CONTRACTOR subject to specific regulations imposed by laws and ordinances and in a manner that will not create a public nuisance nor result in unsightly conditions. CONTRACTOR shall assume full responsibility for acceptable disposition of the material as well as for any damages resulting from his disposal operations.

- END OF SECTION -

SECTION 31 23 15
EXCAVATION AND BACKFILL FOR BURIED PIPELINES

PART 1 GENERAL

1.1 SUMMARY

A. This item shall consist of excavating all pipeline trenches to the lines and grades indicated on the drawings or as directed by ENGINEER in the field, and the backfilling of all pipeline trenches. Excavation shall include the removal of all materials of whatever nature encountered to the depths shown on the Drawings, or as modified in the Field by ENGINEER.

1.2 RELATED SECTIONS

A. Related work specified in other sections:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control & Materials Testing
3. Section 01 45 23 Testing Agency Services
4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
5. Section 03 31 05 Controlled Low Strength Material
6. Section 31 23 19 Dewatering
7. Section 33 05 07.1 Polyvinyl Chloride Pressure Pipe (ASTM D 1785,Modified)
8. Section 33 92 10 Steel Pipe, Specials and Fittings (AWWA C-200 Modified)

1.3 REFERENCES

A. The latest edition of the following publications forms a part of this specification to the extent referred. The publications are referred to in the text by basic designation only.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
3. T 88 Standard Method of Test for Particle Size Analysis of Soils
4. T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
5. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
6. T 191 Standard Method of Test for Density of Soil-In-Place by the Sand Cone Method
7. T 205 Density of Soil In-Place by the Rubber-Balloon Method
8. T 238 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
9. T 239 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
10. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. D 422 Standard Test Method for Particle Size Analysis of Soils
4. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3)
5. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
6. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3)
7. D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity -Flow Applications
8. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

A. Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

B. Pipe Zone: That zone in an Excavation which supports, surrounds, and extends to 12 inches above the top of the pipe barrel. Specifically, 4 inches below the bottom (where rock, hard pan, boulders, etc. are encountered), 12 inches above the top of the pipe, and 1 foot laterally beyond both sides of the pipe, unless noted otherwise on the Drawings.

C. Trench Zone Backfill: That zone in an Excavation which begins 12 inches above the top of the pipe barrel and extends to the natural surface level or the finished grade indicated on the Plans.

D. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 12 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

E. Unstable Material: Unstable material shall consist of materials too wet to allow backfill compaction or to properly support the utility pipe, conduit, or appurtenant structures.

F. Rock: Solid mineral material which cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting. Minimum equipment size, in good running order, shall be similar to a Komatsu 300, Caterpillar 320 or 330, or equal.

1.5 SUBMITTALS

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

1. Copies of Field Density Test reports shall be submitted to ENGINEER or RPR at the beginning of each workday for the previous day's testing of subgrades, embankments and backfill Materials.
2. Copies of all Laboratory Test Reports shall be submitted to ENGINEER or RPR within 24 hours of the completion of the test.
3. Submit gradations and proctors for Pipe Zone Material and Trench Zone Backfill.
4. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.6 SITE CONDITIONS

A. Unsuitable Weather Limitations: CONTRACTOR shall not place, spread, or roll any fill material during unsuitable weather conditions. CONTRACTOR shall not resume operations until moisture content of material is satisfactory.

B. Weather Softened Subgrade: CONTRACTOR shall remove and replace at no additional cost to OWNER soft subgrade materials resulting from adverse weather conditions.

C. Protection of Graded Areas: CONTRACTOR shall protect all graded areas from traffic and erosion and shall keep these areas free of trash and debris. Work required to repair and reestablish grades in settled, eroded, and rutted areas shall be completed to specified tolerances at CONTRACTOR's expense.

D. Reconditioning Compacted Areas: All areas compacted to required specifications that become disturbed by subsequent construction operations or weather conditions shall be scarified, moisture conditioned and re-compacted to the required density prior to further construction.

E. Grading: the final compacted surface of base course shall not vary more than 1/4 inch above or below design grade.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stabilization Material: Use stabilization material to stabilize trench bottom if it is flowing or unstable. If trench bottom is unstable, overexcavate trench bottom and install at 8-inch min thickness of stabilization material below pipe bedding. Stabilization material shall consist of hard, durable particles of stone or gravel, screened or crushed to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.

1. Coarse material shall be crushed or washed and fine material shall be wasted to meet the grading requirements set forth below. Note that if stabilization material is required, an 8 oz. non-woven filter fabric shall be placed between the stabilization material and the pipe zone material.

2. Coarse aggregate, retained on the No. 4 sieve, shall have a percentage of wear not greater than 40 percent when tested by the Los Angeles Test, AASHTO T-96 or ASTM C 131.

Sieve Size (Square Opening)	Percent By Weight Passing Screen
2-inch	100
1-1/2 inch	10 - 50
3/4-inch	0 - 25
No. 4	0 - 10
No. 200	0 - 3

B. Pipe Zone Material: Pipe zone material shall be clean and free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of ENGINEER may be objectionable or deleterious. “Squeegee” or any other flowable material shall not be permitted. Pipe zone material shall conform to the following:

1. Where Drawings call for CLSM in pipe zone, provide Controlled Low Strength Material (CLSM) in accordance with Section 03 31 05, otherwise provide sand pipe zone material as follows.
2. Compacted sand pipe zone from 6” below pipe to 12” over pipe per the following gradation:

U.S. Standard Sieve Size (Square Opening)	Percent By Weight Passing Screen
3/8 – inch	100
No. 4	80-100
No. 10	30-50
No. 40	10-30
No. 200	0-15

C. Select Trench Backfill

1. Trench backfill shall consist of imported fill material or native material meeting soils classification A-1a of AASHTO M 145, with a maximum particle size no greater than 3 inches in any dimension and shall be capable of meeting the compaction requirements. Trench backfill shall be non-plastic. Trench backfill shall be free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of ENGINEER may be objectionable or deleterious
2. Where Drawings require it (unless noted otherwise this includes all trenches in UDOT right of way), provide rapid set (cures in 2 hours) CLSM (flow fill) acceptable to UDOT.
3. Where outside UDOT right of way, trench zone shall be 3/4 inch gradation of UBC (untreated base course) acceptable to UDOT and Engineer.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavation shall be performed to the lines and grades indicated. All excavated materials not intended for reuse shall be removed from the site and disposed of by the Contractor

B. Slope and shore all excavations in compliance with OSHA.

3.2 SAFETY

A. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the latest requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926). CONTRACTOR is responsible for assessing safety needs to meet such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all safety requirements.

B. CONTRACTOR is responsible for assessing needs related to confined space entry, as defined by OSHA. CONTRACTOR shall meet all such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all confined space safety requirements.

3.3 DEWATERING

A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 TRENCH WIDTH

A. The bottom of the trench shall have a minimum width equal to the outside diameter of the pipe plus 24-inches or as detailed on the drawings.

B. The width and depth of the trench shall be ample to permit the pipe to be laid and jointed properly in accordance with the specifications and the drawings, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting, and bracing, and the handling of special units as necessary.

3.5 TRENCH PREPARATION

A. Each trench shall be excavated so that the pipe can be laid to the alignment and grade as required. The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches shall be drained so the pipe laying may take place in dewatered conditions.

B. Bottom Preparation

1. Where rock, hard pan, boulders or other material which might damage the pipe are encountered, the bottom of the trench shall be over excavated 4 inches below the required grade and replaced with Stabilization Material. Otherwise, the bottom of the trench shall be over excavated 6 inches or 1/12 the outside diameter of the pipe, whichever is greater, below the required grade and replaced with Pipe Zone Backfill.

2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 1 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.
3. The bottom of the waterline trench shall be accurately graded to provide a minimum of 6 inches between the bottom of the pipe and the bottom of the trench for placement of CLSM.

C. Removal of Unstable Material

1. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed by ENGINEER and replaced to the proper grade with Stabilization Material. When removal of unstable material is required due to the fault or neglect of CONTRACTOR in his performance of the work, the resulting material shall be excavated and replaced by CONTRACTOR without additional cost to OWNER.

D. For pipelines other than the steel waterline, the trench bottom (at the level of the base of the pipe) shall be given a final trim using a string line, laser, or another method approved by ENGINEER for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench grade shall permit the pipe spigot to be accurately centered in the preceding laid pipe joint, without lifting the pipe above the grade, and without exceeding the permissible joint deflection.

3.6 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 PIPELINE TRENCH BACKFILLING AND COMPACTION

A. Pipe Zone:

1. CLSM (Section 03 31 05) shall be placed from the bottom of the trench to the spring line of the pipe for all pipes and through out the entire pipe zone where designated on the drawings. Sand, as defined in Subsection 2.1.B of this section shall be placed from the spring line of the pipe to the top of the pipe zone.
2. For pipelines which include sand in pipe zones, pipe zone backfill shall be placed in

layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Each layer shall be compacted to at least 96 percent of the maximum Modified Proctor density (ASTM D-1557), unless otherwise specified.

3. Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
4. Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
5. Where the pipe grade exceeds 30%, cohesive material shall be used in lieu of pipe bedding. The cohesive material shall be moistened to within 2% of optimum moisture and compacted as noted.
6. The relative density of the compacted cohesionless material shall not be less than 60% as determined by the Bureau of Reclamation Relative Density of Cohesionless Soil Test (Designation E-12) of the "Earth Manual."

B. Trench Backfill: Trenches shall be backfilled to the grade shown with Trench Backfill material as specified.

1. Trench backfill in asphalted road shall consist of backfilling the trench from above the pipe zone up to underneath the noted recommended depth for untreated base course and asphalt or concrete of finished grade with Trench Backfill material compacted to 96 percent (97% in UDOT roads) of maximum density (ASTM D-1557). Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified.
2. Trench backfill in unimproved or landscaped areas shall consist of backfilling the trench from above the pipe zone to 8 inches below finished grade with Trench Backfill material compacted to 96 percent of maximum density (ASTM D-1557). Backfill from 8 inches below finished grade to finished grade shall consist of topsoil replacement in addition to replacement of all landscaped materials. Trench backfill shall be placed in layers not exceeding 8 inches loose thickness.
3. It shall be the responsibility of CONTRACTOR to be assured that the Trench Backfill material is capable of being compacted to the degree specified. It shall be CONTRACTOR’s responsibility to remove and dispose of all excess excavated material.

C. Final Backfill:

1. Unimproved and Landscaped Areas: The top 8 inches of the trench shall be filled with topsoil. Topsoil may be native material stripped prior to excavation of the trench. Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to a minimum of 85 percent maximum density (ASTM D-1557). Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

2. Roadways shall be completed with the type and thickness of materials (i.e. Untreated Road Base, Asphalt, or Concrete) as indicated or shown on the drawings.

3.8 SPECIAL REQUIREMENTS

A. Special requirements for both excavation and backfill relating to the specific utilities from above the pipe zone to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:

1. Where existing underground pipes or conduits larger than 3 inches in diameter and all sizes of sewer lines or sewer laterals cross the trench above the new work, the backfill from the bottom of the trench to 1 foot above the top of the intersecting pipe or conduit shall be pipe zone material compacted to 95 percent of maximum density (ASTM D-1557). The pipe zone material shall extend 2 feet on either side of the intersecting pipe or conduit to ensure that the material will remain in place while other backfill is placed.

B. The maximum trench length open at any given time shall not exceed 200 feet unless approved by ENGINEER, and must be backfilled in a timely manner.

3.9 MAINTENANCE OF BACKFILL

A. All backfill shall be maintained in satisfactory condition, and all places showing signs of settlement shall be filled and maintained during the life of the Contract and for a period of one year following the day of final acceptance of all work performed under the Contract. When CONTRACTOR is notified by ENGINEER or OWNER that any backfill is hazardous, CONTRACTOR shall correct such hazardous condition at once. Any utility, road and/or parking surfacing damaged by such settlement shall be repaired by CONTRACTOR to the satisfaction of OWNER and ENGINEER. In addition, CONTRACTOR shall be responsible for the cost to OWNER of all claims for damage filed with the Court, actions brought against the said OWNER for, and on account of, such damage.

3.10 FINISH GRADING AND CLEANUP

A. CONTRACTOR shall grade the trench line to a smooth grade to affect a neat and workmanlike appearance of the trench line.

B. All tools, equipment and temporary structures shall be removed. All excess dirt and rubbish shall be removed from the site by CONTRACTOR.

C. CONTRACTOR shall restore the site to at least as good as original condition, including but not limited to final trench grade and restoration of affected public and private facilities whether in the public right-of-way or on private property. Any exception to this requirement must be in writing from ENGINEER for the job specific conditions.

3.11 COMPACTION TESTS

A. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials

a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00 - Quality Control & Materials Testing. Use concrete break tests to test strength of CLSM (flow fill) or concrete backfill.
b. The CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
    i) 50 linear feet of trench backfill.
c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
e. Compliance tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR.
f. ENGINEER may require retesting of backfill that has settled from water penetration in the trench. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to the OWNER.
g. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR's confirmation tests shall be performed in a manner acceptable to ENGINEER.

2. Field Density Tests
    a. Field density tests shall be made in accordance with ASTM D 1557.

- END OF SECTION -

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SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 DESCRIPTION

A. This section provides specifications for dewatering systems and appurtenances to be used during construction as required to keep the excavation free of water.

1.2 SUBMITTALS

A. Before dewatering is commenced, CONTRACTOR shall provide information to ENGINEER outlining the method, installation and details of the proposed dewatering system. CONTRACTOR shall provide ENGINEER with plans setting forth details of the proposed dewatering systems. The dewatering system plans shall be of sufficient detail to indicate sizes of pumps, piping, appurtenances, the ultimate disposal point for water and to indicate the overall completeness and effectiveness of the proposed system.

B. CONTRACTOR shall certify to OWNER that the design and implementation of the proposed dewatering system is sufficient to complete the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. CONTRACTOR shall be responsible for selection of dewatering means, methods and materials.

PART 3 EXECUTION

3.1 DESIGN AND IMPLEMENTATION

A. CONTRACTOR shall be responsible for complete design and implementation of the dewatering system.

B. CONTRACTOR shall be responsible for the design and implementation of any modifications that may be required to the initial design of the dewatering system (at no additional cost to OWNER) to provide a dewatering system that operates adequately to complete the Work.

C. CONTRACTOR shall furnish, install, operate and maintain all machinery, appliances, and equipment to maintain all excavations free from water during construction.

D. CONTRACTOR shall dispose of water so as to not cause damage to public or private property, or to cause a nuisance or menace to the public or violate the law.

E. CONTRACTOR shall be responsible to obtain groundwater discharge permits, if required.

F. CONTRACTOR shall install and operate the dewatering system so as to not cause damage or endanger adjacent structures or property.

G. The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils," does not occur. Dewatering systems shall be designed and operated so as to prevent removal and migration of the natural soils.

H. CONTRACTOR shall have sufficient stand-by equipment at the project site at all times to continuously maintain the dewatering program until Work necessitating dewatering is complete.

I. CONTRACTOR shall have on hand equipment and machinery in good working condition for emergencies and shall have personnel available for operation of such equipment and machinery.

J. CONTRACTOR shall control surface water to prevent entry into excavations.

- END OF SECTION -

SECTION 31 23 23
EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers excavating, backfilling, and compacting of disturbed areas for structures and roadways as directed by ENGINEER.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Materials Testing
3. Section 01 45 23 Testing Agency Services
4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
5. Section 31 11 00 Clearing, Grubbing and Stripping
6. Section 31 23 15 Excavation and Backfill for Buried Pipelines
7. Section 31 23 19 Dewatering

1.3 REFERENCES

A. The latest editions of the following publications form a part of this specification to the extent referred. The publications are referred to in the text by basic designation only.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
3. T 88 Standard Method of Test for Particle Size Analysis of Soils
4. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
5. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
6. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. D 422 Standard Test Method for Particle Size Analysis of Soils
2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3)
3. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3)
5. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

6. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D. The latest Edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction.

E. The latest Edition of the American Public Works Association (APWA) and Associated General Contractors of America Standard Plans and Standard Specifications.

1.4 SUBMITTALS

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

1. Submit gradations and proctors for structural fill materials and backfill materials.
2. Submit copies of Field Density Test reports.

PART 2 PRODUCTS

2.1 WALL BACKFILL MATERIAL

A. Wall backfill material (except where CLSM backfill is indicated) shall consist of import fill material meeting the AASHTO A-1-A soils classifications of AASHTO M 145, with a maximum particle size no greater than 3 inches in any dimension and shall be capable of meeting the compaction requirements.

