

**JEA
Kennedy Generating Station
Jacksonville, Florida**

**Fire Protection Loop Replacement
GENERAL CONSTRUCTION**

197990.70.3000

Approved for Construction

Revision 3

February 6, 2020

**BLACK & VEATCH
JACKSONVILLE, FL**

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Project Identification	
Title:	197990 Kennedy Fire Protection Loop Replacement
Address:	Kennedy Generating Station
Specification:	General Construction
Issue Status:	Approved for Construction
Certification(s)	
	<p>I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of Florida:</p> <div style="text-align: center;"></div> <p>Signed: Matthew B. Blevins Registration No.: 72993</p>

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01100 – General Requirements and Scope of Work

01100.1 Overall Project Description

The JEA Kennedy Generating Station is located in Jacksonville, Florida and consists of two 170 MW simple cycle units capable of firing on natural gas and diesel fuel oil. The existing underground fire protection loop is supplied via two connections to a 12-inch city water pressure main bordering the western boundary of the facility along Talleyrand Avenue. The original loop supplied fire protection water for yard hydrants, the dock hose station, the maintenance/warehouse building manifold, and the truck storage area. In the years leading up to 2011, the original underground fire protection loop was extended with new pipe and valving to provide fire water supply to the Unit 7 & 8 CT projects.

The original underground fire protection loop piping is nearing the end of its useable life and has been identified for replacement. To minimize the challenges associated with excavating at this site, the new fire protection loop piping was designed to be installed above grade. In doing so, excavation was reduced to only that required for the pipe support piers, pipe trench installation, and system piping tie-ins as shown on the Contract Drawings.

The scope of the replacement for the existing south 8-inch fire loop connection will begin at the inlet flange to the backflow preventer. The scope of the replacement for the existing north 6-inch fire loop connection will begin with the installation of a new 8-inch connection to the 12-inch city water pressure main. The original fire protection loop yard hydrants will be replaced with new above ground hydrant manifolds; complete with hose and pumper nozzle connections with discharge valves and caps, new inlet isolation gate valves and new supply piping with pipe supports. The existing hydrants shall be removed and capped below grade. No hydrants shall be abandoned in place. The new fire protection loop piping will be reconnected to the CT fire protection supply piping, dock supply piping, maintenance/warehouse building piping, and truck storage area piping at the tie-ins identified on the Contract Drawings.

A new pipe trench will be formed and poured per the Contract Drawings to allow traffic access to the truck storage area.

The portions of below grade piping replaced by the new above grade fire protection loop will be abandoned in place.

01100.2 Contractor's Scope of Work

The scope of work specified herein includes the materials and services required to furnish and erect the systems included, but is not limited to the following. All work necessary to furnish and erect equipment as indicated on the Contract Drawings and as specified herein shall be provided by the Contractor.

- Earthwork including trenching, excavation, bedding, backfill, and dewatering (if required)
- Erosion control and storm water pollution prevention measures, including maintenance throughout the duration of the defined Scope of Work.
- Roadway construction including subgrade preparation and base course.
- Asphalt pavement repair and replacement if necessary.
- Furnish and installation of above ground hydrant manifolds, backflow preventers and valves.
- Furnish and installation of above and below grade piping.
- Furnish and installation of balance of piping and fittings.
- Furnish and installation of required insulation and lagging.
- Removal and capping of the existing yard hydrants.
- Provide tie-ins to existing fire water system.

The Contractor shall provide all materials and services to furnish and erect a complete system, unless note otherwise. Omission by Engineer of specific equipment and services shall not relieve the Contractor



of his responsibility to provide all materials and services to furnish and erect a complete and operational system as specified herein.

Where provision of specific equipment, materials, and services are specified herein, the Contractor shall provide the equipment, materials and services as specified unless otherwise noted or approved by the Owner.

The Contractor shall furnish all materials, supplies, management resources, labor, and services. The activities shall be accomplished without disturbing or damaging adjacent facilities, utilities or equipment, and structures that are to be preserved.

Contractor shall perform any groundwater dewatering that is required. Contractor shall develop the dewatering plan and obtain the dewatering permit. Contractor shall submit the dewatering permit to JEA for review.

Contractor shall obtain all local, state, federal, or other permits required to complete work.

Contractor understands that the work will be performed in an operating power plant. Work shall be performed in required sequence coordinated with plant operations to minimize operational impact.

Where the term "Contractor" is used herein, it shall refer to the Prime Contractor and/or the Prime Contractor's subsupplier(s) and/or the Prime Contractor's Contractor(s). Where the term "Owner" is used herein, it shall refer to the Owner (JEA) and the Owner's representative(s).

In the event of technical conflicts, errors, or discrepancies, the detailed technical specifications, including this Section 01100 and all higher numbered sections, take precedence over Section 01400, Technical Supplemental Specifications.

01100.2.1 Erosion Control Measures and Storm Water Pollution Prevention Plan

The Contractor shall adhere to the Storm Water Pollution Prevention Plan for Construction Activities (SWPPP) that will be provided by the Owner. Additional site erosion control devices required for adherence to the SWPPP shall be provided by the Contractor. This includes sedimentation protection of the existing inlets. Any damage caused by the Contractor to the site erosion control devices shall be repaired by the Contractor.

01100.2.2 As-Built Drawings

Contractor shall provide as-built drawings of the locations and elevations of equipment, utilities, structures and fixtures. As-built drawings shall be clear and legible and "red-lined" on the most recent drawing revision. Hard Copy As-built drawings shall be submitted to the Owner within 14 days of completion of a system or area. As-built markups requiring clarification shall be resolved within 7 days of the Owner's request for clarification.

01100.3 Scope of Work Clarifications

01100.3.1 General

Any costs for soil remediation, soil improvements, removal of unknown abnormal underground obstructions or contaminated soil shall be considered additional work, and shall not be included in the initial Contract scope of work or pricing. The Contractor shall assume that on-site material is suitable for general fill.

Normal construction surveys for laying out and controlling the work shall be included in the Contractor's scope of work. Dewatering and shoring of excavation works shall be the responsibility of the Contractor.

01100.3.2 Safety, Health, and Accident Prevention

Contractor shall take all precautions to protect the safety of its employees and others on the site. Work safety requirements shall comply with OSHA and Owner's Safe Work Practices.

01100.3.3 Lines and Grades

Basic horizontal and vertical control points exist on site as indicated on the design drawings. These points shall be used as datum for work under this Contract; however, Contractor shall verify that these control points are correct.

Work shall be done to the lines, grades, and elevations indicated on the design drawings. Contractor shall provide suitable equipment and competent workmen who shall locate and lay out the work.

Work done without being properly located may be ordered removed and replaced at Contractor's expense.

01100.3.4 Preservation of Monuments, Stakes, and Existing Monitoring Wells

Contractor shall carefully preserve monuments, benchmarks, reference points, stakes, and existing monitoring wells. Contractor will be charged with the expense of replacement of such items destroyed and shall be responsible for mistakes or loss of time that may be caused. Permanent monuments or benchmarks subject to removal or being disturbed shall be protected until they can be properly referenced for relocation. Contractor shall furnish materials and assistance for the proper replacement of such monuments or bench marks.

01100.3.5 Final Grading

At the completion of the Work, holes, ruts, settlements, and depressions resulting from the work shall be filled and graded to match elevations of adjacent surfaces, and areas disturbed by the work shall be restored to their original condition to the maximum extent practicable and as reasonably acceptable to Owner.

01100.3.6 Utility Conflicts

Contractor is responsible for providing the materials and labor required to resolve conflicts between the structures being installed by Contractor and the existing underground utilities and structures.

01100.3.7 Dewatering

If any dewatering is required to support the construction activities within the Contractor's Scope of Work, it shall be the responsibility of the Contractor and shall be performed in accordance with applicable permits, laws, and regulations. Dewatering shall be required for all Work which requires excavation below the groundwater table unless otherwise stated. The Contractor shall furnish all supervision, labor, materials, tools, and equipment required to install, operate, monitor, and maintain dewatering systems in accordance with the design drawings and permit requirements.

The dewatering systems shall be installed, operated, monitored, and maintained in accordance with the requirements of these specifications, the design drawings, the Southwest Florida Water Management District, FDEP, the State of Florida, Lee County, and other applicable codes and standards. A detailed dewatering plan including identification of where, when, and how dewatering will be performed, calculation of expected dewatering flow, treatment of discharge flow, and demonstration of insignificant impacts to wetlands and offsite water table shall be provided by the Contractor to the Owner. Contractor shall acquire necessary permits.

01100.4 Division of Responsibility

The Division of Responsibility Matrix defining the Contractor's scope of supply and the Owner's scope of supply is included at the end of this section and supplements responsibility definition provided throughout the Contract Documents.

Division of Responsibility Matrix			
Engineering, Procurement, and Construction Items	Contractor	Owner	Remarks
Engineering design		X	
Certified as-built drawings	X		Drawings shall be certified by the Contractor shall be identified with "AS-BUILT" designation per the requirements of the State of Florida.
Construction specifications		X	
Site survey	X(1)	X(2)	(1)As required for construction. (2) Owner shall provide existing survey.
Site Security		X	
Construction power supply	X		Contractor to provide all required temporary facilities.
Construction water supply	X		
Construction sewage and waste disposal services	X		
Construction telecommunications	X		
All construction craft and supervision	X		

01100.5 Drawings and Technical Attachments

01100.5.1 Drawings

The following listed drawings provided separately shall be part of the Contract.

Drawing No. or Other Designation	Rev. No.	Title
197990-CSTG-M2000	1	Piping and Instrumentation Diagram
197990-CSTG-M3000	0	Piping General Arrangement
197990-CSTG-M3001	1	Piping Arrangement
197990-CSTG-M3002	0	Piping Arrangement
197990-CSTG-M3003	1	Piping Arrangement
197990-CSTG-M3004	1	Piping Arrangement
197990-CSTG-M3005	1	Piping Arrangement
197990-CSTG-M3006	0	Piping Arrangement
197990-CSTG-M3007	0	Piping Arrangement



Drawing No. or Other Designation	Rev. No.	Title
197990-CSTG-M3008	1	Piping Arrangement
197990-CSTG-M3050	1	Piping Sections and Details
197990-CSTG-M7000	0	Pipe Supports
197990-CSTG-S5000	0	Pipe Trench Plan, Sections & Details

01100.5.2 Technical Attachments

The Technical Attachments for this project are as listed below.

Drawing No. or Other Designation	Rev. No.	Title
Pipe Spec 11CE2F	A	Above ground fire water piping specification
Pipe Spec 11DANF	A	Underground fire water piping specification

01100.6 Schedule of Submittals

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
	70.1000	General				
	01100	<u>Scope of Work</u>				
	01100	Concrete Mix	2wk	Before	Intended Use	
	02220	<u>Earthwork</u>				
1	02220	CLSM mix design	30	Before	Mobilization	
2	02220	Plasticity test results	1	After	Test	
3	02220	Gradation test results	1	After	Test	
4	02220	Maximum density test results	1	After	Test	
5	02220	Field density and water content test results			Submit on the day performed	
6	02220	CLSM compressive strength test results	1	After	Test	
	15921	<u>Piping Erection</u>				
12	15921	Erection procedure.	15	Before	Erection of the system	
	15941	<u>Insulation and Lagging</u>				
13	15941	Drawings detailing types and thicknesses of insulation for pipelines, auxiliary equipment items, and flatwork areas	30	After	Effective Date	
14	15941	Installation details including fastening of insulation and lagging to supports, flashing methods, convection barriers, lagging closures, and provisions for expansion and contraction	30	After	Effective Date	
	Q100	General Welding Requirements				
15	Q100	Welding Procedure Specifications (WPS) with applicable Procedure Qualification Records (PQR)	30	Before	Start of Fabrication	
16	Q100	Procedures for storing, issuing, and reconditioning of electrodes, wires, and fluxes	30	Before	Start of Fabrication	
17	Q100	Repair procedures associated with a nonconformance report	5	After	Discovery of Repair	
18	Q100	Visual inspectors' qualifications and certificates	30	Before	Start of Fabrication	

Item No.	Reference Doc./Sec.	Submittal Items	Submittal Dates			
			Calendar		Event	Due Date
	Q301	<u>Manufacturer's Standard Coating</u>			.	
19	Q301	Shop drawings that identify shop-applied coating systems	30	Before	Start of Fabrication	
20	Q301	Manufacturer's product data sheets	30	After	Release to Proceed	

01400 - Technical Supplemental Specifications

This section contains technical supplemental specifications that provide additional requirements applicable to the work.

D100 Site Meteorological and Seismic Data

Equipment and field erected tank provided by Contractor shall be designed according to the following building code and site conditions:

General Design Data:	
Building Code	FBC 2014
Risk Category	III
Site Elevation (NAVD88), ft	11
Wind Design Data:	
Ultimate Design Wind Speed, V_{ULT} , 3 second gust at 33 ft (10 m) above ground for Exposure C category, mph	163
Exposure Category	C
Topographic Factor, K_{zt}	1.0

Q100 General Welding Requirements

(Source: 06Jan10 - Revised by Project: 02Jun2011)

Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the time of (contract or specification) approval shall govern.

Q100.1 General

Section Q100 shall be used in conjunction with the other Welding Technical Supplemental Specification sections.

Any conflict identified between the requirements of this Welding Technical Supplemental Specification and the provisions of any applicable industry standard, code, regulation, or any specification, standard, or purchasing document contractually required for a given application shall be referred to Owner for resolution prior to the start of welding.

Where requirements of a referenced code or standard differ from the Welding Technical Supplemental Specification sections, the more stringent or restrictive requirements shall apply.

Any request for deviation from specified requirements shall be submitted in writing and shall include the proposed deviation, rationale for the deviation, any technical data supporting the deviation, and historical experience supporting the deviation.

Q100.2 Welding Processes

Unless otherwise specified, only shielded metal arc welding (SMAW), gas metal arc welding (GMAW), flux cored arc welding (FCAW), submerged arc welding (SAW), plasma arc welding (PAW), stud welding,



and gas tungsten arc welding (GTAW) processes shall be permitted within the restrictions or limitations specified in the applicable Welding Technical Supplemental Specification section. Other welding processes may be used, provided the governing code or standard permits it and written approval has been granted by Engineer.