1. Wall backfill material shall be free from frozen lumps, rocks larger than 3 inches in the largest dimension, roots, trash, lumber and organic material.

2.2 STRUCTURAL FILL

A. Structural fill material, if required, shall meet the following requirements.

1. Material shall be non-expansive granular soil with less than 35 percent passing the No. 200 sieve, with a liquid limit less than 30%, and free from rocks larger than 3 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. Structural fill shall be imported.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavation shall be performed to the lines and grades indicated. Excavated material not required or not satisfactory for backfill shall be removed from the site.

B. Excavations shall be braced and supported as needed to prevent the ground adjacent to the excavation from sliding or settling. Slides shall be promptly removed and corrected by CONTRACTOR

C. Slope and shore all excavations in compliance with OSHA.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 6 inches.

3.3 DEWATERING

A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 BACKFILL

A. Backfill material shall not be placed against concrete structures that have not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,400 psi, whichever is greater.

B. Backfill material shall be placed in no more than 6-inch loose lifts for compaction by hand operated machine compactors, and 8 inches loose lifts for other than hand operated machines.

C. Structural fill placed beneath foundations, footings or the floor slab shall be placed and compacted to at least 96 percent (97 percent in UDOT roads) of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D 1557.

D. Backfill material shall be placed and compacted to at least 96 percent of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.

E. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and re-compacted to the minimum required compaction prior to placing any additional fill material.

F. CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If it is determined that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.

G. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of this contract.

H. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by CONTRACTOR.

I. Final Backfill:

1. Unimproved and Landscaped Areas: Top 8 inches of trench shall be filled with topsoil and landscaped materials. Topsoil may be native material stripped prior to excavation of the trench. Backfill material shall be placed and compacted as specified above.
2. Roadways shall be completed with the type and thickness of materials as indicated or shown on the drawings.

3.5 FINISHED GRADE

A. The finished subgrade and grade of the fill shall not vary more than 0.05 feet from the established grades and cross sections shown on the Drawings.

3.6 COMPACTION TESTS

A. Compaction testing shall be the provided and paid for in accordance with Section 01 45 00 – Quality Control and Materials Testing.

B. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, structural fill, Untreated Base Course and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials
    a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00.
    b. Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
        1) One (1) test per 1.0 feet of backfill thickness placed per structure.
    c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of same kind shall be performed.
    d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
    e. Quality Control tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to Contractor. If ENGINEER requires retesting of backfill, CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to OWNER.
    f. If compaction fails to meet the specified requirements, Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid in accordance with Section 01 45 23 – Testing Agency Services. The confirmation tests shall be performed in a manner acceptable to ENGINEER. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.

2. Field Density Tests

a. Tests shall be performed in sufficient numbers to meet the requirements of Section 01 45 00 and to ensure that the specified density is being obtained.

C. Field density tests shall be made in accordance with ASTM D-1557 and ASTM D-6938.

- END OF SECTION -

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SECTION 32 11 23
ROAD BASE - UNTREATED BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

A. This work consists of the placement of Sub-Base and Untreated Base Course (UBC or UTBC) material at designated areas and roadways and all driving surfaces as indicated on the Drawings.

1.2 RELATED SECTIONS

A. Related work specified in other Sections:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Materials Testing

1.3 REFERENCES

A. The latest edition of the following publication forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils
2. AASHTO T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
3. AASHTO T 191 Standard Method of Test for Density of Soil In-Place by the Sand Cone Method
4. AASHTO T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods. (Shallow Depth)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 422 Standard Method for Particle Size Analysis of Soils
2. ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3)
3. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
4. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lnf/ft3)
5. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
6. ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D. The latest edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction (UDOT).

1.4 SUBMITTALS

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

B. Untreated Base Course (APWA Grade 1 or Grade 3/4).

1.5 MEASUREMENT AND PAYMENT

A. Road Base shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 MATERIALS

A. For UDOT ROW see UDOT Specification 02721 – Untreated Base Course. UDOT will approve material. Otherwise this specification will govern.

B. Untreated Base Course: Untreated Base Course Materials shall meet the Specifications for Grade ¾ or 1 as shown in Table 1.

TABLE 1

MASTER GRADING BANDS			
SIEVE SIZE	**GRADE 1-1/2 GRADATION (PERCENT PASSING)**	**GRADE 1 GRADATION (PERCENT PASSING)**	**GRADE 3/4 GRADATION (PERCENT PASSING)**
1 1/2 inch	100	-	-
1 inch	-	100	-
3/4 inch	81-91	-	100
1/2 inch	67-77	79 - 91	-
3/8 inch	-	-	78 -92
No. 4	43-53	49 - 61	55 - 67
No. 16	23-28	27 - 35	28 - 38
No. 200	6-10	7 - 11	7 - 11

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. Prior to placement of untreated base course materials, the foundation area to receive untreated base course materials shall be scarified to a minimum depth of 8-inches and recompacted to 96% minimum laboratory density as determined by ASTM D-1557.

3.2 UNTREATED BASE COURSE MATERIAL PLACEMENT

A. No Untreated Base Course material shall be placed on sub-grade materials until the sub-grade has been checked and accepted by ENGINEER.

B. Road base material placed on driving surfaces shall be compacted to a minimum density of 96% in accordance with ASTM D-1557 to provide a uniform graded smooth surface.

C. Untreated Base Course material shall be placed to a minimum thickness eight (8) inches or as shown on the drawings.

3.3 FIELD QUALITY CONTROL

A. CONTRACTOR shall be responsible for directing proper placement of all road base materials. CONTRACTOR shall be responsible for the stability of the road base materials during placement and shall replace any portions which have become displaced due to careless or negligent work on the part of CONTRACTOR, or to damage resulting from natural causes, such as storms.

B. Whenever the work areas to receive Sub-Base and/or Untreated Base Course material are covered with snow, the snow must be removed prior to placing the road base and/or Untreated Base Course, and deposited outside the immediate construction areas at CONTRACTOR's expense.

- END OF SECTION -

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SECTION 32 12 16
HOT-MIX ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Hot mix asphalt concrete paving in UDOT highways shall comply with UDOT requirements and UDOT permit

B. Concrete paving in UDOT highways shall comply with UDOT standard specifications and drawings (these are listed in Sheet PV-0) and UDOT permit.

C. In Non-UDOT streets, hot-mix asphalt concrete paving shall comply with in Section 33 05 25 – Pavement Restoration of the APWA Specifications, and as modified herein; and shall comply with City Standards for the asphalt concrete paving in the City in which the construction is performed. If there is a conflict between the specifications of this Section and the City Standard specifications, City Standards shall govern.

1.2 RELATED SECTIONS

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

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Materials Testing
3. Section 01 50 00 Temporary Facilities and Environmental Controls
4. Section 32 11 23 Road Base - Untreated Base Course
5. Section 32 12 14 Tack Coat (APWA)
6. Section 32 12 16 Plant-Mix – Asphalt Paving (APWA)
7. Section 32 17 23 Pavement Marking (APWA)
8. Section 33 05 25 Pavement Restoration (APWA)

1.3 REFERENCES

A. The American Public Works Association General Conditions and Standard Specifications for Construction, latest edition

B. The latest edition of the following publication forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
2. ASTM D 2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method
3. ASTM D 3665 Standard Practice for Random Sampling of Construction Materials

1.4 SUBMITTALS

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

B. Laboratory mix design for proposed hot-mix asphalt concrete paving.

C. Means and methods for removal, reprocessing, and placement of existing asphalt surfaces as base course material.

D. Laboratory mix design for proposed tack coat application.

E. Quality assurance tests for asphalt and aggregate material sources.

F. Copies of batch delivery tickets shall be submitted during progress of the work, and shall show the following information:

1. Name of production facility
2. Serial number of ticket
3. Date and truck number
4. Name of CONTRACTOR
5. Job name and location
6. Weight of asphalt concrete
7. Loading temperature
8. Signature or initial of plant representative
9. Type and grade of asphalt cement
10. Type and grade of aggregate
11. Applicable mix design method
12. Separate weights of aggregate and asphalt

G. Submit type and number of rollers required for compacting asphalt concrete

1.5 SITE CONDITIONS

A. Pave only when air and roadbed temperatures in the shade are greater than 40 deg. F and rising. The temperature restrictions may be waived only upon written authorization from ENGINEER.

B. Do not pave during rain or unsuitable weather or when surface is wet.

1.6 ACCEPTANCE

A. Acceptance of hot-mix asphalt concrete paving is based upon minimum density, minimum thickness, smoothness, and surface appearance. Smoothness and surface appearance shall be as defined by Section 32 12 16.13 of the APWA Specifications. In UDOT ROW, UDOT specifications will govern and UDOT must accept submittals.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIAL

A. The bituminous material shall be AC-10 or PG64-34, DM-1/2, 50 blow for the 1/2" mix design.

B. Sampling and testing shall be the responsibility of CONTRACTOR, and shall be performed as required in Section 01 45 00 - Quality Control and Materials Testing.

2.2 TACK COAT

A. Tack coat material shall conform to all requirements of Section 32 12 13.13 - Tack Coat (APWA).

PART 3 EXECUTION

3.1 PREPARATION

A. Preparation shall conform to all requirements of Section 32 12 16 of the APWA specifications.

B. CONTRACTOR shall map and mark all existing surface utilities within the line of work, and shall lower fixtures if pavement machine is not capable of passing over structure.

C. All asphalt and concrete surfaces within the line of work are to be removed and disposed of properly by CONTRACTOR. CONTRACTOR may, upon written authorization of OWNER, use processed asphalt materials as base course material. Excess materials shall be removed and disposed by CONTRACTOR.

D. Existing asphalt pavements and drive approach extensions to be removed shall be cut by a wheel cutter or other device capable of making a neat, reasonably straight and smooth cut without damaging adjacent pavement and/or concrete that is not to be removed. The cutting device operation shall be subject to the approval of ENGINEER.

E. Any existing base, surfacing, or pavement shall be thoroughly cleaned immediately prior to receiving the plant-mixed surfacing. Where existing pavement is being widened or extended, it shall be cut to a straight vertical face prior to the paving operations and treated with asphalt paint binder.

3.2 BASE COURSE

A. Base course material shall be placed in accordance with Section 32 11 23 of these specifications.

B. Base course surfaces shall be maintained in an acceptable condition for both moisture and density, as defined by Section 32 11 23 - Road Base, until the overlying hot-mix asphalt cement materials have been placed, at no additional expense to OWNER.

C. Processed asphalt materials may be used as base course provided that the resulting gradation for the ¾" and -200 sieves comply with the requirements of Section 32 11 23 - Road Base. Processed asphalt which has been contaminated with clay or silt materials will not be accepted.

3.3 PLACEMENT OF TACK COAT

A. Apply tack coat to all existing asphalt concrete surfaces preparatory to placing asphalt concrete pavement in accordance with Section 32 12 14 – Tack Coat of the APWA specifications.

3.4 PLACEMENT OF HOT-MIX ASPHALT CONCRETE

A. For all excavations within twenty-four (24) inches of any structure, concrete, or edge of existing pavement surface; CONTRACTOR shall remove and replace existing pavement surface to the concrete, structure, or edge of existing pavement surface.

B. Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the original pavement edge, on a straight line, parallel to the center line of the roadway.

C. Where no part of a longitudinal trench is in the pavement, surfacing replacement will only be required where existing surfacing materials have been removed.

D. Spreading shall be as nearly continuous as possible.

E. Placement shall also allow for line, grade, elevations, and thickness specified herein and as shown on the drawings.

F. When asphalt concrete is laid against vertical surfaces such as gutters, the face of the vertical surface shall be roughened for proper bonding, cleaned, and then painted with a light coating of asphalt cement or emulsified asphalt.

G. At terminations of new surface course, the asphalt concrete shall be feathered into the existing surface over such a distance as may be required to produce a smooth riding transition. Base course and single course construction shall be joined by vertical butt joints finished and rolled to a smooth surface.

H. Asphaltic concrete shall not be placed when frozen materials are present in the base or sub-base.

I. Asphaltic concrete shall not be placed during adverse conditions, i.e., rain or when a roadway surface is wet.

J. Asphaltic concrete shall be placed between April 15 and October 15. Asphalt concrete shall not be placed after October 15 and before April 15 of the following year unless roadway surface temperatures are 40° F and rising in the shade. Approval to place the asphalt concrete after October 15 and before April 15 of the following year requires written approval from OWNER.

K. Roadways not completed prior to October 15, and not meeting the requirements of this section, shall be repaired by placing a temporary 2-inch thick asphalt (or other ENGINEER approved surface) course over all exposed, earthen surfaces. These temporary surfaces shall be completely removed and repaired in accordance with these specifications at no additional expense to OWNER.

L. Asphalt rolling shall be in accordance with Section 32 12 16 of the APWA specifications. CONTRACTOR shall establish and document a rolling pattern for obtaining densities. The test strip shall be no shorter than 300 feet. Establishment of rolling patterns are for the purpose of establishing minimum rolling patterns, and shall not release CONTRACTOR of meeting all requirements of these specifications and drawings.

M. The target density for asphalt placement shall be 94 percent of laboratory density plus or minus two (2) percent. If an individual test result falls below 92 percent of maximum

density, the material represented by that test will be considered defective, and shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.

N. The minimum acceptable thickness of asphalt for completed roadways shall be 2 inches, as verified by core samples. Areas found to contain less than the minimum thickness shall be removed and replaced at no additional expense to OWNER.

O. The completed finish shall be as specified in Section 32 12 16 of the APWA specifications.

P. CONTRACTOR shall adjust the height of all street fixtures to match final grade. If required, concrete collars shall be placed around all surface street fixtures (i.e. manholes, valve boxes, monuments, etc.).

Q. CONTRACTOR shall complete all concrete collars within 2 weeks of completion of paving each roadway section.

R. CONTRACTOR shall restripe streets, as required, in accordance with Section 32 17 23 - Pavement Markings of the APWA specifications.

3.5 SITE SAFETY AND TRAFFIC CONTROL

A. Site safety and traffic control shall be the responsibility of CONTRACTOR.

B. CONTRACTOR shall verify full compliance with all applicable local, county, state and/or federal regulations.

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SECTION 33 05 05
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish and install all pipe, fittings, closure pieces, supports, bolts, nuts, gaskets, jointing material, polyethylene wrap, marker tape, tracer wire, and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

A. Related work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 50 30 Protection of Existing Utilities
3. Section 09 90 00 Painting and Finishes
4. Section 31 23 15 Excavation and Backfill for Pipelines
5. Section 33 12 00 Mechanical Appurtenances
6. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ASTM D 2041 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250

C. AMERICAN STANDARDS FOR TESTING AND MATERIAL (ASTM)

1. ASTM A 193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
2. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
3. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
4. ASTM A 536 Standard Specification for Ductile Iron Castings

D. American Society of Mechanical Engineers (ASME)

1. ASME B1.1 Unified Inch Screw Threads, (UN And UNR Thread Form)
2. ASME B18.2.1 Square, Hex, Heavy Hex, And Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)
3. ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, And Coupling Nuts (Inch Series)

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1.	AWWA C 104	Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2.	AWWA C 105	Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3.	AWWA C 110	Standards for Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch, for Water
4.	AWWA C 111	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5.	AWWA C 115	Standard for Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
6.	AWWA C 150	Standard for the Thickness Design of Ductile-Iron Pipe
7.	AWWA C 151	Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
8.	AWWA C 153	Standard for Ductile-Iron Compact Fittings, 3-inch Through 64-inch for Water
9.	AWWA C 219	Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
10.	AWWA C 600	Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
11.	AWWA C 606	Standard for Grooved and Shouldered Joints
12.	AWWA C 651	Standard for Disinfecting Water Mains
13.	AWWA M 11	Steel Pipe – A Guide for Design and Installation

1.4 SUBMITTALS

A. Submit catalog information on all pipe, fittings, valves, couplings, gaskets, tapes, bolts and nuts, wraps, safety tapes, and tracer wires as shown on the Drawings. Information shall indicate manufacture specification compliance and dimensional data.

B. Submit shop drawings on all fabricated piping and pipe supports.

C. Submit bolting patterns, procedures, and bolting equipment data, and calculations for target torque calculations.

D. Certified affidavit of compliance for pipe and fittings or other materials furnished under this Section and as specified in the referenced standards.

1.5 QUALITY ASSURANCE

A. Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to the requirements of the AWWA C151 and AWWA C150 and pipe must be certified for potable water use by the National Sanitation Foundation (NSF/ANSI 61) and must bear the logo "NSF-pw" or "NSF-61" indicating such certification. For pipes 12-inch and smaller, use 350 psi rated pipe. For pipes larger than 12-inches use Class 52 or thicker pipe. The pipe shall be provided with rubber gaskets, specials, and fittings as required. Nominal pipe laying lengths shall be 20-feet.