Any limitation or restriction specified for GMAW short-circuit arc transfer or a variation of GMAW short-circuit arc transfer marketed by welding equipment manufacturers shall be applied the same, whether a constant voltage (CV) power supply or other power supply developed by a welding equipment manufacturer is used.

Q100.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified in accordance with the referenced code. Unless otherwise specified, each manufacturer or contractor is responsible for conducting the tests required by the referenced code to qualify the Welding Procedure Specification (WPS).

Welding procedure qualification with GMAW short-circuit arc transfer using a CV power supply shall not qualify a welding procedure for GMAW using a controlled variation of short-circuit arc transfer by a power supply other than CV or vice versa.

WPSs and applicable Procedure Qualification Records (PQRs) shall be submitted for review by Engineer prior to start of fabrication. Submittal of welding procedures and applicable PQRs shall apply to all suppliers and subsuppliers. Suppliers shall review the documents in accordance with the applicable code and specification requirements and shall accept all of their subsuppliers' welding procedures and applicable PQRs prior to submitting accepted documents to Engineer.

Because of the number of different alloys within various alloy P-number or S-number groups, WPSs for welding P-number or S-number 8, 10H, and 41 through 49 alloy materials should identify the base materials by the Unified Numbering System (UNS) or alloy type to aid in the proper application of the WPS, e.g., P45 (UNS N08367, AL6XN). As an alternative to identifying the UNS number on the WPS, the UNS number of the base material or alloy type from the WPS may be cross-referenced to the WPS by other means.

Standard Welding Procedure Specifications (SWPSs) produced by the American Welding Society (AWS) may be used when permitted by the jurisdictional code. Any supplemental requirements mandated by the jurisdictional code shall be met.

Q100.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the referenced code. The welder and welding operator qualification records shall be available at the shop facility or construction site and shall be made available for review when requested.

Field personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activities such as tack welds, temporary welds, permanent welds, manufacturing aids, tools, fixtures, or other welded items. The only field personnel not qualified or certified as welders or welding operators who are permitted to perform welding are personnel completing welding training or performing welding performance qualification testing required by the applicable referenced code or specification.

Shop personnel not qualified and certified as welders or welding operators are prohibited from performing any welding activity on materials designated for permanent or temporary installation by the contract, such as tack welds or temporary welds.

Welders and welding operators qualified for GMAW short-circuit arc transfer using a CV power supply shall not qualify a welder or welding operator for GMAW using a controlled variation of short-circuit arc transfer by a power supply other than CV or vice versa.

Each manufacturer or contractor is responsible for the qualification of welders or welding operators. Welder or welding operator performance qualification testing shall be performed under the full supervision and control of the manufacturer or contractor.

Q100.5 Filler Materials

Welding filler metal shall comply with the requirements of the referenced code and any modified requirements specified herein. The filler metal shall be as specified in the applicable WPS.

Unless otherwise specified, the welding filler metal for welding similar base metal types shall have a chemical composition as similar as possible to the base materials to be welded. The finished weld as deposited, or after postweld heat treatment (PWHT) when required, shall be at least equal to the base metal's minimum specified properties or characteristics as they pertain to strength, ductility, notch toughness, corrosion-erosion resistance, or other physical or thermal properties.

Unless otherwise approved in writing, the GTAW or PAW process shall require the addition of filler metal.

Unless otherwise specified or permitted by an approved deviation request, the use of the -G electrode/wire classification is prohibited. When permitted, welding procedures specifying "G" classification consumables shall be restricted to the same manufacturer and brand-name consumable used to weld the procedure qualification test coupon. The manufacturer and brand name shall be listed on the WPS and PQR. The manufacturer's standard, including the mechanical properties and chemical analysis, along with the request for using non-AWS classification or "G" classification consumables shall be submitted to Owner prior to fabrication.

SAW multipass weld deposits shall use an essentially neutral flux for welding carbon steels. Alloy, semiactive, or active fluxes shall not be used except as specified otherwise. Fluxes that compensate for losses of alloying elements are permitted. Active flux may be used for single pass welding of carbon steels, provided the weld deposit thickness is approximately 1/4 inch maximum each side for a double-V-groove joint design or approximately 1/4 inch one side for a single-V-groove joint design. The joint thickness shall not exceed 1/2 inch nominal.

When using the SAW process, the flux listed in the WPS is restricted to the specific brand-name flux used in the welding procedure qualification test. Any change in the flux brand name or designation shall require a new welding procedure qualification. For SAW welding of stainless or nickel-base alloy materials, only those fluxes specified by the flux manufacturer as suitable for the particular type of high alloy electrode to be used are permitted.

The SAW process shall not use recrushed slag.

SMAW low-hydrogen type electrodes, including stainless steel and nickel and nickel alloy electrodes, shall be purchased in hermetically sealed or vacuum packed containers only.

Q100.5.1 Filler Material for Welding Miscellaneous Materials

Unless otherwise specified, filler material selection shall be in accordance with the following requirements.

Q100.5.1.1 Filler Materials for Steel and Low Alloy Steel. For the SMAW process, all filler metal shall be of the low-hydrogen type when welding on either carbon steel or low alloy steel materials. Nonlow-hydrogen type electrodes (E6010 or E7010-A1 only) may be used only for root pass welding on carbon steel piping, unless otherwise specified by other Welding Technical Supplemental Specification sections. SMAW low-hydrogen type ferrous electrodes for all fill passes shall have a minimum tensile strength of 70,000 psi (495 MPa) as defined by the applicable SFA or AWS specification. When welding is required for existing unknown carbon steel materials, the carbon content shall not exceed 0.30 percent or 0.40 percent carbon equivalent (CE) as determined by $CE = C\% + (Mn\%/6 + Si\%/6)$.

For the FCAW process when welding carbon steel materials, only AWS filler metal Classifications E7XT-1, -5, -9, -12 with shielding gas shall be used (current AWS classifications also utilize either an "M" or "C" after the final digit).

Low alloy FCAW electrodes of nominal composition 2-1/4 Cr - 1 Mo and higher for use on pressure-retaining components shall be purchased with a diffusible hydrogen designation of H4 maximum (SFA-5.29).

Q100.5.1.2 Filler Materials for Dissimilar Material Welds. Filler metals for welding pressure retaining component materials of carbon steel or low alloy steel to austenitic stainless steel shall be in accordance with the following:

Service $\leq 500^{\circ}$ F (260° C)		Service $> 500^{\circ}$ F (260° C)	
ASME Specification	AWS Classification	ASME Specification	AWS Classification
SFA 5.9 or SFA 5.14	ER309 or ER309L ERNiCr-3	SFA 5.14	ERNiCr-3
SFA 5.4 or SFA 5.11	E309 or E309L ENiCrFe-3	SFA 5.11	ENiCrFe-3
SFA 5.22	E309TX-X or E309LTX-X	N/A	N/A

Where carbon steel or low alloy steel piping is to be welded to austenitic stainless steel components, and the carbon or low alloy steel piping is of such a thickness as to require PWHT, the end of the carbon or low alloy steel pipe shall be buttered with Type 309L, ERNiCr-3, or ENiCrFe-3 filler metal for system service $\leq 500^{\circ}$ F and shall be buttered with Type ERNiCr-3 or ENiCrFe-3 filler metal for system service $> 500^{\circ}$ F; the buttered end shall be postweld heat treated. The buttering thickness shall be 3/16 inch minimum after final surface preparation. The weld joint shall then be made between the austenitic stainless steel and the buttering on the carbon or low alloy steel as applicable. This joining method is applicable only to groove welds unless written approval has been granted by Engineer.

Q100.5.1.4 Not Used

Q100.5.2 Filler Material Control

Storage, handling, and drying of SMAW electrodes and SAW flux shall, as a minimum, be in accordance with the manufacturers' recommendations. In addition, SMAW low-hydrogen type carbon and low alloy steel electrodes shall be stored in ovens at 250° F minimum after the hermetically sealed or vacuum packed container is opened. Bare rod in straight lengths shall be individually flag tagged, stamped, or otherwise identified with the AWS classification or product classification. Each spool of solid or cored rod shall be tagged, labeled, or otherwise identified with the AWS classification or product classification. SMAW low-hydrogen type covered electrodes shall only be reconditioned one time. Any SMAW

electrodes that have been wet or have damaged coatings shall not be used. Any welding filler metals or fluxes not readily identifiable shall not be used.

A written procedure for storing, handling, issuing, and reconditioning electrodes, wires, and fluxes shall be submitted for review by Owner.

Q100.6 Fabrication Controls

Q100.6.1 Welding Preheat and Interpass Temperature

The preheat and interpass temperature requirements are mandatory values and shall be in accordance with the referenced code and as specified herein. The WPS for the material being welded shall specify the minimum preheat and maximum interpass temperature requirements. The thickness used to determine preheat requirements shall be the thickness of the thickest part at the point of welding.

The minimum preheat temperature shall be obtained prior to any welding. This shall include tack welding or temporary tack welding.

Preheating shall provide uniform heating over the complete weld or thermal removal process area.

Preheat and interpass temperatures shall be monitored and checked by temperature indicating crayons, thermocouples (TCs), surface contact pyrometers or thermometers, or other suitable methods.

Preheat of pressure retaining components for carbon steel P-number 1 or S-number 1 materials shall be 175° F when the material specified carbon content is in excess of 0.30 percent and the nominal thickness at the joint is in excess of 1 inch. In addition, 200° F minimum preheat is required for nominal thickness over 1.25 inches, regardless of carbon content. A minimum preheat temperature of 50° F is required for all other carbon steel P-number 1 or S-number 1 materials.

The maximum interpass temperature for welding carbon steel and low alloy steel materials shall be 600° F. The maximum interpass temperature for welding carbon steel when impact testing is required shall be 500° F.

The maximum preheat and interpass temperature for stainless steel materials shall be 350° F. The minimum preheat temperature shall be sufficient to ensure that moisture is removed from the material to be welded.

Q100.6.2 Not Used

Q100.6.3 Not Used

Q100.6.4 Miscellaneous Fabrication Control Requirements

Welding shall not be performed when surfaces of the parts to be welded are wet. The parts to be welded shall be protected from deleterious contamination and from rain, snow, and excessive wind during welding.

Prior to welding, the weld preparation and adjacent base material surfaces shall be cleaned and kept free from paint, oil, grease, dirt, scale, rust, and other foreign materials.

The weld end preparation on carbon and low alloy steel materials that will be stored for extended periods of time may consist of coating with deoxaluminat or an equivalent protective material. This coating may be welded through if applied within the manufacturer's maximum weldable limit of 1.25 mils. Complete removal of the coating is neither required nor prohibited, unless signs of rust or other foreign materials such as oil, grease, dirt, or excessive coating are apparent, in which case these areas shall be cleaned.

Acceptable cleaning solvents include new or redistilled acetone (acetone reclaimed by other methods shall not be used), alcohol (ethyl, methanol, or isopropanol), methyl ethyl ketone, or toluene (toluol). Halogenated cleaning solvents shall not be used for cleaning or degreasing.

All groove butt joints shall be complete joint penetration unless specified otherwise by design documents or the applicable code. Partial penetration weld joints not specified by design shall require written approval by Engineer.

Tack welds that are to remain in the completed weld shall have their stopping and starting ends prepared by grinding or other suitable means for satisfactory incorporation into the completed weld. Tack welds that are to become part of the completed weld shall be visually examined; defective tack welds, including cracked tack welds, shall be removed.

When runoff plates are used, they shall be of the same nominal alloy composition as either of the base metals being joined. If runoff plates are used, they shall be properly removed after completion of welding. The method of removal shall not damage the remaining weld or base metal. Runoff plates shall not be knocked off.

Complete penetration joints welded from both sides shall have the root of the first layer or pass chipped, gouged, ground, or machined to sound metal prior to welding from the second side. This requirement is not intended to apply to automated line processes, where the welding from the second side is controlled to provide adequate penetration and ensure full fusion without back gouging.

Welded joints shall be made by completing each weld layer before succeeding weld layers are deposited. Partial fill passes are permitted to correct localized underfill conditions and for the purpose of maintaining alignment. Block welding is prohibited.

As-welded surfaces are permitted; however, the surfaces of welds shall be uniform in width and size throughout their full length. The cover pass shall be free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys. The surface condition of the finished welds shall be suitable for the proper interpretation of nondestructive examination. If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the minimum required thickness.

All pressure retaining fillet weld joints other than socket welded joints that require a fillet weld size greater than 1/4 inch shall require a minimum of two weld layers, except for those fillet weld joints welded with a mechanized or automatic welding process.

Socket welds shall meet the following requirements within the welding process restrictions and limitations specified in the applicable Welding Technical Supplemental Specification section:

A minimum of two weld layers is required for pipe or tube over 0.200 inch nominal wall thickness.

For pipe or tube 1/2 inch or less in nominal pipe size, the GTAW process shall be used.

Welding slag and spatter shall be removed from all welds.

A gas or gas mixture used for shielding shall be welding grade or shall meet Specification SFA-5.32 and have a dew point of -40° F or lower.

Shop fabricators and suppliers shall check for residual magnetism at each end of the machined field pipe weld bevels. Weld bevels containing residual magnetism greater than 5 gauss shall be demagnetized.

Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

Peening is prohibited. The use of power tools for slag removal is not considered peening.

The application of heat to correct weld distortion and dimensional deviation without prior written approval from Owner is prohibited.

Complete joint penetration welds welded from one side without backing, weld repairs welded from one side without backing, or weld repairs in which the base metal remaining after excavation is less than 0.1875 inch from being through wall, which are fabricated from materials with an ASME P-number of 5B or higher or unassigned metals with similar chemical compositions, shall have the root side of the weld purged with an argon backing gas prior to welding. Unless otherwise specified, backing gas (purge) shall only be argon. The argon backing gas shall be classified as welding grade argon or shall meet Specification SFA-5.32, AWS Classification SG-A. The backing gas (purge) shall be maintained until a minimum of two layers of weld metal have been deposited.