B. Buried Ductile Iron Pipe shall be encased with 8 mil (minimum), Group 2, Class C [black] polyethylene, conforming to the requirements of AWWA C105. All seams in the polyethylene encasement shall be taped with a minimum 12 mil adhesive tape, **Polyken #900**, **3M Scotchrap 51,** or approved equal, to completely seal the seam.

2.2 FITTINGS

A. MJ and Push-on fittings shall conform to the (AWWA C110 or C153), be NSF certified to ANSI/NSF 61 and shall be for a minimum rated working pressure of 250 psi.

B. Flanges shall conform to AWWA C110 AWWA C111, and ANSI B16.1, Class 125 and shall have either raised or plain faces, and shall have a minimum working pressure rating of 250 psi. For pipe sizes 24-inch and smaller, flanged joints may be rated for a maximum of 350 psi with the use of specially designed gaskets.

2.3 DUCTILE IRON PIPE JOINTS

A. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.

1. Mechanical and push-on joints shall conform to the requirements of AWWA C111.
2. Flanged joints shall conform to the requirements of AWWA C115.
3. Restrained joints (abbreviated “RJ”) shall conform to the requirements of AWWA C151. Restrained joints shall **be Flex-Ring, Field Flex-Ring, or Lok-Ring by American Ductile Iron Pipe, Field Lok, TR-Flex by U.S. Pipe**, or approved equal.
4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options available. CONTRACTOR may propose such devices by providing a formal substitution request indicating the locations the devices are to be used with an accompanying thrust block and that the devices is rated at least for the class of pipe being supplied. The devices shall be **MegaLug Model 1100 by EBAA Iron**, or approved equal.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED)

A. Mechanical-type couplings shall be provided where indicated on the Drawings and shall conform to the requirements of AWWA C606. Mechanical type couplings shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed. Mechanical-type couplings shall be **Victaulic Style 31 (flexible or rigid)**, or approved equal.

B. Gaskets shall be the flush seal type.

C. Mechanical-type couplings for equipment connections shall be provided with rigid grooved couplings or flexible type coupling with harness, unless thrust restraint is provided by other means.

D. Grooved fittings, couplings and valves shall be furnished from the same manufacturer as the coupling. Grooving tools shall be from the same manufacturer as the grooved components.

2.5 SOLID SLEEVE-TYPE COUPLINGS

A. Solid sleeve-type couplings shall be provided where shown on the Drawings. Coupling shall be of ductile iron and shall be of the size to fit the pipe and fittings shown. Coupling shall be pressure rated 250 psi and comply with AWWA C110. Restraints shall be provided where indicated on the Drawings.

2.6 BOLTED SLEEVE-TYPE COUPLINGS

A. Sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bonded epoxy. Couplings shall be pressure rated for 250 psi and comply with AWWA C219. Couplings shall be **Style 501 or FC1 by EJ Prescott, Style 501 by Romac**, or approved equal.

2.7 RESTRAINED BOLTED SLEEVE-TYPE COUPLINGS

A. Restrained bolted sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron or ASTM A283 Grade C steel, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bond epoxy. Couplings shall be the rated for 250 psi and comply with AWWA C219. Sleeve length shall be 7 inches for pipe diameters 4-inch through 12-inch and 10 inches for pipe diameters 14-inch and larger. Restraint gland shall be ductile iron meeting the requirements of ASTM A 536. Couplings shall be **Series 470 by Smith-Blair, Style 400RG by Romac, Series 3800 by EBAA Iron, Inc.**, or approved equal.

2.8 FLANGE COUPLING ADAPTER (DISMANTLING JOINT)

A. Provide flanged coupling adapters (dismantling joint) were shown on the Drawings. CONTRACTOR will not be allowed to substitute any other type of flanged coupling adapter unless approved by ENGINEER. The coupling shall be rated as indicated on the Drawings.

B. Flanged coupling adapter bodies shall be fabricated from steel, ASTM A512 or A 513 or Ductile Iron ASTM A536, without pipe stop. The body shall not be less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The follower ring shall be fabricated from steel, ASTM A576 or A36.

C. For flanged coupling adapters installed in piping systems rated for positive pressure, the coupling shall be restrained with harness bolts or tie rods. Other means of restraining the coupling such as set screws will not be accepted. Harnesses shall be designed in accordance with AWWA Manual 11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.

D. Gaskets shall be composed of a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.

E. Flanged coupling adapters (dismantling joints) shall be **Model 975 by Smith-Blair, Model 309 by JCM, Model DJ400 by Romac**, or approved equal.

2.9 GASKETS

A. Except as otherwise provided, gaskets for flanged joints shall be 1/8-inch thick rubber fabric and shall be NSF 61 Approved. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe**, higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange.

B. All buried fittings using steel bolts shall be coated with no-oxide wax and wrapped with polyethylene or as otherwise approved by ENGINEER.

2.10 BOLTS AND NUTS

A. Bolts and nuts shall be rated for the system working pressure with a minimum safety factor of three. Bolts and nuts inside vaults shall be zinc coated steel. Bolts and nuts above grade, exposed or inside structures, shall be zinc coated steel. Bolts and nuts buried or in corrosive environments shall be Type 304 stainless steel.

B. All flange bolt lengths shall be selected by CONTRACTOR such that three full threads, as a minimum, protrude from the hex nut and washer after assembly.

C. Flange bolts shall have ASME B1.1, Class 2A threads, and be manufactured of ASTM A 193, Grade B7 steel. Bolts shall conform to ASME B18.2.1.

D. Flange nuts shall have Class 2A fit, and be manufactured of ASTM A 194, Grade 2H steel, having square or hex heavy dimensions in accordance with ASME B18.2.2.

E. Connection T-bolts for mechanical joint (MJ) fittings shall be Cor-Ten high strength, low alloy steel conforming to AWWA C111.

2.11 CEMENT MORTAR LINING

A. Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the AWWA C104 except that the lining thickness shall be not less than 1/8 of an inch. The pipe interior surfaces shall be smooth and free from factures, excessive crazing, and roughness.

2.12 THRUST BLOCKS/ RESTRAINTS

A. All fittings for pipe 20-inch diameter and larger shall not have thrust blocks, but joint restraints for the adjacent pipe shall be provided for the distances indicated on the drawings. All fittings for pipe smaller than 20-inch diameter shall have proper thrust blocks and restraints as noted for the type of installation required. Joint restraint shall be provided for all bends, fittings, and valves regardless of pipe size or location. Thrust blocks shall be concrete as per Drawings.

B. Joint restraints shall be as defined in Subsection 2.3.A.3 of this Section.

C. Restrained joints shall be suitable for 250 psi test pressures.

2.13 SAFETY TAPE

A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35 gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words “CAUTION BURRIED JVWCD WATERLINE CALL (801) 256-4401”. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

2.14 TRACER WIRE

A. All piping (including service lines) shall be installed with 12 gauge solid copper THHN direct bury blue tracer wire for pipeline location purposes by means of an electronic line tracer.

1. The wires must be installed along the entire length of the pipe on the bottom of the pipe and be held in place with poly tape at all pipe joints and at 5 foot intervals.
2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

2.15 PIPE COATINGS

A. All exposed piping, valves, and fittings including inside vaults and buildings shall be painted as specified in Section 09 90 00 – Painting and Finishes. The exterior of buried pipe and fittings shall be an asphaltic coating approximately one-mil thick.

2.16 COLD-APPLIED WAX TAPE COATING

A. Apply wax tape coating over the following buried piping components: all flanges, valves, actuators, all bolted joints (ie, flanges, mechanical joints, couplings, etc), nuts, bolts, and all metallic appurtenances which are buried.

B. Primer: Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:

1. Color — Brown
2. Pour Point — 100°F to 110°F
3. Flash Point — 350°F
4. Coverage — 1 gallon/100 square feet
5. Manufacturer — **Trenton Wax Tape Primer, Denso Paste Primer**, or approved equal.

C. Wax Tape: Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:

1. Color — Brown
2. Saturant Pour Point — 115°F to 120°F
3. Thickness — 50 to 70 mils
4. Tape Width — 6 inches
5. Dielectric Strength — 100 volts/mil

6. Manufacturer **Trenton No. 1 Wax Tape, Denso "Densyl Tape",** or approved equal.

D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

1. Color Clear
2. Thickness 1.5 mils
3. Tape Width 6 inches
4. Manufacturer **Trenton Poly-Ply, Denso Tape PVC Self-Adhesive**, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.

B. Ductile iron fittings shall be installed in accordance with the ANSI/AWWA C600. Inspect each pipe and fitting prior to installation to verify there is no damage and clean each pipe and fitting prior to installation.

C. Pipe shall be laid directly on the bedding material. Bell holes shall be formed at the ends of the pipe to prevent point loading.

D. No pipe shall be installed on a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

E. Immediately before joining the pipe, the bell end of the pipe shall be thoroughly cleaned. The spigot end of the pipe and the inside surface of the gasket shall be cleaned and lubricated. The lubricant shall be non-toxic, shall not support bacteria growth, shall not be harmful to the gasket material, and shall be compliant with NSF/ANSI 61 requirements. The lubricant shall not impart a taste or odor to the water in the pipe. Tilting of the pipe to insert the spigot into the bell will not be permitted.

F. Buried Ductile Iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105 Method A. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before installation of the encasement. During installation, soil or embedment material shall not be trapped between the pipe and the polyethylene. Cut polyethylene tube to a length at least 2 feet longer than the pipe section. Wrap shall overlap the adjacent pipe joint at least 1 foot. After assembling the pipe joint, overlap the joint with the polyethylene tube and secure to the pipe with adhesive tape completely around the seam. Overlap the joint on the previous pipe with the polyethylene tube and secure to the existing wrap with adhesive tape and completely seal the seam. Take up the slack width at the top of the pipe to make a snug but not tight fit along the barrel of the pipe and secure with poly tape at 5 foot intervals. For installations below the water table or wet areas, circumferential wraps of tape should be placed at 2 foot intervals along the barrel of the pipe prior to lowering the pipe into the trench.

G. Repair punctures to the polyethylene wrap with adhesive tape. Repair cuts, tears, or damage to the polyethylene wrap with a tube cut open, wrapped around the pipe to cover the damaged area, and secure in place with **Polyken #900, 3M Scotchrap 51,** adhesive tape, or approved equal, to completely seal the seam.

H. Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by cutting an "X" in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance, and repair the cut and any other damaged areas.

I. To make a direct tap, apply two or three wraps of adhesive tape completely around the polyethylene encased pipe to cover the area where the tapping machine and chain will be mounted. Install the corporation stop directly through the tape and polyethylene encasement. After the direct tap is completed, inspect for damage and repair if needed.

J. Where polyethylene wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of 3 feet. Secure the end with adhesive tape completely around the seam. Service lines with dissimilar metals shall be wrapped with polyethylene or approved dielectric tape for a minimum clear distance of 3 feet away from the ductile iron pipe.

K. Valves shall be handled in a manner to prevent damage to any part of the valve. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation. Valves shall be installed so that the valve stems are plumb and, in the location, indicated on the drawings.

L. The pipe shall be plugged at the end of each work day or period of suspension.

M. Safety tracer tape shall be installed 18 inches above the pipe along the entire length of pipeline.

N. Tracer wire shall be brought up at valve boxes and fire hydrants as shown on the Drawings. When splicing a wire use a greased filled or approved connector. All splices should occur within a valve box. Wire is to be continuous underground. Underground splices may only be used by specific permission of the OWNER and must be inspected before backfill.

3.2 THRUST BLOCKS

A. Thrust blocks shall be installed at points where the pipe changes direction such as: at all tees, elbows, wyes, caps, valves, hydrants, reducers, etc.

B. Thrust blocks shall be constructed so that the bearing surface is in direct line with the major force created by the pipe or fitting.

C. Thrust blocks shall bear against solid undisturbed earth at the side and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints or the pipe or fitting.

D. Thrust blocks shall be sized and constructed per OWNER's Standards or the drawings, whichever is greater.

3.3 PRELIMINARY CLEANING AND FLUSHING

A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material do not remain in any of the pipeline. If possible, the flushing shall be made with an open pipe end.

B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.4 BOLTING PROCEDURES FOR FLANGED JOINTS

A. Flange joints shall be assembled per the gasket manufacturer's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during joining. Bolting patterns, procedures, and bolting equipment data shall be submitted prior to pipe fitting and bolting.

B. Gaskets, bolts, and anti-seize lubricant used in the bolting procedure shall be selected from those specified herein. Submit target torque calculations for each application. Calculations shall identify specific gasket (manufacturer, model, size, configuration, material), bolts (size and material), and anti-seize lubricant. The calculations shall document and take into consideration the pipe service, working and test pressures, pipe diameter, gasket data sheet, bolt material, gasket supplier-recommended assembly stress, and gasket-supplier recommended bolt stress. Calculations shall be stamped by a professional engineer. Target torque calculations shall be used in the assembly of bolted joints.

C. Flange bolts, nuts, and washers shall be visually inspected and cleaned prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate the flange surface around the bolt holes. This lubricant must be removed by cleaning solvent prior to applying a coating system. Hand-tighten all nuts and bolts then tighten them to 10 to 20 percent of the target torque. The initial torque shall not exceed 20 percent of the target torque. The bolts shall be tightened according to the pattern included in AWWA Manual M11, Figure 12-3.

D. For flanges having 4 to 8 bolts there shall be three rounds of tightening, after hand tightening, to 30 percent, 60 percent and then 100 percent of the target torque. For flanges having 12 or more bolts there shall be four rounds of tightening, after hand tightening, to 20 percent, 40 percent, 80 percent and 100 percent of the target torque. At 100 percent of target torque the flange gap shall be measured at every other bolt to confirm uniformity. The bolts shall be re-tightened to the target torque 24 hours after completion of the initial bolting sequence.

3.5 CATHODIC BONDING AND TEST STATIONS

A. Cathodically bond all ductile iron pipeline joints and provide anodes and test stations per Section 26 42 10, Galvanic Cathodic Protection.

3.6 TRACER WIRE TESTING

A. Tracer wire shall be installed where indicated above or shown on the Contract Drawings on the pipe along the entire length of pipeline.

B. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.

1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER and/or ENGINEER.
2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.7 LEAK TESTING OF PIPELINE

A. CONTRACTOR shall provide additional temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.

B. Source of Water

1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for pressure testing of the pipeline.

C. Testing Procedure

1. Pipe shall be tested at a static pressure of 200 psi for 2 hours and in accordance with the AWWA C600 standards. Pipe shall be tested in segments such that the test pressure at the low point of the segment shall be 210 psi, and the minimum pressure at the high point in the segment shall be 180 psi.
2. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the pipeline test, all at no additional cost to OWNER.
3. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

D. Pressure and Leak Test

1. CONTRACTOR shall test all piping either in sections or as a unit. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown on the Drawings in the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable leakage shall be defined as follows:

$$L = SD(P)1/2/148,000$$

L = Testing allowance (makeup water) in gallons per hour of test
S = Length of pipe in feet
D = Nominal diameter of pipe in inches

P = Average Test Pressure in pounds per square inch (gauge)

3.8 DISINFECTING

A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

3.9 PAINTING

A. All exposed piping including inside vaults shall be painted as specified in Section 09 90 00 – Painting and Finishes.

- END OF SECTION -

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SECTION 33 05 07.1
POLYVINYL CHLORIDE (PVC) PRESSURE PIPE
(ASTM D 1785, modified)

PART 1 GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish and install all PVC pressure pipe and appurtenances as shown and specified, and as required for a complete and workable piping system. Provide PVC pipe a pressure rating of 200 psi or higher.

B. This Section includes PVC pressure pipe with solvent-welded, flanged, or threaded joints in accordance with ASTM D 1785 as modified herein.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 33 00 Submittal Procedures
2. Section 05 45 00 Mechanical Metal Supports
3. Section 31 23 15 Excavation and Backfill for Pipelines
4. Section 33 12 00 Mechanical Appurtenances
5. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI B 16.5 Pipe Flanges and Flanged Fittings Class 150

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM D 1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
2. ASTM D 2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
3. ASTM F 1498 Standard Specification for Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 605 Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
2. AWWA C 651 Standard for Disinfecting Water Mains
3. AWWA C 900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch through 12-Inch for Water Transmission and Distribution

4. AWWA C 905 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14-Inch through 48-inch
5. AWWA M 23 Manual of Water Supply Practices - PVC Pipe - Design and Installation

1.4 SUBMITTALS

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

B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.