Temporary attachments to pressure boundary components outside the weld bevel groove area should be avoided and only used when absolutely necessary. When required, clamps, welded clips, tack welds, or other appropriate means shall be used to properly align the joint for welding. Welded attachments used for fit-up shall be compatible with the base material and shall be welded with a qualified welding procedure. Attachments shall not be knocked off base material. The attachments shall be removed by suitable methods, such as grinding, machining, or sawing, followed by grinding flush with the base material. When thermal cutting is used to remove attachments, approximately 3/16 inch of material shall be left for final removal by grinding. The ground area shall then be visually examined for defects. The area from which attachments have been removed shall be examined as required by the governing code or specification. Any defects found shall be repaired.

Welding across the flanges of Owner's structural steel members (welds that are transverse to the beam or column center line) shall not be an acceptable practice, and Contractor shall design all welded interfaces to Owner's steel structure to specifically avoid this condition. Contractor's design of such interfaces shall achieve full required design strength and stability by means other than welds applied across flanges.

All defects in welds or base materials shall be removed and repaired in accordance with the referenced code.

A written procedure for root side purging shall be described in detail and shall be submitted concurrently with the welding procedures for review by Engineer.

Welding machine ground leads and clamps shall be located to avoid passing welding current through equipment, snubbers, bearings, or any other items where transfer of electrical current may result in damage to equipment.

A complete repair procedure for repairs that are documented as the basis of a nonconformance report shall be submitted to Engineer for review and approval in writing prior to performing the repair. If repair by welding is required, the applicable WPSs and supporting PQRs shall be submitted with the repair procedure. All nonconformance report dispositions shall comply with applicable code requirements.

Q100.7 Nondestructive Examination (NDE)

All NDE shall be performed in accordance with the methods specified in the referenced code and any supplemental NDE specified within the other Welding Technical Supplemental Specification sections.

Except for final visual examination, which is required for all welds, the responsible Contractor's Certified Welding Inspector (CWI) shall perform in-process visual inspections at suitable intervals during the

fabrication and erection process to ensure the applicable requirements of the referenced code, design specification, and WPS are met. Such inspections, on a sampling basis, shall be performed prior to assembly, during assembly, and during welding.

NDE shall be performed in accordance with written procedures that are prepared in accordance with the referenced code and as specified herein. NDE procedures other than for visual examination shall be approved by a qualified and certified NDE Level III. The NDE Level III approval shall be shown on the NDE procedure. NDE procedures shall be submitted for review by Engineer prior to their use.

NDE personnel performing NDE other than visual shall be qualified and certified for the applicable NDE method. Personnel shall meet written practice ASNT SNT-TC-1A, unless permitted otherwise by the referencing code or prior written approval from Engineer is obtained. NDE personnel qualification records shall be made available for review when requested.

All welds shall receive 100 percent visual examination. Visual inspection of welds shall be performed prior to any painting, coating, or galvanizing. Visual weld examination acceptance criteria and other NDE acceptance criteria shall be in accordance with applicable referenced codes and design documents. Records of these examinations shall be documented.

The NDE results shall be provided in a NDE Report that is evaluated, interpreted, and accepted by a Level II or Level III NDE personnel.

Contractor shall obtain and pay for the services of an independent testing laboratory to provide the required field nondestructive examination. Any defective weld shall be removed, repaired, and retested at the Contractor's expense.

Owner may order NDE by an independent laboratory in addition to any examinations specified herein. The NDE type, extent, and method shall be the same as that required for the original weld. If the weld is defective, the laboratory costs shall be paid by the Contractor. If the weld is not defective, the laboratory costs will be paid by Owner. Repair of defective welds and reexamination shall be at the Contractor's expense. Weld acceptance standards shall be in accordance with applicable codes and design specifications. If an individual interpretation is in question, the final authority shall be the responsibility of Owner.

Q100.8 Records

Records of inspections, NDE, impact testing, hardness testing, PWHT charts or records, base material test reports, filler material test reports, radiographic film with applicable reader sheets, deviation requests including resolution documentation, nonconformance reports, and other records, as required, shall be retained by the Contractor for 5 years after completion of the work. Records shall be submitted to Engineer and/or Owner, if requested.

Quality records, including applicable Data Report Forms generated by a manufacturer or assembler in accordance with an approved Quality Control System, shall be provided in accordance with the approved Contract. Quality records shall be legible, appropriately completed, and sufficiently detailed to permit traceability to the item or activity involved.

Q121 Welding of Carbon, Low Alloy, and Stainless Structural Steel (Source: 04Feb10 - Revised by Project: 26Jul2011)

Q121.1 General

This Technical Supplemental Specification provides requirements for welding carbon, low alloy, and stainless structural steel, ductwork, stacks, and other welded steel structures as required by design, in accordance with AWS D1.1, Structural Welding Code - Steel or AWS D1.6, Structural Welding Code - Stainless Steel. Supplemental requirements for welding a seismic load-resisting system (SLRS) shall be

in accordance with AWS D1.8, Structural Welding Code – Seismic Supplement, when seismic detailing or enhanced ductility is required by design. This Technical Supplemental Specification shall be used in conjunction with Section Q100 of the Welding Technical Supplemental Specifications.

Q121.2 Welding Processes

Permitted welding processes shall be as specified in Section Q100 and shall include the restrictions and limitations applicable to those processes as specified herein.

Q121.2.1 Welding Process Restrictions and Limitations

The Gas Metal Arc Welding (GMAW) process utilizing the short-circuiting transfer mode shall not be used in any application, except for the following:

AWS D1.1 – No exceptions.

AWS D1.6 – When welding base metals that have a maximum thickness of 3/16 inch.

AWS D1.8 – No exceptions.

The Flux Cored Arc Welding (FCAW) process shall only be used with shielding gas, except for the following:

AWS D1.1 – When welding base metals that have a maximum thickness of 1/2 inch and that use E71T-8 electrodes.

AWS D1.6 – No exceptions.

AWS D1.8 – When welding base metals that have a maximum thickness of 1/2 inch and that use E71T-8 electrodes. Furthermore, the electrodes shall meet the impact testing requirements of AWS D1.8, Annex B.

The weld progression for manual or semiautomatic vertical position welds shall be uphill, except for the following:

AWS D1.1 – Undercut may be repaired vertically downward, provided the preheat is in accordance with AWS D1.1, Table 3.2, but not lower than 70° F.

AWS D1.1 – When tubular products are welded, the progression of vertical welding may be upward or downward, but only in the direction in which the welder is qualified and as permitted by the Welding Procedure Specification (WPS).

AWS D1.6 – Using the prequalified Gas Tungsten Arc Welding (GTAW), GMAW-S, and FCAW-G processes, progression may be vertically downward for base metal with a 3/16 inch maximum thickness.

AWS D1.6 – Undercut may be repaired vertically downward on the joint faces only, without any base metal thickness limitations when using the prequalified GTAW and FCAW-G processes. When using the prequalified GMAW-S process, undercut may be repaired vertically downward on the joint faces only for base metal with a 3/16 inch maximum thickness.

AWS D1.8 – AWS D1.1 requirements above shall apply.

Q121.3 Welding Procedure Qualification

Welding procedures shall be prepared and qualified or shall be prepared as prequalified in accordance with the applicable AWS code. All prequalified WPSs shall be in the form of a written document. For a WPS to be prequalified, conformance with all of the applicable requirements of AWS D1.1, Section 3 or AWS D1.6, Section 3 shall be required.

For AWS D1.1 welds, when the base metal is required to be Charpy V-Notch (CVN) impact tested by the design specification or contract documents, the WPS qualification shall include the CVN test requirements of AWS D1.1. The minimum CVN test temperature for the welding procedure qualification shall be at or below the minimum test temperature specified by the design specification or contract documents.

For AWS D1.8 welds (Demand Critical and Non-Demand Critical), CVN testing is mandatory. All WPS qualifications shall be performed in accordance with the CVN test requirements of both AWS D1.1 and AWS D1.8. The minimum CVN test temperature for the welding procedure qualification shall be at or below the minimum test temperature specified by the design specification or contract documents.

When the base metal is required to be CVN impact tested by the design specification or contract documents, the filler metal required by the WPS for welding the CVN base metal shall be classified with CVN impact testing at a test temperature at or below the test temperature specified by the design specification or contract documents.

Q121.4 Welder/Welding Operator Performance Qualification

Welders and welding operators shall be qualified in accordance with the applicable AWS code. As an alternative, welders and welding operators may be qualified in accordance with ASME Section IX within the welding personnel performance essential variable limitations permitted by the applicable AWS code.

For AWS D1.8 welding, the shielding gas for FCAW shall constitute an essential variable and any change shall require requalification.

For AWS D1.8 welding, the qualification for welding personnel using the Supplemental Welder Qualification for Restricted Access Welding shall remain valid for 12 months or the duration of the project, unless there is a specific reason to question the welder's ability.

Q121.5 Fabrication Control

Fabrication, assembly, and erection shall be in accordance with the applicable AWS code and the design documents.

When welds joining ASTM A588 weathering steels will experience exposure to atmospheric conditions and are left exposed, bare, unpainted, uninsulated, or otherwise visually observable in their final service condition, the filler metal required for welding shall comply with the requirements specified in AWS D1.1, Section 3.7.3 and Table 3.3.

When tensile forces are to be transmitted through full penetration groove welds on AISC material Groups 4 and 5 rolled shapes, or shapes built up by welding plates more than 2 inches thick together to form the cross section, the requirements of AISC J1.7 in the AISC 9th Edition or AISC J1.5 and J2.6 in the AISC 13th Edition, as applicable, shall apply.

Q121.5.1 Backing and Retainers

When required, backing shall be in accordance with the applicable AWS code.

Nonmetallic retainers or nonfusing metal retainers shall not be used unless specified in the WPS. When used, they shall be removed.

Q121.5.2 Preheat and Postweld Heat Treatment

For AWS D1.1 prequalified carbon and low alloy steels, preheat shall be performed in accordance with AWS D1.1, Table 3.2, applicable to the materials listed and the design documents. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.6 prequalified austenitic stainless steels, the minimum preheat temperature shall be 50° F. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.1 or AWS D1.6 materials that are not prequalified, the minimum preheat temperature shall be in accordance with the preheat temperature established from the welding procedure qualification. The minimum preheat temperature shall be specified in the WPS.

For AWS D1.8 welding, the maximum interpass temperature shall not exceed 500° F.

When required by design, postweld heat treatment shall be performed in accordance with the applicable AWS code and the design documents.

Q121.5.3 Weld End Preparation

Preparation of butt welding ends of piping components for shop welds shall be in accordance with the fabricator's standard end preparation details and WPS. Preparation of pipe butt welding ends for field welds shall be in accordance with ASME B16.25.

Q121.6 Nondestructive Examination (NDE)

In addition to the 100 percent Visual Examination (VE) required of all welds, other required NDE of welds shall be performed in accordance with the applicable AWS code and the design documents defined herein.

Supplemental VE of welds after galvanizing shall be performed as defined in Article Q121.6.1.1.1.

Unless otherwise specified, any weld defects identified by NDE shall have additional examinations conducted as required by Section 6.15 of AWS D1.1 (including AWS D1.8 welds) or Section 6.8 of AWS D1.6, as applicable. All defects found shall be removed, repaired, and re-examined by the same NDE method that identified the original defect.

Q121.6.1 NDE Requirements of Welds

Structures include buildings and non-buildings, as defined in ASCE 7. Non-building structures similar to buildings will require the same NDE methods as the appropriate building structure type.

Q121.6.1.1 Not Used.

Q121.6.1.1.1 Supplemental Visual Examination Requirements of Welds after Galvanizing. The following welds and immediate adjacent areas (within 1 inch of the weld) shall be 100 percent visually examined by the responsible supplier or responsible contractor that performs the galvanizing not less than 48 hours after completion of galvanizing:

Butt joint splices, columns, and beams.

Beam clip angles.

Plate girder and built-up flexural member joint welds.

All areas requiring VE shall be examined for the presence of cracks. The acceptance criteria for the subject welds shall be "free from cracks."

If any cracks are visually identified after galvanizing, Engineer shall be notified prior to repair. Engineer may request additional NDE by MT examination of any similar joint types. Any cracks discovered by MT, but not previously identified by VE, shall require 100 percent MT examination of all similar joint types at the expense of Contractor. Any cracking detected by VE or MT shall be repaired at the expense of Engineer.

Visual inspection of the subject welds after galvanizing may be performed by personnel other than the responsible Contractor's Certified Welding Inspector (CWI). Personnel other than a CWI must have experience suitable to Engineer for performing post-galvanizing weld visual inspection. Visual inspectors' qualifications and certificates or evidence of training or experience shall be submitted to Engineer for review.

Q301 Manufacturer's Standard Coating

Unless otherwise specified, the manufacturer's standard coating systems shall be applied in the shop to ferrous metal surfaces of equipment and materials. The coating systems shall provide resistance to corrosion caused by weather and industrial environments. Manufacturer's standard coating systems shall be specified to provide medium (M) durability in accordance with ISO 12944, Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems, for the intended service environment. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment.

Coating material and application shall conform to the regulations of the air quality management agency having jurisdiction. Materials shall be formulated to contain less than 0.06 percent lead or chromium in the dried film.

Surfaces shall be cleaned, prepared, and coated in accordance with the coating manufacturer's instructions and specified codes. Surfaces to be painted shall be prepared, as necessary, to provide a smooth, uniform base for painting.

Coating films that show defects such as sags, checks, blisters, teardrops, and fat edges will not be accepted. Any coated surface that contains any of the previously mentioned defects shall be repaired or, if necessary, entirely removed from the member or unit involved and the surface recoated.

All internal surfaces that will be exposed to steam or treated feedwater shall be blasted with aluminum oxide (pink or white grade), cut steel wire (SAE J441), steel grit, or steel shot. The blasting media used shall contain no more than 1.2 percent complexed silica and 0 percent free silica.

Surfaces to be finish painted after installation shall be shop painted with one coat of the manufacturer's standard primer.