C. Submit shop drawings of pipe, fittings, and appurtenances showing compliance with this Section; and manufacturer’s literature on tracer wire and accessories.

D. Submit plan for commissioning the waterline, including but not limited to cleaning, pressure testing, and disinfection.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE

A. PVC pipe shall be made from new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, Class 12454, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785.

B. Pipe sections shall be clearly marked to:

1. Identify manufacturer's name or trademark
2. Nominal pipe size and OD base
3. ASTM material code designation
4. Schedule
5. Pressure class
6. ASTM specification designation
7. Product record code

C. **PVC pipe shall be schedule 80 unless otherwise noted.**

2.2 PIPE JOINTS

A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the chemical in the pipe.

B. Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.

C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

A. Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

B. Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. flanges to ASME B 16.5.

2.4 TRACER WIRE

A. All buried piping (including service lines) shall be installed with 12 gauge solid copper THHN tracer wire for pipeline location purposes by means of an electronic line tracer.

1. The wires must be installed along the entire length of the pipe on the top of the pipe and be held in place with ties or hitches spaced not more than 12-feet apart.

2. Sections of wire shall be spliced together using approved splice caps and waterproof seals or solder. Twisting the wires together is not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.

B. PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.

C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 – Mechanical Metal Supports (Pipe Supports). Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.

D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

3.3 PIPE JOINTS

A. Pipe threads shall conform to ASTM F 1498 and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.

B. Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, according to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket. Solvents used on potable water pipes shall be ANSI/NSF 61 certified.

C. Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts, unless noted otherwise. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.4 PRELIMINARY CLEANING AND FLUSHING

A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible, the flushing shall be made with an open pipe end.

B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.5 TRACER WIRE TESTING

A. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.

1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER OR ENGINEER.

2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.6 INSPECTION AND TESTING OF PIPELINE

A. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.

B. Source of Water

1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.

C. Testing Procedure

1. CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Drawings. Caution - Do not use air or gas for testing PVC pipe. Where

no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices

2. In Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.

3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.

4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

3.7 DISINFECTING

A. Disinfection shall be in accordance with Section 33 13 00 - Pipeline Testing and Disinfection for water bearing piping.

- END OF SECTION –

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SECTION 33 05 13
PRECAST CONCRETE MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents

B. Precast reinforced concrete roof Work and roof panels for vault roofs shall comply with the following:

1. Structural Notes, Inspections, and Tests on Sheets S-1 and S-2
2. All Structural Sheets (S-1 to S-4) and other Plans.
3. Division 3 (Concrete) Specifications.

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittals
2. Section 01 45 00 Quality Control and Materials Testing
3. Section 01 60 00 Product Requirements
4. Section 31 23 15 Excavation and Backfill for Buried Pipelines
5. Section 31 23 23 Excavation and Backfill for Structures
6. Section 33 05 05 Ductile Iron Pipe

1.3 REFERENCES

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

B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

1. ASTM A 48 Standard Specification for Gray Iron Castings
2. ASTM A 536 Standard Specification for Ductile Iron Castings
3. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
4. ASTM A 1018 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
5. ASTM B 86 Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings
6. ASTM C 150 Standard Specification for Portland Cement
7. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections
8. ASTM C 497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
9. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

10. ASTM C 858 Standard Specification for Underground Precast Concrete Utility Structures
11. ASTM C 913 Standard Specification for Precast Concrete Water and Wastewater Structures
12. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
13. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
14. ASTM C 1802 Standard Specification For Design, Testing, Manufacture, Selection, And Installation Of Horizontal Fabricated Metal Access Hatches For Utility, Water, And Wastewater Structures

C. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. AASHTO M 306 Standard Specification for Drainage, Sewer, Utility, and Related Castings

1.4 SUBMITTALS

A. CONTRACTOR shall provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate manhole and concrete structure locations, elevations, and piping sizes, material, and elevations of penetrations.

C. Product Data: Submit cover and frame construction, features, configuration, and dimensions. Submit pipe connector materials and dimensions. Submit manhole step materials and dimensions. Submit manhole and structure joint sealant materials.

1.5 QUALITY ASSURANCE

A. CONTRACTOR shall demonstrate that manholes and structures have been properly installed, level, with tight joints, at correct elevations and orientations, and have been backfilled and compacted in accordance with the specifications.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Comply with precast concrete manufacturer’s instructions for unloading, storing and moving precast manholes and structures.

C. Store precast concrete manholes and structures to prevent damage to OWNER’s property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES

A. Reinforced precast concrete manholes in accordance with ASTM C 478 with HS-20 loading. Axial length of barrel sections shall be selected to provide the correct total height with the fewest joints. Conical sections shall be designed to support cast iron frames and covers under H-20 loading, unless noted otherwise. Design criteria shall be as shown on the Contract Drawings. Manholes shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.

B. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990. Wrap exterior section joints with membrane waterproofing and exterior joint wrap meeting the requirements of ASTM C877, Type III, **Marmac, Conseal CS212, or Press-Seal Corp EA-Wrap**, or approved equal.

C. Barrel section to pipe connections shall be sealed with resilient connectors, **Kor-N-Seal by Trelleborg**, or approved equal, complying with ASTM C 923. Mechanical devices shall be stainless steel.

2.2 STRUCTURES

A. See Structural Drawings for additional requirements.

B. Provide reinforced concrete structures and vaults designed for the applications and sizes as shown on the Contract Drawings. Structures shall conform to the requirements of ASTM C 857, ASTM C 858, or ASTM C 913 as required. The minimum wall thickness shall be 5-inches. Cement shall be Type V Portland cement conforming to the requirements of ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. Reinforcing steel shall be embedded in the concrete with a minimum rebar clear cover as recommended by ACI 318. Structure and vaults shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.

C. Structures in areas subject to traffic, and all areas within public street rights of way, including areas behind sidewalks, shall be designed for HS-20 traffic loading with the depth of cover as shown on the plans. Structures Vaults in areas not in public rights of way shall be designed for a minimum vertical live load of 300 psf.

D. Where joints are required, joints shall be interlocking to secure proper alignment between members and shall prevent migration of soil through the joint. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990. Wrap exterior section joints with membrane waterproofing and exterior joint wrap meeting the requirements of ASTM C877, Type III, **Marmac, Conseal CS212, or Press-Seal Corp EA-Wrap,** or approved equal.

E. Openings, where required, shall be of the size and location indicated on the Contract Drawings and shall be provided without obstructions from brackets and supports. Unless noted otherwise, frames and covers shall be fabricated from steel and galvanized after fabrication. Frames shall be integrally cast into the structure concrete sections. Covers shall be tight fitting to prevent dirt and debris entering the structure.

F. Where penetrations are required for piping, conduits, or ducts, such penetrations shall be through precast openings or core drilled through unreinforced thin-wall knock-out sections. Penetrations shall be smooth and exposed reinforcing steel will not be allowed. Unless

noted otherwise, structures do not need to be designed to resist thrust from piping passing through the structure.

2.3 FRAMES AND COVERS

A. Manufacturers. Use only manufacturers called out on the plans unless noted otherwise. If not called out, use D & L Foundry and Supply, East Jordan Iron Works, South Bay Foundry, or approved equal. Use model number shown on the Drawings.

B. Product Description: Casting frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 35B for Gray Iron and ASTM A 536 for ductile iron. Unless noted otherwise, cast iron covers and frames shall be 30-inches in diameter, machined flat bearing surface, removable lid; HS-20 load rating; with embossed lettering saying “JVWCD” cast into cover.

2.4 COMPONENTS

A. Use fabricated stainless steel ladders per details on plans.

2.5 CONFIGURATION

A. Shaft Construction: Square or rectangular with flat lid top section; lipped male/female joints; shaped to receive pipe sections.

B. Clear Inside Dimensions: As indicated on the Contract Drawings.

C. Design Depth: As indicated on the Contract Drawings.

D. Clear Cover Opening: As indicated on the Contract Drawings.

2.6 BEDDING AND COVER MATERIALS

A. Bedding: 3/4" Washed Rock as specified in Section 31 23 23.

B. Soil Backfill to Finish Grade: Trench Backfill Material as specified in Section 31 23 15.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify built-in items are in proper location, and ready for roughing into Work.

C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

A. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

B. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Lift precast components at lifting points designated by manufacturer.

B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 23.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer's plant.

G. Verify manholes and structures installed satisfy required alignment and grade.

H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe.

I. Steps shall be installed 12-inches on centers vertically not more than 1/2-inch out of plumb. The top step shall not be more than 12-inches below the manhole cover.

J. Prior to backfilling, fill all cracks and voids in the manholes or vaults with non-shrink grout, polyurethane sealant, or both.

3.4 FRAME AND COVER INSTALLATION

A. Set frame and cover 2-inches above finished grade for manholes and structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1-inch below top surface of frame.

B. In paved areas set frame and cover 1/4" below finished grade and install concrete collar.

3.5 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control and Materials Testing: Field inspecting, testing, adjusting, and balancing.

B. Vertical Adjustment of Existing Manholes and Structures

1. Where required, adjust top elevation of manholes and structures to finished grades shown on Contract Drawings.

2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

- END OF SECTION –

SECTION 33 12 00
MECHANICAL APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install all valves, and equipment, complete and operable in accordance with the Specifications. Provide the valve classes, manufacturers, models and pressure ratings called out on the plans.

B. Where two or more valves or equipment of the same type and size are required, the valves shall be furnished by the same manufacturer.

C. Flanges shall match flange size and bolt pattern of adjacent piping and appurtenances. All valves and piping appurtenances shall be pressure rated higher than working pressure of system.

D. **Certify all valves have been shop tested and have zero leakage across closed seat. Demonstrate to Engineer by field testing (by pressure or water leakage) that each valve that it has zero leakage.**

E. **All valves in 11400S Pipeline Corridor (ie buried valves and valves in vaults from at 100E and 700E) shall be rated to 350 psi min** – except valves downstream (south of) globe valves which reduce pressure and control flow out of JVWCD system into Draper and Water Pro systems.

1.2 RELATED WORK

A. Related work specified in other sections:

1. Section 01 33 00 Submittals
2. Section 01 45 00 Quality Control & Materials Testing
3. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
4. Section 33 05 05 Ductile Iron Pipe
5. Section 33 05 07.1 Polyvinyl Chloride (PVC) Pressure Pipe (Modified)
6. Section 33 13 00 Pipeline Testing and Disinfection
7. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)

1.3 REFERENCES

A. The latest editions of the following publications form a part of these specifications to the extent referenced. The publications are referred to in the text to by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
2. A 216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
3. B 584 Standard Specification for Copper Alloy Sand Castings for General Applications
4. D-1763 Standard Specification for Epoxy Resins

C. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. C-504 Rubber-Seated Butterfly Valves, 3-inch through 72-inch
2. C-509 Resilient-Seated Gate Valves for Water Supply Service
3. C-512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
4. C-515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
5. C-540 Standard for Power-Actuating Devices for Valves and Sluice Gates
6. C 550 Protective Interior Coatings for Valves and Hydrants

D. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. B 16.1 Gray Iron Pipe Flanges and Flanged Fittings
2. B 16.34 Valves – Flanged, Threaded, and Welding End

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittals.

B. Submit catalog cut sheets on all mechanical appurtenances including: fittings, valves, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance, Cv factor, pressure rating, and dimensional data.

PART 2 PRODUCTS

2.1 GATE VALVES

A. Gate valves shall conform to the requirements of AWWA C-509 or AWWA C-515, and shall be NSF-61 Certified. Valves shall be of the resilient-seat type with non-rising stem, opening to the left, and provided with a 2-inch square operating nut for buried valves or handwheel for valves located in structures. Buried valves shall be of flange or mechanical joint design to match pipe joint system.

B. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes to 3-inches above grade in unimproved areas or at grade with concrete collar in improved areas. All valves and gates shall be new and of current manufacture. The new 16” gate valve shall have a right-angle drive to allow the valve to be installed on its side.

C. The valves shall have an FDA, EPA, AWWA C550 and ASTM D1763 approved two-part thermosetting epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water and complies to NSF 61.

D. The flanges of valves may be raised or plain faced. Where plans call out Class 250 valves or flanges, provide Class 250 flanges, otherwise provide ANSI B16.1 Class 125 flanges.

E. Where plans call out 350 psi rated gate valves provide such, otherwise provide 250 psi rated gate valves. All valves shall be furnished with pressure classes equal to or better than the pressure class of the pipe with which the valves are to be used. Unless otherwise

specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

F. Gate valves shall be manufactured by Clow, Mueller, or approved equal.

2.2 BUTTERFLY VALVES

A. Butterfly valves shall be high performance valves complying with MSS SP-68, with a double eccentric seat, disc and stem design. The valve must meet the latest ASTM, ANSI and API standards for material, design and testing specifications. Stem bearings must be constructed of PTFE and stainless-steel material. The valve stem is to be a one-piece design. Packing must have an adjustable, two-bolt pull down design. Lugged valves must be capable of fully rated double dead-end service. Valves shall be NSF 61 certified and have a Flange by Flange, Flange by Mechanical Joint, Mechanical Joint, or wafer body style, as indicated on the drawings.

B. Provide the valve classes, pressure ratings, and manufacturers called out on the plans.

1. 11400S 100E Vault: 24" and 30" butterfly valves shall be class 300 valves with Class 300 flanges rated to over 400 psi. Certify valves have passed shop test with zero leakage.
2. Electric Actuator for 30" butterfly valve shall be Rotork or AUMA. Submittals shall show this actuator to scale and how it fits and can be easily functionally maintain within the limited space in the vault, it piping, valves, and actuators.
3. All other butterfly valves shall be rated to at least 250 psi min working pressure.

C. Valves shall have a hand wheel operator, 2-inch Standard AWWA nut operator, or traveling nut actuators rated at 450 ft. lbs. torque and extensions as indicated on Plans.

D. Valves shall have FDA, EPA, AWWA C550 and ASTM D1763 approved two-part thermosetting epoxy protective coating (10 mil min inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified.

E. Double Eccentric Butterfly valves shall be **VAG EKN, Av-Tek DEX** or approved equal.

2.3 BALL VALVES

A. **Class 300 Flanged Stainless Steel Ball Valves.** On 11400S Pipeline, upstream of pressure reducing/flow control valves, provide class 300 stainless steel flanged full port ball valves 720 psi CWP, NSF61, **Apollo 87A-900**, or approved equal.

B. **Stainless Steel Ball Valves** (other than those above) shall be NSF61, threaded, 1000 psi CWP, full port, with adjustable stem packing gland; body and ball of ASTM A351 stainless steel; seats of reinforced and packing stem of PTFE; handle of 304 stainless steel with vinyl insulator. Valves shall conform to MSS-SP-110. Valves shall be **Apollo 76F-100-A, NIBCO T-585-S6-R-66-LL, Watts Series S-FBV-1**, or approved equal.

C. Brass Ball Valves shall feature brass body construction with NPT female threaded connections, brass non-rising stem and gland, PTFE packing, brass threaded bonnet, solid wedge disc, and cast iron cross-handle handwheel. Minimum Pressure shall be 200psi. Valves shall be Watts WGV-X, LFWGV or approved equal.

2.4 VALVE BOXES AND LIDS

A. All buried valves shall be installed complete with 6-inch diameter slide type, two-piece cast iron valve box. Manufacturer be **Tyler 562 Series**, **D&L Foundry M-8064**, or approved equal. The valve box lid shall be designated “JVWCD” unless noted otherwise on the drawings.

B. Concrete Collars shall be 10" thick x 2'- 6" in diameter centered on the valve box. Concrete shall be 3000 psi minimum.

2.5 PRESSURE GAUGES

A. Pressure gauges shall be provided where shown on the drawings. Gauges shall meet the requirements of ASME B40.1 Grade 2A and be industrial type with stainless steel movement, liquid filled, and stainless steel, Polypropylene, or Phenolic case. Gauges shall have a rear blowout disc or panel. Unless noted otherwise on the drawings, pressure gauges shall have a 4-1/2-inch dial with white face and black lettering, a ½-inch threaded connection, and shut-off valve. Measuring element shall be a stainless steel Bourdon Tube. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 0.5 percent to 150 percent of the working pressure. Gauges shall be manufactured be **Ashcroft Model 1279 Duragauge, 1900 Series SOLFRUNT by Ametek (U.S. Gauge), Process Gauge by Marsh Bellofram**, or approved equal.