Touchup paint shall be provided for repair painting of at least 10 percent of the finish painted equipment surface. The touchup paint shall be the same type and color as the shop applied material. Application instructions shall be provided.

No coating shall be applied to surfaces within 3 inches (75 mm) of field welded connections.

Coating dry film thicknesses shall be measured using a magnetic or electronic thickness detector in accordance with Society for Protective Coatings (SSPC)-PA2. Additional coating shall be applied to all areas that show a deficiency in dry film thickness.

Q301.1 Control and Electrical Equipment

Control and electrical equipment, including panels, cabinets, switchgear, transformers, and motors, shall be finish painted. Exterior surfaces shall be the manufacturer's standard color unless specified otherwise. The interior portions of cabinets shall be painted a light reflecting color.

Q301.2 Mechanical Equipment

Mechanical equipment, including pumps, compressors, valves, valve operators, external piping surfaces, and other similar equipment, shall be cleaned, prepared, and primed. If mechanical equipment will operate at temperatures above 200° F (93° C) and will not be insulated, a high temperature coating system designed for the operating temperatures shall be applied.

Q301.3 Documentation

Shop drawings shall identify the shop applied coating systems. Data to be provided shall include the coating system manufacturer's name and product designation, the degree of surface preparation, dry film thickness, finish color, and Safety Data Sheets (SDSs). Final dry film thickness test results shall be submitted to Owner for verification.

Q400 General Equipment Requirements

Q400.1 Miscellaneous Materials and Services

Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Supplier in accordance with the following, as applicable:

All nuts, bolts, gaskets, special fasteners, backing rings, etc., between components and equipment furnished under these specifications.

All piping integral to or between any equipment furnished under these specifications, except as otherwise specified.

All necessary connections for the Owner's piping and instruments.

All necessary instrument, power, and control wiring and raceways integral to any equipment furnished under these specifications. This shall include terminal blocks and internal wiring to these terminal blocks for equipment requiring external connection.

Coupling guards for all exposed shafts and couplings.

Leveling blocks, soleplates, thrust blocks, matching blocks, and shims.

Field office furnishings, supplies, telephone service, and equipment for the manufacturer's technical service representatives.

Erection drawings, prints, information, instructions, and other data for use by the Owner's erection contractor.

Detailed storage requirements and lubrication requirements (including frequencies) for use by the Owner's erection contractor.

All special tools or lifting beams.

Lifting eyes and lugs for offloading and setting equipment.

The use of all special tools required for erection of the equipment, exclusive of the maintenance tools furnished. Erection tools shall remain the property of the Supplier, and all shipping costs to and from the jobsite shall be at the Supplier's expense.

Q400.2 Fabrication Restrictions

Unless specifically provided otherwise in each case, all materials and equipment furnished for permanent installation in the work shall conform to applicable standard specifications and shall be new, unused, and undamaged.

Asbestos containing materials will not be allowed.

Flanges, fittings, and valves manufactured in the People's Republic of China shall meet following requirements.

Manufacturer's quality system shall be in accordance with ISO 9001 and the manufacturer shall hold a valid ISO 9001 certificate issued by the certified ISO 9000 certification organization.

Manufacturer shall hold a manufacturer's license issued by the China Special Equipment Inspection & Research Center (CSEI) under General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) or an acceptable equivalent in accordance with Owner's Engineer.

Products shall have markings as required by ASME B16.1, ASME B16.5, ASME B16.9, ASME B16.10, ASME B16.11, ASME B16.25, or ASME B16.34 as applicable.

The final quality certificate and quality inspection documents shall bear the official stamp of CSEI or AQSIQ or its branches.

Individual parts shall be manufactured to standard sizes and gauges so that repair parts furnished at any time can be installed in the field. Like parts of duplicate units shall be interchangeable.

Q400.3 Nameplates and Tags

Nameplates and tags shall be furnished and shop installed for all equipment with a Owner's identification number based upon the guidelines provided herein. The Owner will annotate the Supplier's drawings on initial submittals of technical drawings of the equipment. The information will include the nameplate description, tag number, physical size, and lettering height. The type of nameplate will vary because of size constraints, equipment location and/or orientation, or the environment in which the equipment is located.

In general, nameplates shall be furnished for major equipment, including all operator interfaces, control and electrical panels, cabinets, and instrument racks. The nameplates shall be beveled, laminated white phenolic plastic engraving stock with black core or beveled, two-ply vinyl white with reverse engraved black fill. These nameplates shall be 2 inches by 8 inches (50 mm by 200 mm) with three lines of text. The top two lines of text shall be a brief description of the equipment. These lines of text shall be 3/8 inch (10 mm) high. The bottom line of text shall be the Owner's identification number of the equipment. This line of text shall be 3/16 inch (5 mm) high. Nameplates that are to be mounted on equipment to be installed in nonair-conditioned areas shall be attached with stainless steel panhead screws, rivets, drive screws, or epoxy glue. Nameplates that are to be mounted on equipment to be installed in heated and air-conditioned areas shall be attached with high performance adhesive tape. Nameplates shall be 1/16 to 1/8 inch (2 mm to 4 mm) thick.

Stainless steel tags shall be furnished for field instrumentation, process valves, and other small devices that a plant operator is not likely to have any direct interface with, as directed by the Owner. These

stainless steel tags shall be permanently attached to the equipment with stainless steel panhead screws, rivets, drive screws, or, with the Owner's acceptance, stainless steel wire. The size of these tags shall be a minimum of 1-1/4 inch by 2-1/2 inches (30 mm by 65 mm) 18 Ga thickness and include the Owner's identification number. Lettering shall be electro/laser etched, stamped, or engraved on a polished plate, with text at least 3/16 inch (5 mm) in height. Text shall be sized as large as possible within the size constraints of the tag.

Separate nameplates are not required for pressure indicators. They may be provided instead with nameplate information, as described above, permanently engraved on the faces. Face engraving text size and layout shall be readable without magnification.

Q400.4 Factory Assembly

Equipment shall be shipped completely factory assembled, except when the physical size, arrangement or configuration of the equipment, or shipping and handling limitations make the shipment of completely assembled equipment impracticable, in which case the equipment shall be assembled and shipped as stated in the Supplier's proposal. Any deviations after Purchase Order award could result in Supplier's performance of some assembly at the site or backcharges to the Supplier for others required to perform such assembly. When proposals are submitted without statements describing sectional shipments, it will be understood that no field assembly of the equipment will be required and the Supplier shall be responsible for all costs encountered in the field for assembly of sections, accessories, or appurtenances not listed in the Proposal as requiring field assembly.

When indicated in the Schedule of Submittals, the Supplier shall submit a Shipping Plan confirming and detailing the field assembly requirements as stated in the proposal.

All separately packaged accessory items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip indicating what is in that container only shall be attached to the outside of each container used for packaging. A similar list shall be inside each container. A master packing slip covering all accessory items for a given piece of equipment which are shipped in separate containers shall be attached to one container.

Q400.5 Tools

The Supplier shall furnish and ship with each piece of equipment one set of all special tools required for dismantling, maintenance, and overhaul of the equipment. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.

Maintenance tools for each piece of equipment shall be boxed separately and the boxes shall be marked with the name of the project and the name of the equipment.

The maintenance tools shall include all special handling rigs, bars, slings, and cable. All maintenance tools shall be in new and unused condition and shall become the property of the Owner. The bidder's proposal shall include the list of maintenance tools which shall be furnished with the equipment.

In addition to the tools for maintenance and dismantling, the Supplier shall furnish the use of all special tools required for erection of the equipment. Erection tools shall remain the property of the Supplier and all shipping costs to and from the jobsite shall be at the Supplier's expense. Erection tools for each piece of equipment shall be boxed separately. Erection tools shall not be boxed with maintenance tools.

Q500 Technical Data Submittals

This section, in conjunction with the Schedule of Submittals, stipulates the requirements for technical data that Contractor shall submit for Owner's review.

Q500.1 Submittal Requirements

Technical data shall be submitted in electronic format. Hard copy prints of the electronic files shall also be submitted, as specified below.

Q500.2 Compliance Reports

Reports shall be submitted that record the tests performed. Reports shall be submitted for each piece of equipment.

Q500.2.1 Reports Submittal

Reports shall be submitted electronically in Adobe Portable Document Format (PDF).

Q500.2.2 Submittal Reviews

Contractor's schedule shall allow a minimum of one week for processing and review of submittals by Owner.

Owner, upon receipt of submittals, shall review and return same to Contractor, marked "No Exceptions Noted," "Exceptions Noted," "Received for Distribution," "Returned for Corrections," "Release for Record," "Void," or "Superseded." The timing of Contractor's submittals and Owner's review shall be in accordance with the Completion Dates for same as set forth in the Contract. The submittal of any submittal document by Contractor to Owner under this Contract will be certification by Contractor that the information set forth therein is accurate in all material respects.

Q500.2.2.1 No Exceptions Noted (NE) or Received for Distribution (RD). Upon receipt of a submittal marked "No Exceptions Noted" or "Received for Distribution", Contractor may proceed with its Work to the extent of and in accordance with the submittal. Contractor shall not resubmit unless the drawing or document is revised, in which case it shall be resubmitted as a new document revision in accordance with Q500.2.2.7.

Q500.2.2.2 Exceptions Noted (EN). Upon receipt of a submittal marked "Exceptions Noted" and if Contractor concurs with Owner's comments, Contractor shall incorporate same and may proceed with its Work to the extent of and in accordance with the annotated submittal. Contractor shall submit to Owner within seven calendar days a revision to the original submittal in which Owner's comments has been incorporated. If Contractor determines that it cannot incorporate Owner's comments without prejudice to Contractor's warranty or other obligations under this Contract, Contractor shall so advise Owner in writing within seven calendar days of its receipt of Owner's comments, stating the reasons therefore. Contractor may proceed with its Work to the extent of and in accordance with the annotated submittal only upon Owner and Contractor resolving Owner's comments.

Q500.2.2.3 Returned for Corrections (RC). Upon receipt of a submittal marked "Returned for Corrections," Contractor shall immediately take all necessary action to revise its submittal in accordance with Owner's comments and shall resubmit to Owner for review the corrected original submittal, voiding previous information and adding new documents if required. In no event shall Contractor proceed with the affected Work until its revised submittals have been returned to Contractor marked "No Exceptions Noted" or "Exceptions Noted" by Owner.

Q500.2.2.4 Release for Record (RR). Receipt of a submittal marked "Release for Record" indicates that there are no specific objections to the document. Work may proceed. Certain project information required by the Owner's document management system may have been added electronically to the drawing and provided to Contractor for the record. Contractor shall not resubmit the drawing or document unless revisions to the submittal are required. If revisions are required, Contractor shall incorporate Owner's information and resubmit as a new revision. Owner's project-specific information shall be added if future revisions and submittals are made.

Q500.2.2.5 Void (VO) or Superseded (SS). Receipt of a submittal marked "Void" or "Superseded" does not require any action by Contractor. "Void" indicates that the submittal is no longer applicable to the project and is not being replaced by other drawings or data. "Superseded" indicates that different drawings or data have replaced the previously submitted drawings and data; this status does not pertain to revisions of the same drawings and data.

Q500.2.2.6 Hold (HO). A submittal may be given a status of "Hold" by the Owner, or the Contractor may have "Holds" on the submittal.

For a Hold status designated by the Owner, the Contractor shall not proceed with the work that is designated on "Hold" except as specifically directed by the Owner. Additional information required for the Contractor to release the "Hold" will be transmitted from the Owner later.

The Contractor shall provide information to the Owner about the cause for any "Holds" designated on the submittal and immediately take all action necessary to resolve the "Holds".

Q500.2.2.7 Resubmittals. If during or subsequent to the completion of the submittal process, Contractor makes further changes to the equipment and materials shown on submittals that have been reviewed by Owner, the changes shall be clearly marked on the submittal by Contractor and the submittal process shall be repeated. Any resubmittal of information shall clearly identify the revisions by footnote or by a form of back-circle, with revision block update, as appropriate.

Q500.2.2.8 Owner's Review. Owner's review of submittals will cover only general conformity of the data to the Specifications. Owner's review does not include a thorough review of all dimensions, quantities, and details of the equipment, materials or the accuracy of the information submitted. Review and comment by Owner of Contractor's submittals shall not relieve Contractor of its sole responsibility to meet the Completion Dates requirement of this Contract and to supply Goods that conform to the requirements of this Contract.