1. Pressure gages on 11400 South Pipeline:
   a. Upstream of flow control valves: gages shall be 0 to 400 psi
   b. Downstream of flow control valves: gages shall read 0 to 200 psi

2.6 COMBINATION AIR/VACUUM VALVES

A. Combination Air/Vacuum valves shall be single body, double orifice valves conforming to the requirements of AWWA C 512. Valve float shall be stainless steel. Valves shall be the size indicated on the drawings and shall be **Val-Matic 200C Series (201C to 203C)**, no approved equal.

2.7 PRESSURE REDUCING VALVES

A. Pressure Reducing Valves shall be as follows:

1. For 700E Vault to Water Pro, provide a new Singer 106 RF Valve with a simple pressure reducing function with a downstream pressure setting of 70 psi. Valve will be manually operated and exercised by Water Pro (no remote control).
2. Control pilot the main valve and pilot valve shall both close drip tight.

B. Valve shall be single diaphragm actuated, globe type valve. Valve stem and trim shall be stainless steel and the valve body shall be steel conforming to ASTM A 216, Grade WCB. Ends shall be class 250 flanged (except for reuse of existing valve at State St). Valve manufacturer shall provide a 3 year warranty on the valve and 1 year warranty on the electrical components.

C. Provide valve position transmitter.

D. For each new valve, provide a direct factory representative for 4 hours of start-up assistance, inspection and adjustments so that valve function is works per manufacturer recommendations.

2.8 HOSE BIBBS

A. Provide ¾" **400 psi Apollo MPT x MGHT stainless steel ¼ turn hose bibb**, no equal, with ¾" pressure reducing valve upstream.

2.9 SERVICE SADDLES

A. Shall consist of a 2-piece bronze body and strap, meeting applicable sections of AWWA C800. Outlet shall be tapped with AWWA I.P. thread (F.I.P.T.). Outlet shall be o ring sealed. Saddles shall be ANSI/NSF 61 certified. Shall be **Mueller H-13000 Series, Romac Style 202B**, or approved equal.

2.10 STEEL SPOOLS AND STEEL FITTINGS

A. Steel Spools and Steel Fittings shall be sized to match the existing conditions of the piping. They shall meet the requirements of Section 33 92 10 – Steel Pipe, Specials and Fittings.

2.11 DISMANTLING JOINTS

A. Dismantling Joints bodies shall be fabricated from steel, ASTM A512, without pipe stop. The body shall not be less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The follower ring shall be fabricated from steel, ASTM A576 or A36.

B. For Dismantling Joints installed in piping systems rated for positive pressure, the coupling shall be restrained with harness bolts or tie rods. Other means of restraining the coupling such as set screws will not be accepted. Harnesses shall be designed in accordance with AWWA Manual 11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Hardware and tie rods shall be Type 316 stainless steel with coating to prevent galling.

C. Gaskets shall be composed of a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.

D. Dismantling Joints shall be Model 975 by Smith-Blair, Model DJ400 by Romac, or approved equal.

2.12 GASKETS AND BOLTS

A. Except as otherwise provided, gaskets for flanged joints shall be 1/8-inch thick rubber fabric and shall be NSF 61 approved. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe**, higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange and shall be NSF-61 approved.

B. All bolts and nuts shall be zinc plated. Bolts shall be rated for the system working pressure with a minimum safety factor of three.

2.13 BRASS PIPING

A. Brass piping shall match iron pipe size standards and meet ASTM B 43 Standards for Seamless Red Brass Pipe.

2.14 UNIONS

A. Furnish and install unions for each valve or piece of equipment to permit easy installation and removal of equipment.

2.15 FLOW METER

A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

2.16 PRESSURE TRANSMITTERS

A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

PART 3 EXECUTION

3.1 INSTALLATION

A. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes at grade with concrete collars. All valves and boxes shall be new and recently manufactured.

B. Install mechanical appurtenances as indicated on the plans and in accordance with the manufacturer's written instructions.

- END OF SECTION -

SECTION 33 13 00
PIPELINE TESTING AND DISINFECTION

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers testing and disinfection in order to remove bacteriological contamination of the pipeline. Disinfection is only required if the pipeline is used for potable water.

B. CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and dechlorination of such water, if required.

1. All pressure pipelines shall be tested.
2. Working and testing pressures for the system are as shown on the Drawings.

1.2 RELATED SECTIONS

A. Including but not limited to the following:

1. Section 01 33 00 Submittal Procedures
2. Section 33 12 00 Mechanical Appurtenances
3. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, Modified)

1.3 REFERENCES

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

1. AWWA C-651 - Disinfecting Water Mains
2. Utah Public Drinking Water Regulations

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittals.

B. Furnish a written testing plan and schedule, including proposed chemicals, water source, methods for conveyance to the project, sequence, control, and disposal. District will take the bacteriological tests.

C. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24-hour disinfectant residuals in treated water in parts per million (ppm) for each outlet tested.
6. Date and time of start and completion for flushing.
7. Disinfectant residual after flushing in ppm for each outlet tested.

PART 2 MATERIALS

2.1 DESCRIPTION

A. All test equipment, temporary valves, bulkheads, and other water control equipment, shall be as determined and provided by CONTRACTOR. No materials shall be used which damage the project pipelines for future conveyance of potable water.

B. Disinfecting materials shall consist of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

PART 3 EXECUTION

3.1 GENERAL

A. Source of Water

1. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing and disinfection of the water line system. All testing water used in the pipeline shall be potable water from a State approved drinking water system.
2. All pressure pipelines shall be tested.
3. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the State of Utah, Division of Water Quality.

3.2 HYDROSTATIC AND LEAKAGE TESTING OF PIPELINES

A. CONTRACTOR shall invite Engineer to inspect all piping for leaks, either by monitoring with CONTRACTOR pressure gages, or by visual inspection, each inspection below:

B. **4300S 2200W:** Construct new 12” WSP, 12” GV, 4” GV and restore service. Visually inspect for leaks before wax tape coating and backfilling. Pressurize and visually inspect 40-feet of 2-inch SS pipe before backfilling. Visually inspect AV piping for leaks in 60” MH.

C. **4400S 300W:** Construct new 12” DIP piping, 12” GV, 4” GV’s and restore service. Visually inspect for leaks before wax tape coating and backfilling. Pressurize and visually inspect 40-feet of 2-inch SS pipe before backfilling. Visually inspect AV piping in 60” MH.

D. **4500S 350E:** Construct new 4” piping and GVs. Visually inspect for leaks in 60” MH before, wax tape and Wasser coating pipe and valves per plans. Leave MH un-backfilled

E. **Leak Test All 11400S Pipe Isolation Valves in a 48 Hour Leak Test:**
1. Preparatory Construction and Testing Work:
a. Construct and leak test 700E vault (rehab) piping and valves (see Sheet C-12).

2. Then construct and leak test **all 11400S Pipeline Isolation Valves**, including:

a. **Install 12" Buried GV at 700E**: Remove 12" buried BFV and replace with 350 psi buried 12" GV (see Sheet C-6) and connect GV to downstream pipes (ie new 12" DIP piping to 700E Vault).
   1) Leak test new 12" 350 psi buried GV's filling both pipes from 350 psi GV to new 400 psi Apollo hose bibb in 700E vault verifying there is no flow out of Apollo hose bibb valves.
   2) Note: visually leak test other valves in 700E vault similarly.

b. **Install & Test 100E Vault Valves:** Replace 30" / 24" BFVs and WSP (see Sht C-11B), then pressurize 11400 South Pipe and inspect for leaks as follows:
   1) Close 30" and 24" BFVs. Fill 33" Pipe East of 30" BFV. Disassemble all 30" and dismantling joints. Visually inspect 30" BFV and East 24" BFV for leaks.
   2) Fill 33" pipe West of 30" BFV and visually inspect West 24" BFV for leaks.
   3) Visually inspect 8" (to drain), 4" (to AV), and 2" bypass valves for leaks
   4) Reassemble all dismantling joints, pressurize and visually inspect all piping. All closed valves and all piping shall have zero leakage.

F. Before hydrostatic testing, clean pipelines 24-inches diameter and larger by sweeping clean of debris and visually inspecting they are clean.

G. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. CONTRACTOR may test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Sections that have a zero leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days or paint lining has cured. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water (maximum filling velocity shall not exceed 0.25 foot per second, calculation based on the full area of the pipe). CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the pipe being tested or any other pipe that it connects to. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. Care shall be taken that air relief valves are open during filling.

H. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to ENGINEER shall be taken. Additional water shall be added to the pipeline to replace any water absorbed by the cement mortar lining.

I. The hydrostatic test shall consist of holding the designed test pressure (system pressure or as otherwise specified for the valve vaults) on the pipeline segment for a period of 2 hours. Visible leaks that appear during testing shall be repaired. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period.

J. Pipe with welded joints shall have no leakage.

K. Exposed piping and valves shall show no visible leaks and no pressure loss during the test.

L. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

M. Isolation valves (gate valves, butterfly valves, ball valves, etc) shall be tested during startup to verify joints and isolation valve seats have no leakage. Flow control valves (ie pressure reducing valves) shall be tested to verify min and max upstream and downstream pressures and flows at each.

N. Blowoff isolation valves (gate valves and plug valves) shall be operated and tested during a simulated blow down operation to demonstrate functionality of the valves to the satisfaction of ENGINEER. Isolation valves (gate valves or butterfly valves) shall not be used for throttling.

3.3 DISINFECTING OF PIPELINES PROCEDURE

A. Leakage and pressure testing must be completed prior to disinfection procedures.

B. All water and solution piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the "American Water Works Association Standard for Disinfecting Water Mains" (AWWA C651).

C. CONTRACTOR may use one of the three chlorination methods – tablet, continuous feed, and slug, as outlined in AWWA C651 that is acceptable to OWNER. Care must be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

D. Heavily chlorinated water shall not be discharged onto the ground or into surface drainage facilities. Upon completion of disinfection, Sodium Bisulfate (NaHSO4), or other approved dechlorination agent, shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 0.01 ppm total chlorine residual.

E. After approval of disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.3 ppm.

F. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the pipeline being tested. Sampling and testing will be completed by CONTRACTOR. All samples shall be tested for bacteriological (chemical and physical) quality in accordance with ”Standard Methods for Examination of Water and Wastewater” and shall show the absence of coliform organisms. If the initial disinfection fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense of CONTRACTOR.

3.4 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

B. Final Fill: After successful pressure and disinfection tests are completed, the pipeline(s) shall be filled with fresh potable water and shall remain filled.

- END OF SECTION –

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SECTION 33 92 10
STEEL PIPE, SPECIALS, AND FITTINGS (AWWA C 200)

PART 1 GENERAL

1.1 DESCRIPTION

A. "WSP" (welded steel pipe) is an abbreviation for welded steel pipe, specials, and fittings.

B. Provide, fabricate and install steel pipe (WSP), specials, and fittings, complete and in place, in accordance with AWWA C200 and as modified herein.

C. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets.

D. CONTRACTOR shall provide fabrication and installation of steel pipe, specials, and fittings, complete and in place, in accordance with AWWA C200 and as modified herein.

E. A special is defined as any piece of pipe other than a normal full length of straight pipe. This includes, but is not limited to, elbows, manhole sections, short pieces of straight pipe, reducers, tees, and bulk heads.

F. Default Linings and Coatings: Unless plans require otherwise, all steel pipe, fittings, and specials in vaults shall have these linings and coatings:

1. Shop lined and coated buried steel pipe: AWWA C214 tape coated with AWWA C205 mortar lining and coating in accordance with this section.
2. Field coating of buried steel tees, outlets, flanges, and existing pipe connections: Wax Tape Coat in accordance with Section 33 05 05 (see paragraph 2.16).
3. Field coating of other welded joints / butt straps (except outlets, flanges): Shrink sleeve coat in accordance with this Section.
4. Shop and Field In-Vault Pipe Coatings: System 4 in accordance with Section 09 90 00. Some sites require field coating after welding. Some sites also require limited wax tape coating in accordance with Section 33 05 05.
5. Shop and Field In-Vault Pipe Linings: Mortar line in accordance with this section. Some sites require field mortar lining after welding.

1.2 RELATED WORK

A. Related Work specified in other sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control Testing
3. Section 01 45 23 Testing Agency Services
4. Section 01 50 30 Protection of Existing Facilities
5. Section 09 90 00 Painting and Finishes
6. Section 09 98 10 Pipeline Coatings and Linings
7. Section 31 23 15 Excavation and Backfill for Pipelines
8. Section 33 12 00 Mechanical Appurtenances
9. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI B16.1 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
2. ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
3. ANSI/AWS B2.1 Specification for Welding Procedure and Performance Qualification

C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

1. ASME B 16.3 Malleable Iron Threaded Fittings
2. ASME B 16.5 Pipe Flanges and Flanged Fittings
3. AMSE Boiler and Pressure Vessel Code

D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 20 Standard Specification for General Requirements for Steel Plates for Pressure Vessels
2. ASTM A 193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
3. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
4. ASTM A 234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
5. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
7. ASTM A 370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
8. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts
9. ASTM A 572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
10. ASTM A 578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
11. ASTM A 1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
12. ASTM A 1018 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
13. ASTM E 165 Standard Practice for Liquid Penetrant Examination for General Industry

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 200 Steel Water Pipe 6-inch and Larger
2. AWWA C 205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4-inch and Larger-Shop Applied
3. AWWA C 206 Field Welding of Steel Water Pipe
4. AWWA C 207 Steel Pipe Flanges for Waterworks Service - Sizes 4-inch Through 144-inch
5. AWWA C 208 Dimensions for Fabricated Steel Water Pipe Fittings
6. AWWA C 209 Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
7. AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
8. AWWA C 214 Tape Coating Systems for the Exterior of Steel Water Pipelines
9. AWWA C 216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings
10. AWWA C 219 Bolted, Sleeve-Type Couplings for Plain-End Pipe
11. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
12. AWWA C 606 Standard for Grooved and Shouldered Joints
13. AWWA C 651 Standard for Disinfecting Water Mains
14. AWWA M 11 Manual of Water Supply Practices – Steel Pipe – A Guide for Design and Installation

F. AMERICAN WELDING SOCIETY D1.1 WELDING CODE

1.4 SUBMITTALS

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

B. Shop Drawings

1. Prepare and submit certified dimensional drawings consistent with the pipeline alignment and grade in the Contract Drawings, including all fittings and appurtenances, and with the size, location, elevation and slope information of existing utilities, pipelines, and encasements obtained by CONTRACTOR in accordance with Section 01 50 30 - Protection of Existing Faciliti.
2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances; and other pertinent information required for the manufacture of the product. Standard joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.
3. Details for elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement. Fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the drawings. Provide design calculations for all fittings and specials, including all reinforcement requirements.
4. Material lists and steel reinforcement schedules that describe materials to be utilized.
5. Line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, and the direction of each fitting in the completed line

compatible with requirements of AWWA Manual 11 (M-11). In addition, the line layouts shall include:

a. The pipe station and invert elevation at every change in grade or horizontal alignment.
b. The station and invert elevation to which the bell end of each pipe will be laid.
c. Elements of curves and bends, both in horizontal and vertical alignment.
d. Pipe joint type.
e. The limits within each reach of each type of field-welded joint and of concrete encasement.
f. Location of mitered pipe sections, beveled ends, butt straps and deep bell lap joints for temperature stress control.
g. Location and details for each valve, meter, pump, fitting, and other equipment as shown on the drawings used to determine pipe dimensions. Include location of closures, cut-off sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
h. Location of bulkheads, including those shown and as required, for hydrostatic testing of pipeline.

6. Welding Information
   a. The Shop Drawings shall define the weld type and distinguish between shop and field welds. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important and shall be carefully controlled to minimize shrinkage stresses and distortion.
   b. Written welding procedures for shop and field welds, including Welding Procedures Specifications (WPS's) and Procedure Qualification Records (PQR's) shall be submitted.
   c. Written nondestructive testing procedure specifications and nondestructive testing personal qualifications for shop and field welds shall be submitted.
   d. Current (within the last 6 months) Welder Performance Qualifications (WPQ's) shall be submitted for each welder used prior to their performing any Work either in the shop or field. Qualification testing shall be as specified in paragraph 1.3 – Quality Assurance.
   e. Submit the credentials of CONTRACTOR's Certified Welding Inspectors (CWI's) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society (AWS), QC-1 Certification. Other nondestructive testing (NDT) quality control personnel shall be certified as required by AWS D1.1.
   f. Submit NDT data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic testing (RT), magnetic particle testing (MT), dye penetrant testing (PT), ultrasonic testing (UT), or air test examination methods as specified. Test data shall be reviewed and signed by the CWI.
   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 written weld repair procedure for each type of shop and field weld proposed for use on the project.
   i. Submit a written rod control procedure for shop and field operations demonstrating how CONTRACTOR intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the rods are used for each weld.

7. Drawings showing the location, design, and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.
8. Details and locations of closures for length adjustment and for construction convenience. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation prior to starting any field welding. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures. Submit plan for monitoring pipeline temperatures.
9. Detail drawings indicating the type, number, and other pertinent details of the slings, strutting, and other methods proposed for pipe handling during manufacturing, transport, and installation.
10. Manufacturer's written Quality Assurance/Control Program.

C. Certifications: CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in AWWA C 200, AWWA C 205, AWWA C 206, AWWA C 207, AWWA C 208, AWWA C 209, AWWA C 214, AWWA C 216, AWWA C 219, and the following supplemental requirements:

1. Certified copies of mill test reports on each heat from which steel is rolled. Test shall include physical and chemical properties. Submit certified copies of mill test reports for flanges.
2. Hydrostatic test reports.
3. Results of production weld tests.
4. Sand, cement, and mortar tests.
5. Records of coating application, including technical data sheets, manufacturer name, product name and thickness.

D. Performing and paying for sampling and testing necessary for certification are CONTRACTOR's responsibility.

E. Manufacturer’s Qualifications: Furnish a copy of manufacturer’s certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer’s experience in fabricating AWWA C200 pipe. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe for this project.

F. Design Calculations of Fittings and Specials: Furnish a copy of design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of pipe, fittings, and specials.

1.5 QUALITY ASSURANCE

A. Pipe Manufacturer Qualifications: The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator’s Association (SPFA), or Lloyd’s Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this project. The manufacturer shall have the capability of meeting the schedule requirements of this project. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel. Verification of experience and production capability will be conducted as part of the initial submittal review process for steel pipe and the CONTRACTOR’s progress schedule.

B. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C205, C206, C208, and C214 as supplemented by the requirements herein. CONTRACTOR shall notify ENGINEER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.

C. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C205, C206, C208, and C214 as applicable.

1. After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel. The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.
2. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment. One set of tests per operator per work shift shall be performed.
3. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test provided welds are tested by nondestructive means and demonstrated to be sound.
4. Material tests shall be performed at no additional cost to OWNER. ENGINEER and OWNER shall have the right to witness testing conducted by CONTRACTOR or pipe manufacturer/fabricator; provided that CONTRACTOR's schedule is not delayed for the convenience of ENGINEER or OWNER.

D. Welding Procedure Specifications: Welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for welds in the shop or the field. Welds qualified per the ASME BPVC shall include supplementary Essential Variables for notch-tough welding. Provisions of ANSI/AWS D1.1 qualified welds pertaining to notch-tough welding shall apply.

E. Welder Performance Qualifications: Welding shall be performed by skilled welders, welding operators, and tackers who have had experience in the methods and materials to be used. Welders shall be qualified per the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds.

F. Shop Testing of Steel Plate Specials:

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: This applies to bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.
2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165, Method A or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.
3. Reinforcing plates shall be tested by the solution method using approximately 40 psi air pressure introduced between the plates through a threaded test hole. Test hole shall be properly plugged following successful testing.

4. Any weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures. Weld defects shall be gouged out and re-welded. After corrections, the special shall be retested.
5. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.
6. Testing shall be performed before joints have been coated or lined.
7. Ultrasonic examination shall be performed in accordance with the following:
    a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:
        1) Any plate in the welded joint has a thickness exceeding 1/2-inch.
        2) Any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service.
    b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.
    c. The ultrasonic examination shall be in accordance with ASTM A578 with a Level I acceptance standard.
8. Plates that are not in conformance with the acceptance criteria in ASTM A578 may be used in the WORK if the areas that contain the discontinuities are a distance at least 4 times the greatest dimension of the discontinuity away from the weld joint.

G. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as indicated below. Testing shall include submitting written documentation of procedures per Section V of the ASME Boiler and Pressure Vessel Code, and acceptance criteria shall be in accordance with Section VIII of the ASME BPVC.

1. Field Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME BPVC Section VIII Division 1. If in the opinion of the ENGINEER, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
2. Fillet Welds: 100 percent examine every fillet weld using the magnetic particle inspection method.
3. Groove Welds: 100 percent ultrasonically examine groove welds that cannot be readily radiographically spot examined.
4. CONTRACTOR's certified welding inspector (CWI) shall 100 percent visually examine every weld as a minimum.
5. In addition to weld tests indicated, doubler pads shall be air tested as stated in AWWA C206.
6. CONTRACTOR shall be responsible for performing and paying for said tests and the ENGINEER has the right to witness testing conducted by CONTRACTOR.

H. Onsite Observation: SUPPLIER shall provide an experienced staff member if requested by CONTRACTOR to be onsite while the pipe and fittings are being installed. The staff member's duties shall include, but not be limited to the following:

1. Observe the installation and welding of the pipe and fittings.
2. Report any concerns to OWNER'S on-site observer.
3. Answer questions and provide assistance to OWNER and CONTRACTOR.

I. Certified Welding Inspector: Furnish the services of a certified welding inspector(s) (CWI) for the shop and field welding as specified in AWWA C200 and C206. After receiving CWI qualification, the CWI shall have at least 3 years of professional work experience similar to the work being performed for the project. The CWI's shall be directed by a CWI supervisor with at least 5 years of professional work experience similar to the work being performed for the project. The certified welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. Shop weld tests shall be reviewed and signed by the certified welding inspector(s).

J. Field Testing: Field testing shall conform to the requirements of Section 33 13 00 - Pipeline Testing and Disinfection.

K. Welding Requirements: Welding procedures used to fabricate and install pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code-Steel or the ASME Boiler and Pressure Vessel Code, Section 9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

L. Welder Qualifications: Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the project shall be used in qualification tests.

1.6 WARRANTY

A. A one-year warranty for the pipe shall be included from CONTRACTOR and shall cover the cost of replacement pipe and freight to the project site, should the pipe have any defects in material or workmanship.

B. In addition to the standard pipe warranty, the welding contractor shall provide in writing a warranty for a period of one year for all welded joints, including formation, installation, and pressure testing.

C. Unless otherwise noted, the warranty periods shall begin when Substantial Completion is issued for the contract.

PART 2 PRODUCTS

2.1 GENERAL

A. Manufacturers of steel pipe and steel fittings or specials shall be under the direction and management of one steel pipe manufacturer only. This does not prevent a separate fabricator from fabricating specials or fittings; however, WORK shall be directed by the Main Pipe Manufacturer. The responsibility of the Main Pipe Manufacturer shall include at a minimum:

1. Verify pipe, fittings, and specials are being manufactured in full accordance with the drawings and specifications and applicable codes and standards.
2. Manage the design, fabrication, testing and delivery of the pipe, fittings, and specials. Provide field support if requested to CONTRACTOR during installation and testing.

3. Prepare and submit submittal information and Shop Drawings.
4. Make any corrections that may be required to the submittal information and Shop Drawings.
5. Certify that the pipe and specials have been manufactured in accordance with the Drawings and Specifications.

B. Lined and coated steel pipe and specials shall conform to AWWA C 200, C 205, C 209, C 214, C 216, C 210, and C 222. subject to the following supplemental requirements. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with welded joints as indicated on the Drawings. For pipe, specials, and fittings 14-inches diameter and larger, the nominal inside diameter after lining shall not be less than the diameter indicated on the Drawings, allowing for tolerances according to AWWA C 200 and C 205. Pipe, specials, and fittings smaller than 14-inches diameter may be furnished in standard outside diameters. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.

C. Markings: The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. Each pipe, special, and fitting number shall be located on the inside and outside area of pipe, special, and fitting. Interior marking shall be in full conformance with NSF 61. Each pipe, fitting and special shall be marked at each end with top field centerline. The word “Top” shall be painted or marked on the outside top spigot of each pipe section or fitting. Mark “Top Match Point” for compound bends per AWWA C 208.

D. Handling and Storage: The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 2-inches diameter, sandbags, or suitable means so that the pipe including coating and lining coating will not be damaged. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling. The ends of pipes shall be securely bulkheaded or otherwise sealed during transportation and shall remain sealed until installation.

E. CONTRACTOR shall replace or repair any pipe, specials, and fittings damaged at no additional cost to OWNER.

F. Strutting: Adequate strutting shall be provided on specials, fittings, and straight pipe so as to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation. For mortar-lined steel pipe, specials, or fittings the following requirements shall apply:

1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe, special, or fitting is loaded, transported, unloaded, installed, and backfilled at the Site.
2. The strutting materials, size, and spacing shall be the responsibility of CONTRACTOR and shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.

3. Strutting on shop lined pipe shall consist of wood stulls and wedges. Strutting shall be installed in a manner that will not harm the lining.
4. Any pipe, special, or fitting damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced at no additional cost to OWNER.

G. Laying Lengths: Maximum pipe laying lengths shall be 48-feet with shorter lengths provided as required to accommodate CONTRACTOR's operation.

H. Lining: The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of the correction pieces and closure assemblies shall be shown on the pipe layout diagrams.

J. Backfill with CLSM: Where required, backfill with Controlled Low Strength Material (CLSM) shall be the full depth of the pipe zone from 6 inches below to 6 inches above the pipe as a minimum.

2.2 MATERIALS

A. Mortar: Materials for mortar shall conform to the requirements of AWWA C 205; provided, that cement for mortar coating shall be Type II modified or Type V and mortar lining shall be Type II modified or Type V. Cement in mortar lining and coating shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement. Admixtures shall contain no calcium chloride.

B. Fabricate wrought steel pipe that is 12-inch diameter and smaller in accordance with ASTM A 53 or ASTM A 106, Grade B, and to the thickness indicated on Contract Drawings. Unless noted otherwise, minimum steel wall thickness shall be 3/8-inches. For

C. Where larger diameter cylinders are called out on plans (ie Sheet C-11B) fabricate steel pipe to match existing diameters shown on Contract Drawings.

D. Steel for Cylinder and Fittings: Use Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:

1. Minimum yield strength of steel is 42,000 psi.
2. Be manufactured by a continuous casting process.
3. Be fully killed.
4. Be fine grain practice.
5. Maximum carbon content of 0.25 percent.
6. Maximum sulfur content of 0.015 percent.
7. Minimum elongation of 22 percent in a 2-inch gauge length.
8. Be in accordance with one of the following, ASTM A1011, ASTM A283, ASTM A572, or ASTM A1018.
9. Maximum carbon equivalent of 0.45, calculated as follows:

$$CE = C + \frac{(Mn+Si)}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Ni+Cu)}{15}$$

E. Pipe shall be manufactured as fabricated pipe per AWWA C 200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C 200 shall not be used. Pipe sections shall be fabricated by either of the following methods:

1. Pipe sections may be fabricated by spirally welded short cylindrical coils of steel, joined circumferentially by complete penetration butt joint welds.
2. Pipe sections may be rolled or pressed from no more than three (3) sheets the full length of the pipe and welded with no more than three (3) longitudinal seams.

F. Steel equal to or greater than 1/2-inch thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A370. Test each heat of steel by taking one specimen from any two coils per heat number. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 deg F.

1. Plate: Charpy tests shall be conducted on each plate as required in ASTM A 20.
2. Coils: Charpy tests shall be conducted on the first 500 tons of steel by testing each coil as follows:
   a. Tests shall include representative sampling of steel thicknesses required for the Work.
   b. Each coil shall be tested by taking coupons from the outer, middle, and inner wrap of the coil. Middle coil coupons may be taken from the ends of full-length pipes that are closest to the middle of the coil.
   c. Coils that do not meet the above Charpy acceptance criteria shall not be used in the production of the pipe.

G. External Pipeline Coating: In accordance with Section 09 98 10 – Pipeline Coatings and Linings.

2.3 DESIGN OF PIPE

A. General: The pipe shall be suitable to transmit potable water under the conditions indicated on the Contract Drawings. The steel pipe shall have field welded joints as indicated. The pipe shall be cement mortar lined unless noted otherwise as per Section 09 98 10. Field lining will only be allowed where specifically approved in advance by ENGINEER.

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to AWWA C200.

C. Pipe Dimensions: Pipe shall be of the diameter and minimum wall thickness indicated on the Drawings.

D. Fitting Dimensions: Fittings shall be of the diameter and class to match the adjacent piping.

E. Joint Design: Unless indicated otherwise, the standard field joint for steel pipe shall be as indicated in the following table. 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 as indicated on the Contract Drawings or in Section 33 13 00 - Pipeline Testing and Disinfection. Provide air test tapped holes with weld-o-lets for each double welded lap joint or butt strap joint.

Pipe Diameter	Application	Joint Type
60-inches and less	Non-Restrained Areas	Single Lap Welded Joint or Double Lap Welded Joint
	Restrained Areas	Single Lap Welded Joint, Butt Welded Joint, or Flanged
	Closures; Restrained and/or Non-Restrained	Butt Strap Joint

F. Lap joints prepared for field welding shall be in accordance with AWWA C 200. The method used to form, shape, and size bell ends shall be such that the physical properties of the steel are not substantially altered. Bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. Faying surfaces of the bell and spigot shall be essentially parallel except for mitered bells, but the bell slope shall not vary more than 2 degrees from the longitudinal axis of the pipe.

G. Spiral weld seams shall be tested by the visible penetrant method of ASTM E 165 or magnetic particle inspection method of ASME Section VIII, Division 1, Appendix VI, for a minimum distance of 12-inches from each end of each joint after the spigot and bell are formed. Defects shall be repaired at no additional cost to OWNER.

H. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated. Holdback areas shall be coated as indicated in Section 09 98 10 – Pipeline Coatings and Linings.

I. Joint Shop Coating: Holdback areas for welded joints and butt straps shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended finish coating as specified in Section 09 98 10 - Pipeline Coatings and Linings and Section 09 90 00 Painting and Finishes.

J. Shop Fit Test: Make certain that joints are correctly field assembled and that excessive annular space between spigots and bells and that the pipe meets the requirements of AWWA C 200. The pipe fabricator shall perform dimensional measurements for all pipe joints to verify joints are within manufacturing tolerances prior to shipment. The pipe ends shall be match marked after shop assembly.

1. The shop fit test shall join the pipe ends in the shop with proposed adjacent pipe end.
2. Record the actual annular space with the data to include as a minimum:
   a. Maximum/minimum space at any point.
   b. Space at 90-degree intervals top, bottom, and at springline.

K. Restrained Joints

1. Located where indicated and where required to meet seismic requirements, restrained joints shall be field-welded joints, either single, or double lap-weld, or butt-weld, flanges, or butt-straps as indicated on the Contract Drawings. Designs shall include stresses created by the greater of:
   a. Temperature differential of 50 degrees F plus Poisson's effect in combination with hoop stress, or;
   b. Thrust due to bulkheads, bends, reducers, and line valves resulting from working pressure in combination with hoop stress.
2. For field welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 21,000 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint.

L. Flanges

1. Flanges shall be in accordance with AWWA C 207 Class D for operating pressures up to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches.
2. Flanges shall be AWWA C 207 Class E for operating pressures over 150 psi to 275 psi or shall be Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250).
3. Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flanges shall be shop coated with a soluble rust preventive compound which is NSF 61 certified if used on potable water pipelines.
4. Gaskets shall be full-face, 1/8-inch thick, cloth-inserted rubber, **Garlock 3505, Durlon 7910**, or approved equal.

M. Bolts and Nuts for Flanges

1. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

2.4 SPECIALS AND FITTINGS

A. Design: Except as otherwise indicated, materials, fabrication and shop testing of Specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C 208. (Specials consisting of access manways, outlets for air valves, blow-off valves, etc. are excluded from the criteria as follows and collar plates, wrapper plates or crotch plates shall be required for reinforcing the outlet connections in accordance with AWWA M-11 and AWWA C208 requirements.) The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria:

1. Working and Transient Pressure Design

$$T = \frac{PwD/2}{Y/Sw} \qquad T = \frac{PtD/2}{Y/St}$$

Where:

T = Steel cylinder thickness in inches

D	=	Outside diameter of steel cylinder in inches
Pw	=	Design working pressure in psi
Pt	=	Design transient pressure in psi
Y	=	Specified minimum yield point of steel in psi
Sw	=	Safety factor of 2.5 at design working pressure
St	=	Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

2. Mainline Pipe Thickness: Plate thickness for specials shall not be less than for the adjacent mainline pipe.
3. Thickness Based on Pipe Diameter

Nominal Pipe Diameter, in	Pipe Manifolds Piping Above Ground Piping Structures
24 and under	3/16-in
25 to 48	1/4-in
over 48	5/16-in

a. Minimum plate thickness shall be the greater of the adjacent mainline pipe, the thickness on the Drawings, the thickness calculated as indicated herein or as shown on the table above indicating the minimum thickness based on pipe diameter.
b. Refer to ASME B36.10M for dimensions of wall thickness for standard weight pipe and nominal pipe size.

B. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M 11.

C. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M 11. Reinforcement shall be designed for the design pressure indicated and shall be in accordance with the Drawings. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. Horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions

may be encountered, the chord produced by deflecting the pipe shall be no further than 6-inches from the alignment indicated.

E. Vertical deflections shall fall on the alignment and be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points indicated.

F. Outlets, Tees, Wyes, and Crosses

1. Outlets 12-inches and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters. Minimum plate thickness for reinforcements shall be 10-gauge.
2. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M 11 and the design pressures and factors of safety above.
3. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M 11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
4. Where Manual M 11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.
5. Outlets shall be fabricated so that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field welded joints. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.
6. Tees, wyes, crosses, elbows, and manifolds shall be fabricated so that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2-inches, whichever is greater. Longitudinal weld joints in adjacent cylinder sections shall be oriented so that there is a minimum offset of 5 times cylinder thickness or 2-inches, whichever is greater.

G. Steel Welding Fittings: Steel welding fittings shall conform to ASTM A 234.

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. The collared ends shall be grooved for the fitting. Where pipe 12-inches and smaller is furnished in standard schedule thickness and where the wall thickness after grooving equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

2.5 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Unless indicated otherwise, interior surfaces of pipe, specials, and fittings shall be cleaned and lined in the shop with cement mortar lining applied centrifugally in conformity with AWWA C 205. Lining for all mitered fittings produced by cutting, rolling and re-welding such as elbows from 5 to 90 degrees up to 72-inches in diameter shall be centrifugally applied in the shop. Fabricated tees, manifolds or elbows greater than 72-inches or tees with crotch plates where heat treating or normalization is required may be lined in accordance with AWWA C205. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found defective at the Site, the damaged or

unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to OWNER.

B. The minimum lining thickness and tolerance shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings and AWWA C 205.

C. The pipe shall be left bare as indicated where field joints occur. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

D. Defective linings shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe specials or fittings with cracks wider than 1/16-inch shall be removed and patched.

E. The progress of the application of mortar lining shall be regulated in order that handwork, including the repair of defective areas, is cured in accordance with the provisions of AWWA C205. Cement mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

F. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM standards and this Section. Coating and lining applied in this manner shall provide protection equal to that for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-application.

G. Cement-Mortar Lining for Field Application at joints: Unless otherwise indicated, all steel pipe joints shall be mortar lined. The materials and design of in-place cement mortar lining shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings and AWWA C 205, and the following supplementary requirements:

1. Pozzolanic material shall not be used in the mortar mix.
2. Admixtures shall contain no calcium chloride.
3. The minimum lining thickness shall be as indicated for shop-applied cement mortar lining, and finished inside diameter after lining shall be as indicated.
4. Temperature and shrinkage cracks in the mortar less than 1/16-inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16-inch shall be removed and repaired.

H. Protection of Pipe Lining/Interior: All pipe, specials, and fittings with plant-applied cement-mortar linings, shall be supplied with a 12-mil polyethylene sheet or other suitable bulkhead on the ends of the pipe and on each opening to prevent drying out of the lining. Bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 90 00 – Painting and Finishes.

B. Exterior Coating of Buried Piping: Pipe for buried service, including bumped heads, shall be coated per Section 09 98 10 – Pipeline Coatings and Linings.

C. Flexible coatings shall conform to Section 09 98 10 - Pipeline Coatings and Linings. Flexible coating systems shall include a cement mortar protective overcoat (rock shield), in accordance with Sections 09 98 10 - Pipeline Coatings and Linings.

2.7 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 one-inch tall, permanent black, and shall read: “CAUTION – WATER LINE BURIED BELOW” or similar. Joining clips shall be manufacturer’s standard tin or nickel coated. Refer to Drawings for location of tape placement.

1. Tape shall be 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 one-inch tall permanent black on a blue background. Lettering shall read: “CAUTION – WATER LINE BURIED BELOW”. Refer to Contract Drawings for location of tape placement.

1. Tape shall be manufactured by **Reef Industries (Terra Tape), Allen (Markline)**, or equal.

2.8 MARKERS

A. Provide pipeline markers at the locations indicated. Markers in open fields shall be concrete post types and markers in areas beneath or adjacent to paved streets with curbs/gutters shall be brass cap type installed in the top of the curb.

B. Concrete Posts: Posts shall be square reinforced concrete posts as indicated, provide above the centerline of pipeline. Concrete shall be 3000-psi concrete in accordance with ASTM C 94. The cement shall be Type V. Each of the four (4) sides shall have information painted above ground in 3-inch tall black letters. Paint shall conform to Federal Specification TT-P-24, Type IV.

1. Side 1: Paint OWNER’s name.
2. Side 2: Paint the lateral name, per ENGINEER.
3. Side 3: Paint the appurtenance designate, per ENGINEER.
4. Side 4: Paint the station number.

C. Carsonite Survivor: Carsonite survivor series markers may be substituted where shown for the concrete post markings as required for the concrete posts except that all information shall be on a single decal surface.

D. 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. Caps shall be **Sokkia 813406,** or equal, stamped with the following information:

1. Owner's name
2. Station number.
3. Lateral name, per ENGINEER.
4. Distance and direction to appurtenance or lateral centerline.

2.9 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements of the Specifications and Contract Drawings. Access manholes with covers shall be as indicated, installed during fabrication, not in the field. Threaded outlets shall be forged steel suitable for 3000 psi service.

PART 3 EXECUTION

3.1 INSTALLATION

A. Handling and Storage: Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements stated in Part 2, above. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks that may be harmful as determined by ENGINEER. Such damaged lining and coating/interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided at no additional cost to OWNER.

B. Pipe damaged prior to Substantial Completion shall be repaired or replaced at no additional cost to OWNER.

C. Repair of Defects: Patching inserts, overlays, or pounding out defects shall not be permitted. Repair of notches or laminations on second ends shall not be permitted. Deformation of pipe ends through mechanical means or other methods to achieve pipe fit up of defective pipe shall not be permitted. Damaged ends shall be removed to a point of uniform, non-damaged cylinder end and properly prepared. Distorted or flattened lengths shall be rejected. Buckled sections shall be removed and replaced with a full pipe cylinder. CONTRACTOR shall submit a written repair plan and receive favorable review from OWNER prior to the start of any repair work.

D. CONTRACTOR shall inspect each pipe, special, and fitting for damage. CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.

E. Before placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the project.

F. Pipe, specials, and fittings backfilled with CLSM shall be laid directly on moist sandbags or other suitable supports in preparation for the CLSM pipe zone material. Sandbags shall be placed to provide at least 6-inches of CLSM below the bottom of the pipe. Sandbags shall be spaced at a maximum interval of 8-feet and one set shall be placed within 3-feet on both sides of each joint. CONTRACTOR shall provide additional sandbags as needed to support the pipe on line and grade. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Installation Tolerances: Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:

1. Each section of pipe, special, or fitting having a nominal diameter less than 48-inches shall be laid to line and grade, within plus or minus 2-inches horizontal deviation and plus or minus 1-inch vertical deviation.
2. Each section of pipe, special, or fitting having nominal diameter 48-inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
4. After installation, pipe, specials, and fittings shall not show deflection greater than 1.5 percent for mortar-lined and mortar-coated pipe, specials, and fittings; 2.25 percent for mortar-lined and flexible-coated pipe, specials, and fittings; and 3.75 percent for flexible-lined and flexible-coated or bare pipe, specials, and fittings. The allowable deflection shall be based on the design inside diameter.
5. CONTRACTOR shall not permit the pipeline to experience a differential settlement after welding of more than 1.5” over 300 feet.

H. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, CONTRACTOR may change the alignment and/or the grades in accordance with the requirements of the Specifications and Drawings. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer without prior approval from ENGINEER. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.

I. Except for short runs, pipes shall be laid uphill if on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be installed as indicated.

J. Struts in pipe 42-inches diameter and larger shall be left in place until backfilling operations have been completed. Struts in pipe smaller than 42-inches may be removed immediately after laying. CONTRACTOR shall monitor pipe deflection by measuring pipe inside diameter before struts are removed and 24 hours after struts are removed. Pipe deflection

shall not exceed 3 percent 24 hours after the struts are removed. After the backfill has been placed, the struts shall be removed and shall remain the property of CONTRACTOR. For pipe backfilled with CLSM, struts shall be left in place until the CLSM backfill has obtained a minimum 7-day cure.

K. Cold Weather Protection: No pipe, special, or fitting shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe, special, or fitting shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

L. Pipe, Specials, and Fitting Protection: The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe, specials, and fittings. CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.

M. Flotation: At all times, means shall be provided to prevent the pipe from floating. Take necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. CONTRACTOR shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from materials and in a clean and sanitary condition.

N. Pipe Cleanup: As pipe laying progresses, CONTRACTOR shall keep the pipe interior free of debris. CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting the completed pipeline. When pipe laying is not in progress and at the end of each day, CONTRACTOR shall cover the exposed ends of all pipes to prevent animals, dust, dirt, and other debris from entering the pipe.

3.2 WELDED JOINTS

A. General: Field welded joints shall be in accordance with AWWA C 206.

B. Welding Procedures, Welding Qualifications and Testing:

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C 200, as applicable. Qualifications shall be in accordance with all position pipe tests as defined in Section 5 of AWS D1.1.
2. For field welding, the welder qualification testing shall be performed at the Site. Previous qualifications will not be accepted. CONTRACTOR shall obtain the services of an independent testing laboratory to perform the welder qualification on-Site. Copies of test data and certifications shall be provided to ENGINEER. Costs for welder qualification testing shall be paid by CONTRACTOR at no increased cost to OWNER.
3. Upon completion of each field-welded joint submit within 48 hour CWI inspection report indicating each welds (by station) complies with CONTRACT.

4. Inspect field lap welds by magnetic particle or dye penetration methods. Inspect field butt welds shall in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
5. Double welded lap joints and butt strap joints shall be air tested. Repairs and retesting shall be required if any loss of pressure occurs and shall be at no increased cost to OWNER.
6. Personnel performing the visual inspection of welds shall be qualified and currently certified as Certified Welding Inspector (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to meet the requirements of SNT-TC-1A.

C. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

D. Butt straps shall be as indicated. When fitting up the ends of pipe to be welded or fitting butt-strap pieces, jacking or clamping shall not be allowed. Cold working the metal with sledges or localized application of heat and working the metal with sledges shall not be allowed. If field displacement of joints, where butt strap joints are indicated, does not allow proper fit up with the tolerances indicated, special closure butt straps or mitered pieces shall be shop fabricated and installed.

E. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter. Welding grounds shall not be attached to the coated part of the pipe.

F. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

G. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 50 deg F as measured in the trench.

H. Temperature Control Joints: At intervals not exceeding 250-feet along welded reaches of the pipeline and at the first regular lap-welded field joints outside concrete encasements and structures, the pipe shall be laid with an initial lap of not less than 1-inch greater than the typical lap dimension. The welding of each such temperature control joint shall be performed when the temperature is approximately the lowest during the 24 hour day, after at least 250-feet of pipe have been laid and the joints have been welded ahead of and in back of the shrinkage control joint, and after backfill has been completed to at least 1-foot above the top of the pipe ahead of and in back of the shrinkage control joint. Where temperature control joints occur in a traveled roadway or other inconvenient location, the location of the temperature control joint may be adjusted, as necessary.

I. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by

shimming, jacking, or other suitable means. The weld shall then be made in accordance with AWWA C 206. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve temperature stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.

J. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16-inch.

K. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.

L. Inspection of Field Welded Joints: An independent testing laboratory shall inspect the joints. Inspection shall be as soon as practicable after the welds are completed.

1. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.
2. In addition, double fillet welds on butt strap joints or double welded lap joints shall be air tested by shop drilling and tapping for 1/4-inch national pipe thread in the lap or bell end of the pipe. Apply 40 psi of air or other satisfactory gas into the connection between the 2 fillet welds. Test pressure shall be measured with a 4-inch diameter, minimum, pressure gauge with a range no greater than 0 to 100 psi. The air test shall consist of holding the test pressure undiminished for 5 minutes. If the air test fails, paint the welds with a soap solution and mark any leaks indicated by the escaping gas bubbles. Leaking portions of the welds or defective welds shall be removed and rewelded. The amount of material removed shall be limited to that required to correct the defect. After the repair is made, the joint shall be checked by repeating the original test procedure to verify that there is no leakage at the inside weld. Close the threaded openings with pipe plugs or by welding them.
3. Butt welds shall be inspected by radiographic methods in accordance with API Standard 1104.

M. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.

N. Repair of Welds: Welds that are defective shall be repaired by CONTRACTOR to meet the requirements of this Specification. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and water, loose scale, dirt, and other foreign material shall be removed from the inside surface of the pipe.

B. Joint Coating of Shop-Applied Tape and Mortar Coated Pipe: Joints shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.

C. Every joint will be tested by CONTRACTOR with an electrical detector capable of at least a 12,000 volt output, furnished by SUPPLIER. Holiday tests will be conducted in accordance with NACE RP0274. Holidays shall be repaired by CONTRACTOR at no additional cost to OWNER.

D. Coating Repair: Coating repair shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings.

E. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.

F. Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be mortar filled by tightly packing mortar into joint recess and troweled flush with at pipe interior mortar surface. Remove excess mortar. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch. See Field Mortar Lining of Joints in Section 09 98 10, Pipeline Coatings and Linings.

3.4 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 Section 09 98 10 – Pipeline Coatings and Linings.

B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it. Joints shall be thoroughly cleaned and prepared prior to installation. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation.

C. Valves shall be installed so that the valve stems are plumb and, in the location, indicated.

D. Buried valves and flanges shall be coated and protected in accordance with Section 09 98 10 - Pipeline Coatings and Linings.

E. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush. The gasket shall be centered, and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable calibrated torque wrench. Clamping torque shall be applied to the nuts only. Full face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

F. Insulated Joints: Insulated joints and appurtenant features shall be provided as required. CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test shall be performed by CONTRACTOR. If the resistance test indicates a short circuit, CONTRACTOR shall remove the insulating units to inspect for damage, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

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 dirt and foreign matter with special attention given to the contact surfaces of the pipe, gaskets, and couplings.

The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.

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. Bolts shall be tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable calibrated torque wrench set for the torque recommended by the coupling manufacturer. Clamping torque shall be applied to the nut only.

3.5 CORROSION CONTROL

A. Joint Bonding, Anodes and Test Stations: Unless specifically indicated otherwise, bond all non-welded joints and provide anodes at 1,500 feet maximum spacing. Install test stations at the anode locations on all pipes 24-inch diameter and larger. Joint Bonding, Anodes, and test stations shall be in accordance with Section 26 42 10 – Galvanic Cathodic Protection.

3.6 MARKING TAPE INSTALLATION

A. Continuously install metallic marking tape along the pipe at the depth and location indicated.

B. Continuously install plastic marking tape along the pipe at the depth and location indicated.

3.7 PRESSURE TESTING

A. Pressure testing and disposal of test water shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION -

SECTION 40 91 23
MISCELLANEOUS PROPERTIES MEASUREMENT DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the Work necessary to install a ready to use and tested process and analysis system. CONTRACTOR shall provide all components required for a complete and functional system.

1.2 RELATED WORK

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

1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

B. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 207 Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
2. AWWA C 751 Magnetic Inductive Flowmeters

C. NSF INTERNATIONAL (NSF)

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

1.4 SUBMITTALS

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

B. Submit catalog cuts on all process equipment including: switches, meters, sensors, or other items shown on Contract Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance and dimensional data.

C. CONTRACTOR shall supply operation and maintenance manuals for all process equipment.

1.5 WARRANTY

A. Manufacturer shall provide to OWNER written guarantee against defects in material or workmanship for a period of one (1) year.

1.6 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants. Each system shall be factory calibrated and certified prior to delivery.

1.7 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of manufacturers regularly engaged in the design and manufacturing of this type of equipment. The manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving CONTRACTOR from responsibility for the proper installation and functionality of the work.