02220 – Earthwork and Trenching Datasheet

Table 1 – General		
General		
1	Application	Excavation, subgrade preparation and backfill Construction of fills and embankments, surfacing, and grading Disposal of debris
2	Execution Requirements	In accordance with site requirements
3		
Codes and Standards		
4	Classification of Soils	ASTM D2487
5	Description and Identification of Soils	ASTM D2488
6	Particle Size Analysis	ASTM D422
7	Compaction Tests	
8	Standard Proctor	ASTM D698
9	Modified Proctor	ASTM D1557
10	In Place Density and Unit Weight Tests	ASTM D1556
11	In Place Density and Water Content Tests	ASTM D6938
12	Maximum Index Density and Unit Weight Tests	ASTM D4253
13	Minimum Index Density and Unit Weight Tests	ASTM D4254
14	Liquid Limit, Plastic Limit, and Plasticity Index Tests	ASTM D4318
15	Earthworks and Construction Safety	OSHA 29CFR Part 1926, Subpart P, "Excavations"
16		

Table 2 – Products		
17	Concrete Aggregates used as Fill Material	ASTM C33 or Standard Specification for Road and Bridge Construction, Florida Department of Transportation (DOT)
18	Lime Treated Soil	Standard Specification for Road and Bridge Construction, Florida Department of Transportation (DOT)

19	Nuclear Surface Moisture-Density Gauge	Select from: Troxler Model 3430, 3440, 3450, 3451 Campbell Pacific Nuclear (CPN) Model MC-3 and MC-1
20		

Table 3 – Execution		
Requirements and Performance		
21	Materials, Compaction, and Testing Requirements	As specified in Schedule A
22		
Testing		
23	Laboratory Testing	Performed by an independent testing laboratory acceptable to the Owner
24	Field Sampling and Testing Qualifications	NICET Level II Construction Materials Testing
25	Field Sampling and Testing Technicians	Employed by an independent testing company acceptable to the Owner Provide assistance to field testing representative upon request
26	Field Sample Locations	Selected by the Site QA Manager Arrange so as to represent the average density over the depth of the layer Perform additional field control tests as directed by Site QA Manager
27	Definitions	
28	Maximum Dry Density	Per ASTM D698 or ASTM D1557
29	Optimum Moisture Content	Per ASTM D698 or ASTM D1557
30	Relative Density	Per ASTM D4254
31	Distribution of Test Results	Provide to Owner on the day the test is performed
32		
General		
33	Backfill, Fill and Earth Materials	Do not place during freezing weather unless acceptable to the Engineer Do not place on frozen surfaces Maintain free from frozen materials, snow, or ice

34	Safe Detours	<p>Provide whenever it is necessary to cross, obstruct, or close roads, driveways, parking areas, and walks</p> <p>Install and maintain suitable and safe bridges or other temporary expedients for the duration of the work</p> <p>If the work affects a public roadway, provide traffic control in accordance with the Manual of Uniform Traffic Control Devices and all local permitting requirements</p>
35	Tree Removal	<p>Remove trees only from areas within the construction limits unless specifically authorized by the Site Construction Manager</p> <p>Additional tree removal may be permitted when necessary for the effective execution of the work</p>
36	Tree Protection	<p>Protect trees left standing from permanent damage</p> <p>Park construction equipment and vehicles outside the dripline of remaining trees</p> <p>Trim standing trees as directed by the Site Construction Manager</p>
37	Erosion and Sediment Control Measures	<p>Install prior to any clearing operations</p> <p>Maintain during the course of the project</p>
38	Previously Constructed Structures and Facilities	<p>Applies to both structures and facilities existing when this construction began and structures and facilities already provided under these specifications</p> <p>Do not impair or endanger stability by excavation work</p> <p>Provide adequate sheeting and shoring to protect and maintain stability and the sides of excavations until they are backfilled</p> <p>Design and build sheeting, bracing, and shoring to withstand all loads and restrain all settlement caused by earth movement or pressure and maintain the shape of the excavation</p>
Site Preparation		
39	Schedule	Perform clearing operations before excavations, subgrade preparation, and fill construction
40	Clearing and Grubbing	As specified herein
41	Ground Clearing	Clear and remove all trees, brush, shrubs, debris, and surface vegetation in the construction areas
42	Stumps and Roots	<p>Completely grub and remove larger than approximately 2 inches in diameter</p> <p>Remove matted roots regardless of size</p>
43	Surface Vegetation	Remove complete with roots to a depth of approximately 4 inches below the ground surface

44	Topsoil	Strip subgrades of all organic topsoil before preparation Remove from the site as specified herein
45	Previous construction	Strip subgrades of all concrete, asphalt, conduit, pipes and demolition or construction debris
46	Noncombustible Material Removal	Remove from the construction areas for disposal off-site In accordance with the requirements of the regulatory authorities having jurisdiction
47	Combustible Material Removal	Remove and dispose off-site; Burning is prohibited In accordance with the requirements of the regulatory authorities having jurisdiction
48	Burning Operations	Conduct as acceptable to the Site Construction Manager
49	Materials Burned	Pile materials neatly and burn completely Pile for burning in a manner to minimize fire risk Completely reduce to ashes
50	Fireguards	Prevent the spread of fire beyond the limits of the burning site Provide adequate width wherever surface vegetation is near any brush pile
51	Burning Weather Conditions	No burning when the direction or velocity of the wind causes a danger of fire spreading
52	Burning Permit	In accordance with all applicable government requirements Provide a copy to the Site Construction Manager each day burning occurs
53		
Water Removal		
54	Diversion of Surface Water	Divert surface water to prevent entrance into the excavations
55	Dewatering	As specified herein
56	Requirements	Design and operate by a dewatering specialist Provide adequate dewatering to remove and dispose of all surface and ground water entering excavations Keep the excavations dry Lower the water level in advance of the excavation utilizing wells, well points, or similar methods

57	Engineering Review	Submit the proposed dewatering system to the Engineer for review
58	Control of Ground Water	Control ground water in a manner to preserve the strength of foundation soils, cause no instability of excavation slopes and no damage to existing structures
59	Water Level	Maintain the water level, as measured by piezometers, continuously about 12 inches below the prevailing excavation level, or within about 12 inches of impermeable strata
60	Well Screening	Install wells and well points with suitable screens and filters so that continuous pumping of fines does not occur
61	Maximum turbidity	29 NTU Above Background
62	Header Systems	Lay on top of the ground only if they do not obstruct plant operations, construction activity, or traffic
63	Discharge Routing	Route to existing stormwater management system Ensure plant drainage system is not overloaded
64	Dewatering Operation	Operate continuously, if necessary, to maintain the specified water level until construction is no longer affected by ground or surface water
65	Pipe and Conduit Cleaning	Keep pipe or conduit used for drainage purposes clean and free of sediment
66	Dewatering System Removal	Remove all temporary dewatering piping and equipment after work completion and before the Contractor demobilizes from the site
67	Permanent Plant and Site Drainage	Repair all damage to the permanent plant and site drainage caused by dewatering operations
68		
Excavated Materials		
69	Stockpiling	Stockpile excavated materials that meet the specified requirements for fills, embankments, and backfills
70	Clean soil or gravel	Stockpile for later use
71	Large Rocks	Keep boulders over 12 inches in diameter separate from other excavated materials Dispose of boulders as directed by the Owner
72	Separation of Rock	Keep rock that cannot be handled and compacted as earth separate from other excavated materials and do not mix with backfill, fill, or embankment materials
73		
Roadway Roadbeds		

74	Construction	Includes excavation, subgrade preparation, and construction of fills and embankments
75	Excavation	Remove the overburden in excavated roadbed areas Shape the subgrade to line, grade, and cross section Remove soft, organic, and other unacceptable material from the subgrade and replace with material meeting structural fill requirements
76	Compaction	Compact the subgrade in accordance with Schedule A requirements
77	Subgrade Finish	Uniform surface to allow for proper drainage
78	Tolerance	Within 0.1 foot of the elevation indicated on the drawings
79	Ditches	Maintain ditches and drains along the subgrade for effective drainage Reshape and recompact the subgrade when ruts of 2 inches or more in depth are formed
80	Material Stockpile	Do not store or stockpile material on subgrades
81		
Fills and Embankments		
82	Compliance with Drawings	Construct fills and embankments to lines and grades indicated on the drawings
83	Subgrade Preparation	Scarify, level, and roll Ensure the subgrade surface is well bonded to the previous layers of fill Areas identified as soft or excessively disturbed shall be removed and replaced with compacted soil Seal subgrade with a smooth drum roller when inclement weather is expected, then scarify prior to adding overlying lifts Standing water is not permitted Allow areas that have been exposed to heavy rain or standing water to dry to within 2 percent of optimum water content prior to adding overlying lifts
84	Observation	Witnessing and approval of subgrade by a qualified soil technician and construction management required prior to fill placement
85	Material	

86	Source	<p>Use earth materials obtained from excavations for the construction of fills and embankments to the maximum extent available</p> <p>Obtain additional material from borrow pits or approved off-site sources</p>
87	Borrow Areas	<p>Excavate material necessary to complete fills and embankments from off-site borrow areas and haul the fill or embankment to site; No borrow material will be available on the Owner's property and it must be furnished from an acceptable source</p>
88	Objectionable Material	<p>Keep rocks or stones larger than allowed in Schedule A, brush, stumps, logs, roots, debris, and organic or other objectionable materials out of the material deposited</p>
89	Contamination	<p>Use material obtained from offsite sources free of contamination</p> <p>Free of contamination is defined by the FDEP Clean Fill Criteria that does not exceed the Soil Cleanup Target Levels</p> <p>Provide documentation proving the material is free of contamination</p>
90	Placement	<p>Scarify the top 1 inch of each lift to promote bonding between lifts</p> <p>Place materials in approximately horizontal layers</p> <p>Spread and level material deposited in piles or windrows prior to compaction</p>
91	Compaction	<p>Compact each layer thoroughly to meet the requirements specified in Schedule A</p> <p>Modify the compaction methods to attain the specified density if the material first fails to meet the density specified</p> <p>Recompact failed layers until they meet the specification requirements in Schedule A</p>

92	Water Content	<p>Add water to meet the moisture content required by Schedule A and work into each layer using harrow, disk, blade, or other acceptable equipment to provide a uniform moisture content</p> <p>Remove water to meet the moisture content required by Schedule A using mechanical means to work the soil or other acceptable methods and equipment to provide uniform moisture content.</p> <p>Use of chemical additives to reduce or modify the moisture content requires Owner approval.</p> <p>Alter compaction methods if the material fails to meet the specified density required</p>
93		
Additional Requirements for Structures		
94	Structure Excavation	
95	Compliance with Drawings	Complete the excavation for structures the designated lines and elevations
96	Undercutting	<p>Control machine excavation to prevent undercutting the subgrade elevations indicated on the drawings</p> <p>Do not undercut vertical faces of excavations to provide for extended footings</p>
97	Excavation Below Structures	
98	Structures supported on subgrade	<p>Replace material excavated below the bottom of concrete structures with concrete placed monolithically with the concrete above</p> <p>Rock fill or lean concrete may be used, if acceptable to the Engineer</p>
99	Structures supported on piers or piles	<p>Replace material excavated below structures with crushed rock or gravel</p> <p>Compact the crushed rock or gravel to a density equal to or greater than the density of the adjacent undisturbed soil</p>
100	Structure Subgrade	
101	Compliance with Drawings	Ensure the finished elevation of stabilized structure subgrades is not above the subgrade elevations indicated on the drawings
102	Subgrade Requirements	<p>Ensure subgrades for structures are firm, dense, free from mud, and sufficiently stable to remain firm and intact</p> <p>Thoroughly compact subgrades to the specified density listed in Schedule A</p>

103	Structural Fill Replacement	Over-excavate structure subgrades that cannot achieve the required density and replace with structural fill as defined in Schedule A
104	Subgrade Stabilization	Stabilize subgrades that are otherwise solid, but mucky on top due to construction operations, by reinforcing them with one or more layers of crushed rock or gravel unless otherwise noted on the drawings
105	Structural Fill	
106	Applicability	Fill placed beneath structures
107	Materials	Meet the requirements provided in Schedule A
108	Compaction	Mechanically compact backfill in accordance with the requirements in Schedule A
109	Compaction beneath pipes, drives, roads, or other surface construction	Requires special care
110	Trenching Through Structural Fill	Place and compact structural fill to at least 12 inches above the top of the pipe elevation before the trench is excavated
111	Structure Backfill	
112	Material	Use backfill material composed of earth only and, to the extent possible, free of wood, grass, roots, broken concrete, stones, trash, or other debris
113	Moisture Content	Use loose earth having a moisture content as specified in Schedule A in order to obtain the specified density of the compacted soil Work so the moisture content is distributed uniformly Uniformly distribute water added for correction of moisture content prior to compaction Use wet, not just damp, granular material when compacted
114	Placement	Deposit backfill around and outside of structures in approximately horizontal layers
115	Compaction	Mechanically compact backfill in accordance with the requirements in Schedule A Inundation with water to compact structure backfill is prohibited
116	Rolling Compaction	Rolling compaction of structure backfill will be permitted provided the desired compaction is obtained and damage to the structure is prevented
117	Restriction	Depositing or compacting tamped, rolled, or otherwise mechanically compacted backfill in water is prohibited
118		

Pipe Trench Excavation		
119	General	<p>Limit opening of trench in advance of pipe laying to no more than is necessary to expedite the work</p> <p>Open cut from the surface except where boring is required</p>
120	Alignment and Grade	Fix and determine by means of batter boards and offset stakes, laser beam equipment, or surveying instruments, unless otherwise accepted
121	Trench Widths	<p>Provide adequate working space and pipe clearance during installation</p> <p>Keep to a minimum to allow installation and compaction around the piping</p> <p>Limit width as specified below</p> <p>Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes that do not extend lower than 12 inches above the top of the pipe</p>
122	Only one pipe in a trench, maximum trench width measured at the bottom of the pipe	
123	Pipe 48 inches (1,200 mm) outside diameter and smaller	Pipe outside diameter plus 24 inches
124	Pipe larger than 48 inches (1,200 mm) outside diameter	Pipe outside diameter plus 48 inches
125	Multiple pipes in a common trench	
126	Maximum trench width	Based on the outside diameter of the outside pipes
127	Maximum clear distance between the trench wall and the adjacent pipe	
128	Pipe 48 inches (1,200 mm) outside diameter and smaller	Pipe outside diameter plus 24 inches
129	Pipe larger than 48 inches (1,200 mm) outside diameter	Pipe outside diameter plus 48 inches
130	Trench width exceeding specified Trench Width limits	<p>Take corrective measures as required by the loading conditions</p> <p>Measures may include:</p> <ul style="list-style-type: none"> Use of a stronger pipe Special pipe embedment Concrete encasement. <p>Submit corrective measures to the Engineer for engineering review prior to implementation</p>

131	Trench Depth	Excavate to the depth required for the installation of embedment material or concrete for encasement below the underside of the pipe
132	Excavation in locations where operation may cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground	Mechanical equipment prohibited Use hand excavating methods
133	Bell Holes	Provide adequate clearance for tools and methods used to install the pipe Prevent parts of any bell or coupling from being in contact with the trench bottom, walls, or embedment when the pipe is jointed
134		
Pipe Embedment		
135	Trench Subgrade	Firm, dense, free from mud, and sufficiently stable to remain firm and intact Stabilize subgrades that are otherwise solid, but mucky on top due to construction operations, by reinforcing them with one or more layers of crushed rock or gravel unless otherwise noted on the drawings
136	Maximum depth of mud or muck allowed to remain on stabilized trench bottom when pipe embedment material is placed	1/2 inch
137	Embedment Classes	As shown on drawing DS-0053
138	Class A	Use with the following piping materials: Not Used
139	Class B	Use with the following piping materials: HDPE, Ductile Iron
140	Class C	Use with the following piping materials: Not Used
141	Placement below pipe	Spread embedment material on the trench bottom and grade the surface to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints
142	Placement above bottom of pipe after each pipe has been placed in final position on the bedding material	Deposit sufficient pipe embedment material under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations Deposit uniformly and simultaneously on sides of the pipe to prevent lateral displacement

143	Compaction	Compact embedment material a minimum of 4 passes with a vibratory flat plate type compactor Adjust compactive effort and moisture content to provide a firm but slightly yielding support for the pipe Compact each layer uniformly
144	Pipe coatings	Ensure coatings are not damaged during placement and compaction
Pipe Trench Backfill		
145	Material	Use either job excavated material or material from offsite sources
146	Compaction	Compact trench backfill above the pipe embedment for the full depth of the trench above the embedment Use appropriate methods and equipment for the material being compacted Ensure no damaging shocks are transmitted to the pipe
147	Contamination	As specified herein for fills and embankments
148	Beneath established lawn areas	Finish the top portion of backfill with at least 6 inches of topsoil similar to the topsoil in adjoining lawn areas
Pavement Removal and Replacement for Trenching		
149	Cutting concrete and asphalt pavement	No larger than necessary to provide adequate working space for proper installation of pipe ducts structures and appurtenances Start cutting with a concrete saw and provide a clean groove at least 1-1/2 inches deep along each side of the trench Ensure pavement cuts are straight or accurately marked curved lines parallel to the centerline of the trench Provide shoulder not less than 6 inches in width between the cut edge of the pavement and the top edge of the trench
150	Associated excavation	Excavate trench such that trench width at the bottom is not greater than at the top Undercutting of trenches is prohibited

151	Drives, walks, curbs, or other surface construction	<p>If the trench parallels the length of concrete walks and is all or partially under the walk, remove and replace the entire walk</p> <p>Where the trench crosses drives, walks, curbs, or other surface construction, remove and replace the surface between existing joints or saw cuts</p>
152	Replacement surfacing	<p>Replace surfacing over backfilled trenches crossing surfaced areas</p> <p>Match the existing surfacing and finish flush with the adjoining surfaces</p> <p>Asphalt pavement section shall be replaced with a minimum of 12 inches of FDOT 911 aggregate base course, 2 inches FDOT SP12.5 asphalt base course, and 1 inch FDOT 9.5 surface course.</p>
Additional Requirements for Fill Materials		
153	Applicability	Provide Compacted Rock Fill, Compacted Sand Fill, and Drainage Fills where indicated on the drawings
154	Compacted Rock Fill	
155	Material	<p>Consists of crushed rock</p> <p>Crushed concrete meeting gradation and requirements may be used with Engineer's approval</p>
156	Placement	Handle and place crushed rock in a manner that prevents segregation of sizes
157	Rock Moisture Content	The moisture content specified in Schedule A is required for fill material to achieve the compaction required
158	Compaction	Perform compaction with vibrating mechanical compactors in accordance with the requirements in Schedule A
	Fill Finishing	Where concrete is to be placed on the compacted rock fill, finish the fill with a thin layer of clean concrete sand to fill all voids and interstices to obtain the required subgrade elevation
159	Compacted Sand Fill	
160	Material	Use clean, natural sand
161	Subgrade	Place sand fills on undisturbed or compacted subgrade
162	Compaction	<p>Compact using mechanical vibrators</p> <p>Compaction and moisture content must meet the requirements in Schedule A</p>
163	Drainage Fills	Unwashed material is unacceptable

164	Sand Drainage Material	ASTM C33, clean concrete sand
165	Drainage Filter Material	Washed rock or crushed gravel
166	Compaction	Compact sand drainage fill and drainage filter material with a vibrating compactor Compaction and moisture content must meet the requirements in Schedule A
Project Completion		
167	Maintenance and Restoration	
168	Erosion and Settlement	Repair fills, embankments, and backfills that settle or erode before final acceptance of the work Repair pavement, structures, and other facilities damaged by settlement or erosion Fill, compact, and grade the settled or eroded areas to conform to the elevation indicated on the drawings or to the elevation of the adjacent ground surface
169	Facilities Damage	Repair damaged facilities in a manner acceptable to the Owner
170	Earth Slope Maintenance	Maintain earth slopes of the roads and railroads to the lines and grades indicated on the drawings until the final acceptance of the work
171	Final Grading	Grade all ground surface areas disturbed by construction activities after all construction work has been completed Finish the grading to the contours and elevations indicated on the drawings or, if not indicated, to match the contours and elevations of the original, undisturbed ground surface Provide smooth uniform surfaces with the final grading shall for effective drainage of the ground areas

172	Disposal of Surplus Materials	<p>Spoil surplus earth and materials not suitable for the work on the site in a manner and location designated by the Owner</p> <p>Spoil material not suitable for work separately from surplus material</p> <p>Keep stockpiles of surplus material free from brush, trees, debris, or other organic or deleterious materials</p> <p>Offsite disposal may be used if allowed by the Site Construction Manager</p> <p>Deposit materials in the on-site disposal areas and level in 12 inch maximum layers</p> <p>Compact on-site material with at least three passes of a bulldozer</p> <p>Dispose of material in accordance with all federal, state, and local requirements pertaining to construction landfills</p>
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Schedule A Materials, Compaction, and Testing Requirements										
Material	Plasticity Requirements	Gradation Requirements	Maximum Dry Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness
Roadway and railroad roadbed	-	-	ASTM D1557, Method C	3 initial tests; further tests as directed	90% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 500 sy (420 sm), or as required	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) depth
Fills and embankments	-	6 inch (150 mm) max; 3 inch (75 mm) max in upper 18 inches (460 mm)	ASTM D1557, Method C	3 initial tests; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 500 cy (380 cm), or as required	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) thick lift prior to compaction (loose lift)
Structure subgrade	-	-	ASTM D1557, Method C	1 initial test; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 1,000 sy (840 sm), or as required. Min one per foundation for foundations over 10 sy (8 sm)	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) depth
Structural fill (Fills beneath structures)	Non-plastic	3 inch (75 mm) maximum; ≤5 percent minus No. 200 (75 µm)	ASTM D1557, Method C	3 initial tests; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 200 cy (150 cm), or as required	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) thick lift prior to compaction (loose lift)

Schedule A Materials, Compaction, and Testing Requirements										
Material	Plasticity Requirements	Gradation Requirements	Maximum Dry Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness
Structure backfill	Structure backfill placed against below grade walls shall be non-swelling material with a liquid limit (LL) less than 40 and a PI less than 15.	3 inch (75 mm) max ≤85 percent minus No. 200 (75 µm)	ASTM D1557, Method C	3 initial tests; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 200 cy (150 cm), or as required	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) thick lift prior to compaction (loose lift)
30 inch (750 mm) pipe or smaller Crushed rock or crushed gravel embedment	Non-plastic	Perform at least two gradation tests; at least 95% passing 1/2 inch (12.5 mm) sieve and not more than 5% passing No. 4 sieve (4.75 mm)	ASTM D4253 and ASTM D4254	2 initial tests; further tests as directed	70% Relative Density	ASTM D6938; ASTM D1556	One test per 100 feet (30 m) of trench for each lift	-	-	8 inches (200 mm) max
Sand embedment	Non-plastic	Perform at least two gradation tests; at least 95% passing No. 4 (4.75 mm) sieve and not more than 5% passing No. 100 sieve (150 µm)	ASTM D698, Method C	2 initial tests; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 100 feet (30 m) of trench for each lift	-	-	8 inches (200 mm) max

Schedule A Materials, Compaction, and Testing Requirements										
Material	Plasticity Requirements	Gradation Requirements	Maximum Dry Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness
Ground-water barrier	Cohesive material (Soil Classification GC, SC, CL, or ML as indicated in ASTM D2487, Table 1	-	ASTM D698, Method C	2 initial tests; further tests as directed	95% Max. Dry Density	ASTM D6938; ASTM D1556	One test for each groundwater barrier	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) max
Trench backfill	LL < 40 PI < 15	3 inch (75mm) max particle size	ASTM 698, Method C	2 initial tests; further tests as directed	90% Max Dry Density	ASTM D6938; ASTM D1556	One test per 100 feet (30 m) of trench for each lift	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) max
Trench backfill where trench crosses a roadway, permanent parking lots or other trench and facilities subject to damage by settlement	Non-plastic	3 inch (75mm) max particle size	ASTM D698, Method C	2 initial tests; further tests as directed	95% Max Dry Density	ASTM D6938; ASTM D1556	One test per 100 feet (30 m) of trench for each lift	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) max
Compacted rock fill	Non-plastic	1-1/2 in. (38 mm) max. to crusher fines ASTM C33 or Type ____ per Section ____ of ____ DOT	ASTM D4253 and D4254	3 initial tests; further tests as directed	70% Relative Density	ASTM D6938; ASTM D1556	One test per 200 cy (150 cm), or as required	As required to achieve field density	ASTM D6938; ASTM D1556	8 inches (200 mm) thick lift prior to compaction (loose lift)

Schedule A Materials, Compaction, and Testing Requirements										
Material	Plasticity Requirements	Gradation Requirements	Maximum Dry Density	Maximum Density Test Frequency	Required Field Density	Field Density Test	Field Density Test Frequency	Required Field Water Content	Field Water Content Test	Required Lift Thickness
Compacted sand fill	Non-plastic	≥75% minus No. 4 (4.75 mm); ≤10% minus No. 200 (75 µm);	ASTM D1557, Method C	3 initial tests; further tests as directed	90% Max. Dry Density	ASTM D6938; ASTM D1556	One test per 200 cy (150 cm), or as required	-2% to +2% of optimum water content	ASTM D6938; ASTM D1556	8 inches (200 mm) thick lift prior to compaction (loose lift)

13902 - Fire Protection Systems

13902.1 General

It is not the intention to specify herein all details of design and construction. The Contractor shall ensure that the equipment has been designed, fabricated, and erected in accordance with all engineering codes, standards, and governmental regulations applicable to the specified service.

The Contractor shall have full responsibility for compliance with the requirements of these Specifications. Review and/or approval of drawings, data, or specifications by the Owner with regard to general design and controlling dimensions does not constitute acceptance of any designs, materials, or equipment that will not fulfill the functional or performance requirements established herein.

In case of a conflict within the technical requirements, the following hierarchy shall apply:

- (1) Mandatory governmental regulations and codes.
- (2) Owner-specified requirements provided on the data sheets.
- (3) Requirements provided in the technical attachments.
- (4) Requirements provided in the technical specifications.
- (5) Requirements provided in Section 1400.
- (6) Referenced industry codes and standards and material specifications.

13902.1.1 Scope of Work

The Contractor shall furnish complete fire protection systems including, but not limited to, the following: all piping and supports per the contract drawings, OS&Y valves, fittings, pipe hangers and supports, above ground hydrant manifolds complete with hose and pumper nozzles connections with discharge valves and caps, and instrumentation as required for complete fire protection system(s). Each system shall be designed to provide the required protection for the specific hazard.

13902.1.2 Not Used.

13902.1.3 Not Used.

13902.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply:

Work	In Accordance With
Overall design	NFPA, AHJ, and applicable codes
Fire hydrant manifolds	NFPA 24, 291, FM, UL Standard 246

Work	In Accordance With
*Equipment supplied shall be listed by Underwriters Laboratories Inc. (UL) or shall be included in the Approval Guide as published by Factory Mutual (FM) Engineering. Equipment shall be considered as FM-approved only if it conforms to the characteristics and limitations of the individual component approvals and if those components are used in the service intended by the Approval Guide.	

Any conflict between referenced codes or standards, or between the standards and these specifications, shall be referred immediately to the Owner who shall determine which standard or specification requirements shall govern.

13902.1.5 Materials

The following materials shall be used:

Component	Material
Piping	
Wet-pipe systems	Galvanized piping not required. Minimum Schedule 40
Piping upstream of the sprinkler and spray systems	Black steel, ASTM A53, Grade B, seamless; or ASTM A106, Grade B, seamless. Minimum Schedule 40
Flanges	
Flanges	Hot-dip galvanized following welding when connected to galvanized pipe
Piping larger than 2 inches (50 mm)	Welded flanges or shop welded connections. (UL or FM Listed grooved style fittings are acceptable except where piping is attached to the turbine pedestal.)
Pipe accessories	
Gaskets	Red rubber sheets, 1/16 inch (1.6 mm) thick, full face, ASTM D2000, No. 2AA705A13L14
Thread sealant	Teflon ribbon, Optional for gas suppression piping: Loctite 592 sealant and primer NF-73656
Thread tolerances	NFPA 13 and ANSI B1.20.1 pipe threads
Bolts and nuts	Steel machine bolts
Plugs	Square heads and of a metal dissimilar to fitting to which they are attached
Piping supports	Per NFPA 13 and 15
Supplementary support beams (pipe support)	ASTM A36, fireproof construction
Valves	

Component	Material
Gate valves	OS&Y type, flanged or welded ends as specified in the Valve List in Section 15263

13902.1.6 Approved Manufacturers of Components

For the following components (if any), the manufacturers listed below provide examples of the quality of workmanship required by these specifications. If the Subcontractor wants to propose a non-listed manufacturer that is considered to provide an equivalent level of quality, the manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Hydrant Manifolds	Williams
Backflow Preventer	Watts
Valves	Mueller

13902.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor unless specifically identified as a Bid Option or Owner-conducted. Tests identified as an option are to be priced separately. If identified as Owner-conducted, costs for the initial test will be the responsibility of the Owner. However, the Contractor is responsible for all costs associated with correcting deficiencies and retesting in the event of a test failure:

Tests	In Accordance With	Conducted By
Testing and system acceptance of water based fire protection systems	NFPA 11,13, 14, 15 and 16, 25, and applicable building code	Contractor
Entire System	Applicable NFPA and building codes	Contractor

13902.1.8 Technical Attachments

Not Used.

13902.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 1400.