PART 2 PRODUCTS

2.1 GENERAL

A. Each process measurement system shall typically consist of a sensor and analyzer/transmitter. Where shown on the Contract Drawings, the analyzer/transmitter may be utilized for multiple sensors. When an analyzer/transmitter is used for multiple sensors, it shall be capable of displaying simultaneously each process measurement.

B. Each analyzer/transmitter shall be equipped with a means to transmit process measurement data to the plant SCADA system.

1. For hardwired signals, unless indicated otherwise on Contract Drawings, provide the following:
   a. 4-20 mA output signals for each process measurement (for up to 500 Ohm loads).
   b. Two programmable SPDT relay outputs, rated at 5A up to 230 VAC, for each process measurement.

2. Where shown on the Contract Drawings, provide the following digital communications to the plant SCADA system:
   a. HART Protocol
   b. PROFIBUS
   c. MODBUS

C. Each analyzer/transmitter shall be powered by 115VAC (+/- 10%) at 60 Hz unless shown on Contract Drawings as being powered by 24 VDC (+/- 15%). Each analyzer/transmitter shall retain its programmable settings in non-volatile memory. Battery powered instruments, analyzer, or transmitters will not be accepted.

D. Each sensor and corresponding analyzer/transmitter shall be supplied as a complete and operable system. This includes all cabling, mounting hardware and fasteners. When installed outdoors, the analyzer/transmitter shall be protected from the sun such that direct sunlight will not shine on the display.

E. All analyzers/transmitters shall be waterproof and made from corrosion resistant materials.

F. All sensors to be immersed in liquids shall be rated for permanent submersion and shall be corrosion resistant.

2.2 MAGNETIC FLOW METERS

A. Magnetic flow meters shall be the low the low frequency induction type which produces a DC pulsed signal directly proportional to and linear with the flow rate. Liners shall be polyurethane. Flow meters shall be rated at 250 psi. Standard output shall be an analog 4-20 mA signal with a local indication from a liquid crystal display (LCD) reading in gallons per minute flow. The meter shall also have a totalizer (with pulsed output), and non-full pipe detection. Meters shall have a minimum of 2 self-cleaning electrodes. Meter shall be Mod Bus RS-485, include a remote display, include DA1 and DA2 diagnostics, and include Heartbeat Verification. CONTRACTOR shall field verify length of cable connection and provide 25+ feet of cable for potential future changes of location.

B. Meters shall have a minimum of three (3) pair of flow measuring probes that provide accurate flow measurement with “zero up / zero down” straight pipe diameters. CONTRACTOR shall field verify length of cable for connection. Provide functional Ethernet connection to read meter.

C. Flanged connections shall be constructed of Type 304 or Type 316 stainless steel with pressure ratings to match the connecting pipe.

D. Liner shall be polyurethane or PTFE and electrodes stainless steel suitable for potable water service. Liners and electrodes for service other than potable water shall be constructed of materials conforming to the manufacturer’s recommendation for the intended service.

E. Meter housing shall be rated for NEMA 6 for submersible operation.

F. Meters shall include grounding rings.

G. The transmitter shall have six digit LCD displays for flow rate, percent of span, and totalization; be capable of measuring flow in both directions; automatic range change; capability to convert DC pulse signal from the tube to a standardized 4 to 20 mA DC signal into a minimum of 700 ohms; self-diagnostics and automatic data checking, and a scaleable frequency output, 0 to 100 Hz.

H. The flow measuring system shall conform to the following:

1. Time constant: 0.5 to 1000 seconds; galvanic or optic isolation
2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent full scale velocities over 3 feet per second.
3. Repeatability: 0.25 percent of full scale
4. Power consumption: 30 watts or less
5. Power requirements: 120 VAC, plus or minus 10 percent, unless indicated otherwise on the Contract Drawings. Battery powered flow meters are not acceptable.

I. 700 East (Water Pro) magnetic flow meters shall be **8700 Series by Rosemount.**

2.3 PRESSURE TRANSMITTER

A. The pressure transmitter shall be an electronic pressure transducer tailored to the installation shown in Drawings and suitable for planned application. The system shall include a pressure transducer with integral diaphragm seal. The pressure transmitter shall operate on 24 VDC, and shall provide a 4-20 mA DC signal to the RTU panel. The loop signal shall measure the water pressure and have a 4-20 mA signal output. The pressure transmitter shall have a LCD display showing the pressure in “psi”. The pressure transmitter shall be coded “DW” for NSF drinking water certification. Pressure transmitters shall be **Rosemount Series 3051**, or approved equal. Provide isolation valve with pressure transmitter if none is shown in Contract Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. All equipment shall be mounted and installed as per manufacturer recommendations. Coordinate final location with ENGINEER.

3.2 FLOW METER FIELD CALIBRATION AND QUALITY CONTROL

A. Each instrument shall be tested before commissioning and ENGINEER shall witness the interface capability in the PLC control system and associated registers.

1. Each instrument shall provide direct programming capability through the PLC
2. Each instrument shall provide direct control of totalizer reset functions through PLC
3. Each instrument shall be supported with a device profile for direct integration in PLC

B. ENGINEER shall witness all instrument verifications in the field.

C. Manufacturers Field Services shall be provided for start-up and commissioning by a Factory field service representative or a manufacturer authorized service provider (ASP).

1. Manufacturer representative shall verify installation of all installed flow tubes and transmitters.
2. Manufacturer representative shall notify ENGINEER in writing of any problems or discrepancies and proposed solutions.
3. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability, and electronics health. A comparative report shall be generated for each meter tested.
4. Manufacturer representative shall generate a configuration report for each meter
5. Meters shall be field calibrated to verify proper operation within the expected flow ranges for the project.

3.3 TESTING

A. After installation of the equipment is complete, operating tests shall be carried out to assure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected, and the tests shall be reconducted.

- END OF SECTION –

SECTION 40 92 57
ELECTRIC MOTOR ACTUATORS

PART 1 GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish and install electric motor actuators and appurtenances for butterfly valves, complete and operable, in accordance with the Contract Documents.

B. The valve manufacturer shall be made responsible for coordination of design (valve stem diameter, threading, key and keyway adaptation, and other dimensional information), assembly, testing, and installation of actuators on the valves; however, CONTRACTOR shall be responsible to OWNER for compliance of the valves and actuators with the Contract Documents.

C. Where two or more valve actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but it not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 33 12 00 Mechanical Appurtenances

1.3 REFERENCES

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

B. American Water Works Association (AWWA)

1. AWWA C 542 Electric Motor Actuators for Valves and Slide Gates

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittals.

B. Shop drawing information for actuators, floor stands, and extension stems shall be submitted together with the valve submittals as a complete package.

C. Submit information on electric motor actuator including cut sheets, technical brochures, electrical diagrams, control schematics, and operation and installation manuals.

D. Submit calculations showing dynamic seating and unseating torques versus output torque of the actuator.

PART 2 PRODUCTS

2.1 GENERAL

A. All electric motor actuators shall conform to the requirements of AWWA C 542.

B. Actuators shall contain motor, gearing, manual over-ride, limit switches, torque switches, selector switch, drive coupling, integral reversing motor controls, control voltage transformer, indicator lights, handwheel, lubricants, heating elements, wiring, terminals, position feedback transmitter, and mechanical dial position indicator.

C. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts, etc. shall be carried out without removal of any actuator covers over an Infra-Red or wireless interface.

D. The electric motor actuator shall mount directly to the butterfly valve as specified in Section 33 12 00 – Mechanical Appurtenances. The actuator supplier shall coordinate with the butterfly valve supplier to determine the proper actuator size and configuration.

E. Position and limit switches, position transmitters, controls, indicating lights, devices, and selector switches shall be coordinated with the input/output requirements of the control system as indicated in the Drawings and specified herein.

2.2 ACTUATOR SIZING

A. The actuator shall be sized to guarantee valve closure at the specified maximum pressure and flow within specified time shown in Table 40 92 57 -1 below.

B. One actuator size shall be available covering output speeds from 18 to 200 rpm for a given torque range to avoid over-sizing and unnecessary weight load on the valve stem, flange, and yoke. An increase of actuator size caused by higher actuator output speed is not acceptable to avoid weight over-sizing actuators. Actuators must be selected to provide sufficient torque required for safe valve operation. Actuator output torque must be available at 90% of nominal voltage.

2.3 ENVIRONMENT

A. Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 25°F to 140°F, up to 100% relative humidity.

2.4 ENCLOSURE

A. Actuators shall be O-ring sealed, watertight, NEMA 4. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site cabling, the terminal compartment having the same ingress protection rating as the actuator with the terminal cover removed.

B. The enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be plated stainless steel. The use of un-plated stainless steel or steel fasteners is not permitted.

2.5 MOTOR

A. The motor shall be specifically designed for the valve actuator service. The motor will be of the induction type with Class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated.

B. Motors shall be capable of operating on 208 volt, 3 phase, 60 Hz power.

C. Electrical and mechanical disconnection of the motor shall be possible without draining the lubricant from the actuator gearcase.

D. Protection shall be provided for the motor as follows:

1. Stall – the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
2. Over Temperature – thermostat will cause tripping of the motor, auto-reset on cooling.
3. Single phasing – lost phase protection
4. Direction – phase rotation correction

2.6 GEARING

A. The actuator gearing shall be totally enclosed in an oil-filled or grease lubricated gearcase suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammerblow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design shall be such as to permit opening the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. 90-degree operating type of valves drive gearing shall be self-locking to prevent the valve back-driving the actuator.

2.7 HAND OPERATION

A. A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

B. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise noted. For linear type valves the actuator handwheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 90 lbs through stroke and 180 lbs for seating/unseating of the valve.

2.8 DRIVE INTERFACE

A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. The drive bushing shall be positioned in a detachable base of the actuator. Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator.

2.9 LOCAL CONTROLS

A. The actuator shall incorporate local controls for Open, Close and Stop, and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: Local control only, stop (no electric operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

B. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

C. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.10 TORQUE AND LIMITS

A. Torque and turns limitation to be adjustable as follows:

1. Position Setting Range – multi-turn: 2.5 to 8,000 turns, with resolution to 7.5 degrees of actuator output.
2. Position Setting Range – direct drive part turn actuators: 90° ±10°, with resolution to 0.1 degree of actuator output.
3. Torque Setting: 40% to 100% rated torque

B. Position Measurement: Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts.

C. Measurement of torque shall be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux, etc. are not acceptable.

D. A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.

E. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

2.11 REMOTE VALVE POSITION AND STATUS INDICATION

A. Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

B. The contacts shall be rated for 5mA to 5A, 120V AC, 30V DC.

C. As an alternative to providing valve position indication any of the four above contacts shall be selectable to signal one of the following:

1. Valve opening, closing or moving
2. Thermostat tripped, lost phase
3. Motor tripped on torque in mid travel, motor stalled

4. REMOTE selected
5. Actuator being operated by handwheel
6. Actuator fault

D. Provision shall be made in the design for an additional four contacts having the same functionality.

E. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be spring return type with a Normally Open/ Normally Closed contact pre-wired to the terminal bung.

F. The Monitor (Availability of Fault) relay, being energized from the control transformer will de-energize under any one or more of the following conditions:

Available Mode	Fault Mode
Loss of main or customer 24V DC power supply	Loss of main or customer 24V DC power supply
Actuator control selected to local or stop	Motor thermostat tripped
Motor thermostat tripped	Actuator internal fault
Actuator internal fault	

G. Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analog signal corresponding to valve travel and/or torque for remote indication when required. The transmitter will auto range to the set limits.

2.12 LOCAL POSITION INDICATION

A. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully closed in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With main power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 10 feet.

B. Red, green, and yellow LEDs corresponding to open, closed, and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker, and fault indication. The digital display shall be maintained and updated during handwheel operation when main power to the actuator is isolated.

C. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operation, alarm, configuration, and graphical data logger information. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.

D. Data logger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

1. Torque versus Position
2. Number of starts per hour

3. Dwell time
4. Average temperature

E. The main display shall be capable of indicating 4 different home-screens of the following configuration:

1. Position and status
2. Position and torque (analog)
3. Position and torque (digital)
4. Position and demand (positioning)

F. Provision shall be made for the addition of an optional environment cover to protect the display for high levels of UV radiation or abrasive materials.

G. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.13 INTEGRAL STARTER AND TRANSFORMER

A. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:

1. Energizing of the contactor coils
2. 24V DC or 120V AC output for remote controls (maximum 5VA)
3. Supply for all the internal electrical circuits

2.14 REMOTE CONTROL FACILITIES

A. The necessary control, wiring, and terminals shall be provided integral to the actuator enclosure. Open and close external interlocks shall be made available to inhibit local and remote valve opening/closing control. It shall be possible to configure the interlocks to be active in remote control only.

B. Remote control signals fed from an internal 24V DC (or 120V AC) supply and/or from an external supply between 20V and 60 V DC or 40V and 120 V AC, to be suitable for any one or more of the following methods of control:

1. Open, Close, and Stop Control
2. Open and Close maintained or “push to run” (inching) control
3. Overriding Emergency Shut-down to close (or open) valve from a normally closed or open contact.
4. Two-wire control, energize to close (or open), de-energize to open (or close)

C. Additionally provision shall be made for a separate ‘drive enable’ input to prevent any unwanted electrical operation.

D. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The motor starter shall be protected from excessive current surges during rapid travel

reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2 kV.

E. Provision shall be made for operation by distributed control system utilizing the following network systems:

1. Modbus (no equal)

2.15 MONITORING CAPABILITIES

A. Capabilities shall be provided for monitoring actuator operation and availability as follows:

1. Actuator text display indication of the following status/alarms:
   a. Closed limit, open limit, moving open, moving closed, stopped
   b. Torque trip closing, torque trip opening, stalled
   c. Thermostat trip, phase lost, 24V supply lost, local control failure
   d. Configuration error, Position sensor failure, torque sensor failure
   e. Battery low, power loss inhibit

2. Integral data logger to record and store the following operational data:
   a. Opening last/average torque against position
   b. Closing last/average torque against position
   c. Total open/close operations
   d. Maximum recorded opening and closing torque values
   e. Event recorder logging operational conditions (valve, control, and actuator)

B. The data logger shall record relevant time and date information for stored data.

C. Data logger data shall be accessed via non-intrusive wireless communication and data displayed on the local LCD. Sufficient standard intrinsically safe tools shall be provided for downloading data logger and actuator configuration files from the actuators and subsequent uploading to a PC. The actuator manufacturer shall supply PC software to enable data logger files to be viewed and analyzed.

2.16 WIRING AND TERMINATION

A. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end. The terminals shall be embedded in a terminal block of high tracking resistance compound.

B. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a minimum of 3 threaded cable entries with provision for an additional 5 extra conduit entries.

C. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable. A durable terminal identification card showing a plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

1. Serial number
2. External voltage values
3. Wiring diagram number

4. Terminal layout

D. The code card shall be suitable for CONTRACTOR to inscribe cable core identification alongside terminal numbers.

2.17 COMMISSIONING KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram, and cover seals to make good any site losses during commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set-up and adjustment during valve/actuator testing and site installation commissioning.

2.18 PERFORMANCE AND TEST CERTIFICATE

A. Each actuator must be performance tested and individual test certificates shall be supplied without additional cost to the OWNER. The test equipment should simulate a typical valve load, and the following parameters should be recorded:

1. Current at maximum torque setting
2. Torque at maximum torque setting
3. Flash test voltage
4. Actuator output speed or operating time

B. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, and wiring diagram number.

Table 40 92 57 – 1 Actuator Schedule

Valve ID	Location	Service	Valve Type	Max Pressure/Max Flowrate	Motor Type	Open/Close Speed (seconds)
-	Valve Vault	Open - Close	Butterfly	275 psi/ 9,500 gpm	AC Reversing	200/200

2.19 MANUFACTURER, OR APPROVED EQUAL:

A. AUMA Actuators SQ

B. Rotork IQTM

PART 3 EXECUTION

3.1 INSTALLATION

A. Electric motor valve actuators shall be installed in accordance with the manufacturer's written instructions. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways.

3.2 SERVICES OF MANUFACTURER

A. Field Adjustments: Field representatives of valves with electric motor actuators shall adjust actuator controls and limit switches in the field for the required function.

B. Inspection, Start-up, and Field Adjustment: The manufacturer shall furnish an authorized representative who shall visit the site and witness the following:

1. Installation of the equipment – not less than 2 hours
2. Inspection, checking, and adjusting the equipment – not less the 2 hours
3. Start-up and field testing for proper installation – not less than 2 hours

C. Instruction of OWNER's Personnel: The authorized representative shall visit the site for not less than 2 hours to instruct 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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