13902.2 Products

13902.2.1 Not Used

13902.2.2 Not Used

13902.2.3 Not Used

13902.2.4 Not Used

13902.2.5 Not Used

13902.2.6 Fire Equipment

13902.2.6.1 Scope. The Contractor shall furnish the following items complete as specified and in accordance with the specifications and documents:

Above ground fire hydrant manifolds complete with inlet isolation gate valves and accessories, including hose and pumper nozzle connections with discharge valves and caps.

13902.2.6.2 Engineering Data. Submit the following drawings to the Owner for review:

Certified outline drawings of fire hydrant manifolds, valves, including dimensional data.

13902.2.6.3 Code Requirements. Fire hydrant manifolds and equipment, valves, and accessories shall be FM-approved. If FM approval is not available, then UL-listed equipment shall be provided.

13902.2.6.4 Fire Hydrant Manifolds. Above ground hydrants manifolds shall be furnished for the protection of facility buildings and equipment. Hydrant manifolds shall be manufactured by Williams Fire & Hazard Control Company or Owner-approved equivalent.

13902.2.6.4.1 Type. As shown on the technical drawings, the hydrant manifolds shall be 6" assemblies with the specified inlet and outlet connection. Each outlet connection shall include a discharge valve and cap to protect the threading. The manifold body shall include vent and drain connections with 3/4" threaded couplings with plugs. The hydrant manifolds shall be installed above ground and shall be supported as outlined in the technical drawings.

13902.2.6.4.2 Design. The hydrant manifolds shall be designed for a working pressure of 175 psi (12.1 bar) and a hydrostatic pressure of 350 psi (24.1 bar). The hydrant manifold construction material shall be carbon steel to comply with the above ground fire water piping specification 11CE2F as described in the Pipeline List in Section 15225.

13902.2.6.4.3 Connections. Hydrant manifolds shall be furnished with a 6 inch (150 mm), ANSI Class 150 flange inlet connection. Outlet connections shall consist of two 2-1/2 inch (63.5 mm) hose nozzles and one 4 inch (100 mm) pumper nozzle. Outlet connection threads shall be in accordance with NT.

13902.2.6.4.4 Painting. The fire hydrant manifolds shall be shop finish painted. The shop primer and finish paint shall be the manufacturer's standard. The color of the above grade portions of the fire hydrants shall be OSHA Safety Red.

13902.2.6.5 Not used

13902.2.6.6 Not used

13902.2.6.7 Not used

13902.3 Execution

Erection and installation of fire protection system equipment and piping shall be in accordance with the requirements of the environmental criteria in the front end sections of this document.

15225 - General Service Pipe

15225.1 General

15225.1.1 Scope of Supply

Scope of supply shall include furnishing materials for non-boiler external piping systems as indicated in the attachments listed in Article 15225.1.8. Materials shall include straight lengths of pipe, fittings, flanges, and unions. Gaskets and flange bolting materials shall be furnished if indicated in the attachments. Special welding adapters shall be furnished if indicated in the attachments.

If the general service pipe to be furnished under this specification is part of the scope of the work under a larger procurement package to be designed and furnished by the Supplier, the scope of piping and accessories to be furnished will be determined by Supplier's overall design.

15225.1.1.1 Pipeline List or Pipe Class. The Pipeline List or Pipe Class, if included, specifies the operating and design conditions and types of pipe to be used with each piping system. The Pipeline List or Pipe Class designates the pipeline identification code; line description; operating, design, and test pressures and temperatures; pipe material, nominal sizes, and corresponding schedule or wall thickness; valve class rating, end preparation requirements, and material; insulation class; remarks; and special features.

PIPELINE LIST						
PIPELINE CODE	PIPELINE DESCRIPTION	OPERATING PRESSURE/ DESIGN PRESSURE/ TEST PRESSURE	OPERATING TEMPERATURE/ DESIGN TEMPERATURE	PIPE MATERIAL/ PIPE SIZE	ANSI CLASS/ INSULATION THICKNESS	REMARKS
CSTG-L-11CE2F	Fire Water Aboveground	60 psig 150 psig 225 psig	100°F 140°F	ASTM A106 Gr B Carbon Steel 8" SCH 40 6" SCH 40	CL 150/1" Mineral Wool CL 150/1" Mineral Wool	UL FM Approved/ Insulation shall be clearly marked to Identify Fire Protection Service
CSTG-L-11DANF	Fire Water Below Ground	60 psig 150 psig 225 psig	100°F 140°F	AWWA C151/A21.51 Ductile Iron 6" STD	CL 150/NA	UL FM Approved

15225.1.1.2 Quantity Spreadsheet. The quantity spreadsheet, if included, is a bill of quantities or other spreadsheet listing the quantities to be furnished for each type, size, and material of piping component. It may also serve as the instrument by which the Supplier submits proposed total pricing and unit pricing information. If the bill of quantities shows a zero quantity for a given component, the item is included only for the securing of a unit price against possible future need.

15225.1.1.3 Not Used.

15225.1.1.4 Plan and Section Drawings. Plan and section drawings, if included, indicate the routing of piping for which materials are to be furnished under this Contract. The Owner shall use the plan and section drawings to determine the quantities of straight lengths of piping, fittings, flanges, gaskets, bolting, etc., to be furnished for each section of pipeline.

15225.1.1.5 Piping and Instrument Diagrams/Flow Diagrams. Piping and instrument diagrams or flow diagrams, if included, indicate the materials and line sizes of piping systems for which materials are to be furnished under this Contract.

15225.1.1.6 Additional Scope.

Welding rod and other associated consumables for welded joint piping systems furnished	Yes
Solvent cement and other associated consumables for solvent cement joint piping systems furnished	Yes
Polyethylene sleeve material for field wrap of ductile iron pipe furnished	Yes

15225.1.2 Not Used

15225.1.3 Not Used

15225.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Materials for piping and application of piping materials	The most current edition of the ASME Code for Pressure Piping, B31.1, Power Piping, including all addenda thereto
Sizes, schedule numbers, and dimensions of carbon steel and alloy steel pipe, and stainless steel pipe schedules not covered by ANSI B36.19M	ANSI/ASME B36.10M

Work	In Accordance With
Sizes and dimensions of stainless steel pipe designated as Schedule 10S, 40S, or 80S	ANSI/ASME B36.19M
Wall thickness tolerances for carbon steel and alloy steel pipe	ASTM A530
Manufacturing standard for mechanical joint and push-on joint ductile iron pipe	ANSI/AWWA C151/A21.51
Manufacturing standard for flanged ductile iron pipe	ANSI/AWWA C115/A21.15
Polyethylene tubes for protection of ductile iron pipe that will be installed underground	ANSI/AWWA C105/A21.5
Cement linings for ductile iron pipe	ANSI/AWWA C104/A21.4
Butt weld fitting manufacturing standard	ANSI/ASME B16.9 and ANSI/ASME B16.28
Socket-weld and threaded forged steel fittings manufacturing standard and minimum pressure class ratings	ANSI/ASME B16.11
Carbon steel flanged fittings	ANSI B16.5
Steel castings for pipe system components	In accordance with Technical Supplemental Specification Q400
Cast iron fittings for use with plastic lined or rubber lined pipe	ANSI B16.1, Class 125
Ductile iron fittings for use with plastic lined or rubber lined pipe	ANSI/AWWA C110/A21.10
Welding adapters	Paragraph 104.3 of ANSI/ASME B31.1
Manufacturing standard for cast iron fittings for use with lined steel pipe	ANSI B16.1
Manufacturing standard for ductile iron fittings for use with lined steel pipe	ANSI/AWWA C110/A21.10
Manufacturing standard for cast iron and ductile iron flanged fittings	ANSI/AWWA C153/A21.53
Manufacturing standards for mechanical joint and push-on joint ductile iron and cast iron fittings	ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.1
Steel flange construction requirements	ANSI/ASME B16.5
Cast iron and ductile iron flange construction requirements	ANSI/AWWA C115/A21.15

Work	In Accordance With
Compressed fiber gaskets and elastomeric gaskets	ANSI B16.21
Ring joint gaskets	ANSI B16.20
Flange bolting requirements - alloy steel bolting	ANSI/ASME B16.5
Flange bolting requirements - carbon steel bolting	ANSI B16.1
Carbon steel bolting dimensional standards	ANSI B18.2.1 and ANSI/ASME B18.2.2
Cleaning interior surface of carbon steel pipe	The Society for Protective Coatings (SSPC)
Abrasive shot blast cleaning	The Society for Protective Coatings (SSPC) and PFI Standard ES-29 (sand or silica bearing blasting materials are not allowed)

15225.1.5 Materials

The following materials shall be used:

Component	Material
Steel pipe	
Carbon steel	ASTM A106 Grades A, B, C; ASTM A53 Type S Grades A or B; ASTM A53 Type E Grade B; ASTM A134 Grades A283 A, B, C, D and A285 A, B, C; ASTM A139, Grade B; ASTM A333; API 5L Grade B seamless, Schedule 40 minimum for 2 inch (50 mm) and smaller, or as indicated on attachment(s)
Ductile iron pipe push-on joint gaskets	Neoprene or other synthetic rubber. Natural rubber will not be acceptable.
Ductile iron fittings for use with plastic lined or rubber lined steel pipe	ASTM A395, lined with lining material equivalent to that of the pipe
Carbon steel flange material standards, ANSI Pressure Classes 150 and 300	ASTM A181/A181M or ASTM A105/A105M
Carbon and alloy steel butt weld fitting material standards	ASTM A234/A234M

15225.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Supplier wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Compressed fiber gaskets	Richard Klinger, Inc. - Klingersil Garlock, Inc. - Blue-Gard
Spiral wound gaskets	Flexitallic Gasket Company Garlock
Spiral wound gasket filler	Flexitallic Gasket Company - Flexite Super Garlock

15225.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Supplier unless specifically identified as a Bid Option or Owner-conducted. Tests identified as an option are to be priced separately. If identified as Owner-conducted, costs for the initial test will be the responsibility of the Owner. However, the Supplier is responsible for all costs associated with correcting deficiencies and retesting in the event of a test failure:

Tests	In Accordance With	Conducted By
Testing of mechanical joint and push-on joint ductile iron pipe	ANSI/AWWA C151/A21.51	Supplier

15225.1.8 Technical Attachments

Not used.

15225.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 1400.

15225.2 Products

15225.2.1 Piping Material Requirements

All pipe shall be in accordance with the applicable codes and standards designated in Article 15225.1.4 and the attachments thereto. Except as otherwise specified, schedule numbers, sizes, and dimensions of piping shall conform to the applicable standards specified in Article 15225.1.4.

Material substitutions shall not be made without written approval by the Owner.

15225.2.1.1 Steel Pipe. Carbon steel and alloy steel pipe shall be ungalvanized seamless type unless otherwise specified.

Steel plate piping, where allowed by these specifications, shall be of the straight seam welded type unless otherwise specified.

15225.2.1.2 Ductile Iron Pipe. Ductile iron pipe shall be of the mechanical joint or restrained push-on joint type as indicated herein. Unless otherwise specified, interior surfaces of ductile iron pipe shall be cement lined.

Unless otherwise specified, the exterior surface of all ductile iron pipe shall be coated before shipment with a bituminous material.

Ductile iron piping systems shall be provided with restrained mechanical joints.

Where specified on the attachments listed in Article 15225.1.8, polyethylene tubes shall be furnished by the Supplier as required to allow field wrapping of buried ductile iron pipe in accordance with ANSI/AWWA C105/A21.5 Method A.

15225.2.1.3 Not used

15225.2.1.4 Not Used

15225.2.1.5 Not Used

15225.2.1.6 Not Used

15225.2.1.7 Not Used

15225.2.2 Not Used

15225.2.3 Fittings

If a quantity list is included as a part of this specification, fittings shall be constructed of materials indicated on the list. If the Supplier determines that the fittings are to be furnished based on pipe routing and piping system design conditions, the materials for pipe fittings shall be equivalent to the material of the pipe with which they are used, except that plastic or rubber lined cast iron or ductile iron fittings shall be used with plastic or rubber lined steel pipe, as indicated on the attachment(s).

15225.2.3.1 Steel Fittings. Unless otherwise indicated on the attachment(s), steel fittings 2-1/2 inches (65 mm) and larger shall be butt welding type and steel fittings 2 inches (50 mm) and smaller shall be socket welding type.

Butt Welding Fittings. Butt welding fitting wall thicknesses shall be equal to the pipe wall thickness with which they are used. Fittings shall be manufactured in accordance with the applicable standards listed in Article 15225.1.4.

Unless otherwise indicated on the drawings, elbows shall be of the long radius type and conform to the applicable standards listed in Article 15225.1.4.

Forged Steel Fittings - Socket-Welded and Threaded. Forged steel fittings shall be used for socket-welded and threaded connections. Socket-welded and threaded fittings shall conform to the applicable standards listed in Article 15225.1.4. Metal thicknesses of fittings shall be adequate to provide actual bursting strengths equal to or greater than those of the pipe with which they are to be used.

Minimum pressure class rating of socket-welded and threaded fittings shall be in accordance with the applicable standard listed in Article 15225.1.4.

Integrally Reinforced Forged Branch Outlet Fittings. Specially designed integrally reinforced forged branch outlet fittings shall be furnished if so indicated on the attachment(s).

For piping systems designed and routed by the Supplier, specially designed integrally reinforced forged branch outlet fittings (weldolets or sweepolets) may be furnished in lieu of reducing outlet tees when the main run pipe wall thickness does not exceed 3/4 inch (19.1 mm). Unless otherwise specified, all branch connections 2 inches (50 mm) and smaller shall be made with specially reinforced welding adapters,

sockolets (SOL), or threadolets (TOL). These adapters shall be integrally reinforced forged branch outlet fittings.

Integrally reinforced forged branch outlet fittings shall be manufactured by a manufacturer listed in Article 15225.1.6.

15225.2.3.2 Not Used

15225.2.3.3 Not Used

15225.2.3.4 Not Used

15225.2.3.5 Not Used

15225.2.3.6 Not Used

15225.2.3.7 Not Used.

15225.2.3.8 Ductile Iron Fittings. Fittings shall conform to the standards listed in Article 15225.1.4.

Except as otherwise specified, interior surfaces of ductile iron pipe fittings shall be cement lined.

Except as otherwise specified, the exterior surfaces of all ductile iron pipe fittings shall be coated with a bituminous material.

15225.2.3.9 Not Used

15225.2.4 Flanges

Flanges shall conform to applicable standards indicated in Article 15225.1.4. Unless otherwise specified, flanges shall be as follows:

For the case where the Supplier determines flanges to be furnished based on attached drawings or based on the Supplier's overall design, flanges mating with flanges on piping, valves, and equipment shall be of sizes, drillings, and facings that match all connecting flanges.

Flange class ratings shall be adequate to meet the design pressure and temperature specified in the attachment(s) for the piping with which they are used.

Flange materials shall be equivalent to the pipe with which they are used.

15225.2.4.1 Steel Flanges. All steel flanges 2-1/2 inches (65 mm) and larger shall be of the weld neck type and all steel flanges 2 inches (50 mm) and smaller shall be of the socket type-except as indicated on the attachment(s). Steel flanges shall have raised face flange preparation-except as specified otherwise herein. Flat face flanges shall be used to mate with cast iron, ductile iron, FRP, PVC, CPVC, and plastic or rubber lined flanges.

All steel flanges shall conform to the design and manufacturing standards and the material specifications indicated in Article 15225.1.5.

15225.2.4.2 Not Used.

15225.2.5 Gaskets

Gaskets shall be furnished if so indicated on the attachment(s).

Unless otherwise specified, elastomeric or compressed fiber gaskets shall be used with flat face flanges. Compressed fiber gaskets shall be used for slip-on raised face flanges and ANSI CL 150 socketwelded raised face flanges. Spiral wound gaskets shall be used with all raised face flanges other than slip-on or ANSI CL 150 socketwelded flanges. Gaskets are not required for lined pipe-to-lined pipe connections unless otherwise recommended by the manufacturer. Gaskets containing asbestos are not acceptable.

15225.2.5.1 Compressed Fiber Gaskets. Compressed fiber gasket materials shall be suitable for a maximum working pressure of 600 psi (4.1 MPa) and a maximum working temperature of 750° F (400° C). Gaskets shall be dimensioned to suit the contact facing. They shall be full faced for flat face flanges and shall extend to the inside edge of the bolt holes on raised face flanges. Gaskets for plain finished surfaces shall be not less than 1/16 inch (1.6 mm) thick and for serrated surfaces shall be not less than 3/32 inch (2.4 mm) thick.

15225.2.5.2 Spiral Wound Gaskets. Spiral wound gaskets shall be constructed of a continuous stainless steel ribbon wound into a spiral with nonasbestos filler between adjacent coils. The gasket shall be inserted into a steel gauge ring whose outside diameter shall fit inside the flange bolts properly positioning the gasket. The gauge ring shall serve to limit the compression of the gasket to the proper value. Compressed gasket thickness shall be 0.130 inch ±0.005 inch (3.302 mm ±0.127 mm).

15225.2.5.3 Elastomeric Gaskets. Elastomeric gasket materials shall be cloth inserted sheet elastomer. They shall be full face and 1/16 inch (1.6 mm) thick unless otherwise specified. Elastomeric gaskets shall be used for temperatures up to 150 °F (66 °C) and EPDM type elastomeric gaskets for temperatures up to 215 °F (100 °C).

15225.2.6 Not Used

15225.2.7 Unions

All piping unions shall be of the ground joint type constructed of materials equivalent in alloy composition and strength to other fittings in the piping systems in which they are installed. Union pressure classes and end connections shall be the same as the fittings in the piping systems in which they are installed.

Steel unions shall have hardened stainless steel seating surfaces on both faces.

15225.2.8 Coating and Wrapping of Pipe To Be Installed Underground

Exterior surfaces of carbon and stainless steel pipe to be installed underground shall be provided with a shop applied fusion bonded epoxy (FBE).

No coating shall be applied within 4 inches (100 mm) of field weld connections. Underground carbon and stainless steel pipe and fittings shall be provided with the CSA 245.20, shop applied, FBE coating system 3M Scotchkote 206N.

Except as specified otherwise herein, all pipe surface preparation, material, coating application, inspection, and repairs for the shop applied FBE coating system; and marking, handling, storage, and shipping of the coated pipe shall be in accordance with Canadian Standard Association Standard Z245.20-98, or latest revision for all steel piping.

FBE coating thickness shall be 14 mils minimum, 16 mils average, and 20 mils maximum.

Polyethylene compatible adhesive tape shall also be furnished by the Supplier as required.

15225.2.9 Cleaning

Interior and exterior surfaces of all piping shall be thoroughly cleaned of sand, mill scale, greases, oils, dirt, and other foreign materials.

15225.2.9.1 Interior Cleaning. Interior surfaces of all piping shall be cleaned in accordance with the Cleaning Code specified for fabrication on the Pipeline List or Pipe Class (if included) and as described in the applicable standards indicated in Article 15225.1.4.

Interior surfaces specified to be prepared in accordance with Cleaning Code NO require no special cleaning.

15225.2.10 Coatings

All carbon and alloy steel piping shall be coated as specified herein and in the Supplemental Specifications in Section 1400.

15225.2.10.1 Not Used.

15225.2.10.2 Exterior Surface Coatings. Piping exteriors, parts, and appurtenances shall be prepared and coated in accordance with the following.

All exposed surfaces shall be prime painted except for piping internals (including internal surfaces of branch connections), stainless steel, flange faces, threaded surfaces, external surfaces within 3 inches (80 mm) of field welded connections, and external surfaces of insulated pipe.

Piping shall be painted using the coating system that is specified on the drawings and in the Pipeline List or Pipe Class (if included). Painting shall be in accordance with Section 1400.

15225.2.10.3 Weld End Coatings. Machined weld end preparations for field welds on carbon and alloy steel piping shall be coated with a weldable consumable coating as specified on the drawings and in the Pipeline List or Pipe Class (if included) to prevent surface corrosion prior to welding.

15225.2.10.4 Flange Face/Threaded Connection Coating. Flange faces on shotblast cleaned pipe shall be given an application of a water soluble preservative coating as specified on the drawings and in the Pipeline List or Pipe Class (if included). Flange faces on piping cleaned by the pickling method shall be given an application of an oil soluble preservative coating as specified on the drawings and in the Pipeline List or Pipe Class (if included).

15225.2.11 Jointing Materials and Tools

Where specified in Article 15225.1.1.6, the Contractor shall furnish welding rod, flux, solvent cement, or any other consumable materials required for proper erection of the pipe and fittings furnished under these specifications. Welding rod and related materials shall be in accordance with the Supplemental Specifications in Section 1400. Solvent cement and related materials shall be in accordance with the recommendations of the manufacturer of the pipe with which they will be used.

The Supplier shall provide any special tools required for joining plastic or pressed fit pipe for the use of the erecting contractor. These tools shall remain the property of the Supplier and will be returned upon completion of erection.

15225.2.12 Preparation for Shipment

Interior and exterior surfaces of piping and accessories shall be cleaned and shall have preservative coatings applied prior to shipment to the jobsite in accordance with the Supplemental Specifications in Section 1400.

Open ends and branches of piping shall be securely closed as follows to protect the interior cleanliness and end surfaces during shipment:

Weld end larger than 2 inches (50 mm)--Attach a plastic cap or metal cap lined in the end with 3/4 inch (20 mm) soft wood and seal with waterproof tape.

Female opening 2 inches (50 mm) and smaller, such as Sock-o-let--Press in a light metal or plastic insert and seal with waterproof tape.

Miscellaneous loose items shall be suitably packed in heavy wooden boxes with waterproof linings to prevent entry of dirt and moisture.

15225.3 Execution

Piping erection shall be in accordance with the requirements of Section 15921 - Piping Erection.

15263 - General Service Valves Datasheet

General Requirements					
	Contractor shall furnish valves as listed and specified herein.				
1	Special features such as electric actuators or pneumatic actuators, locking devices, valve boxes and handwheel extensions, limit switches, vacuum service, boiler code, and UL/FM rating shall be furnished as specified.				
Codes and Standards					
2	Construction of all valves and accessories		ASME Power Piping Code B31.1, MSS Standards		
3	Construction of all steel body valves		ASME B16.34 or API 602		
4	Face-to-face and end-to-end dimensions of steel valves 2-1/2 inches (65 mm) and larger and all iron body valves		ASME B16.10		
5	Flanges		ASME B16.5		
6	Sizing of bypasses and drains		MSS SP-45		
Testing and Guarantees					
7	Hydrostatic shell and seat leakage tests		In accordance with ASME B16.34 or API 598 Conducted by Supplier or Manufacturer		
8	Radiographic Examination Requirements				
9	For castings installed by the Owner, radiographic exams shall be conducted as indicated below in accordance with the requirements in ASME B16.34, Paragraph 8.3.1.1(a)(1). In addition, any components which contain a hazardous or flammable/combustible fluid shall also be inspected in accordance with these requirements. Supplier shall document any defects found in these examinations and provide notification to the Owner of the repairs performed.				
10	Size - NPT	Press. Class	Design Temp	NDE Sample	Acceptance Criteria
11	>2"	All	>=750F	100%	B16.34, Para 8.
12	>2"	>300#	>=350F	100%	B16.34, Para 8.
Materials					
13	Valve materials shall be as listed in the Valve List.				
14	Certified Material Test Reports (CMTR) shall be furnished for all valves with design temperatures exceeding 210°F (99°C). If the aluminum content exceeds 0.08%, documentation demonstrating compliance with ASTM A703 S23 must be submitted. If necessary, the Supplier shall perform a chemical analysis per ASTM A703				
15	Grade C 12A Material: A repair procedure for ASME/ASTM SA/A 217 Grade C 12A castings, including supporting WPS's and PQR's, shall be submitted to the Owner for review and approval prior to performing any repairs. The Owner shall reserve the right to either have repairs made on the casting or request an entirely new casting be made.				
Additional Requirements					

16	General Requirements	
17	All check valves shall be designed for installation in either horizontal piping or vertical piping with upward flow.	
18	Steel Body Valves 2-1/2 Inches (65 mm) and Larger	
19	Steel body valves 2 1/2 inches (65 mm) and larger shall have cast steel bodies. Valve ends shall be butt weld type unless otherwise specified.	
20	Check valves shall be non-slam tilting disk type, guided piston type, swing disk type, or double disk spring check type as required by the Supplier's design. Double disk spring check type valves shall only be used in cold water lines 14 inches (350 mm) and larger.	
21	Valve bodies and bonnets shall be designed to support the valve operators (handwheel, gear, electric actuator, or pneumatic actuator) with the valve in any position and without external support.	
22	When both a drain and a bypass are to be provided on the same main valve, a drain valve shall connect to the piping between the two bypass valves to permit independent drainage of both sides of the main valve.	
23	Bypass valves, drain valves, and piping shall have pressure-temperature ratings equal to or exceeding those of the main valve and shall be constructed of materials equivalent to the main valve.	
24	Pipe for bypasses and drains shall be seamless and shall not be lighter than Schedule 80. Fittings and valves shall be welded type.	
25	Bonnet Vents for Gate Valves	
26	All bonnets for gate valves with design temperatures over 150° F (65° C) shall be provided with vent lines connecting the valve bonnet to the valve body either upstream or downstream of the valve disk. The default location shall be the upstream side of the disk unless otherwise specified. Vent lines shall contain at least one globe or angle valve. Vent valves, piping, and fittings shall have pressure-temperature ratings equal to or exceeding those of the main valve and shall be constructed of materials equivalent to the main valve. Vent valves shall be not less than ANSI Pressure Class 600. Piping shall be seamless and shall not be lighter than Schedule 80. Fittings and valves shall be weld type. Arrangement and location of the vent piping shall be acceptable to the Owner. Valves equipped with bonnet vents shall be marked with a flow direction arrow, either cast into the valve body or permanently attached to the valve body.	
27	The use of a slot in the disk to vent the bonnet to the valve body, either upstream or downstream is not permitted.	
28	Iron Body Gate, Globe, and Check Valves	
29	Iron body valves shall be "IBBM" (iron body bronze mounted).	
30	Handwheels	
31	Handwheels shall be selected to limit the normal operating forces to less than 80 pounds (356 N) and the seating/unseating forces to less than 120 pounds (534 N) at the rim of the handwheel. Handwheels shall not exceed 24 inches (61 cm) outside diameter.	
32	Locking Devices	
33	Locking devices shall allow the valve to be locked in either the open or closed position by use of a standard padlock.	

34	Handwheel Extensions	
35	Handwheel extensions shall be provided as required for reasonable ease of manual valve operation by plant personnel.	
36	Underwriters Laboratories Inc. Listed and Factory Mutual Approved	
37	Where required by the Supplier's design, valves shall be Underwriters Laboratories Inc. (UL) listed and Factory Mutual (FM) approved.	
38	Installation Instructions	
39	If field erection is not part of the scope of this Contract, installation instructions for installing any valves shipped loose shall be provided. The instructions shall state valve plug or disk position during joining operations, disassembly requirements, and all other precautions, recommendations, or special instructions for proper installation.	
40	Identification	
41	Each valve assigned a valve number by the Owner shall be provided with a permanent stamped stainless steel tag bearing the "Valve Number" securely attached to the valve with 20 gauge stainless steel wire. Lettering on the tag shall be 3/16 inch (5 mm) minimum. Each accessory item furnished with the valve, but not securely attached to the valve, shall be provided with an identical identification tag. Valves shall be identified by Valve Numbers on the Supplier's shop drawings and piping and instrument diagrams, and on all correspondence involving valves.	

Valve List

VALVE TAG NUMBER	ABBREVIATED DESCRIPTION	VALVE TYPE/ SIZE- IN-OUT	VLV CLASS/BODY MATERIAL/END PREP	DESIGN PRESSURE/DESIGN TEMPERATURE/ FLUID	REMARKS
CSTG-BV-01	Hydrant Manifold Isolation Valve- For HYD-01	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-02	Hydrant Manifold Isolation Valve- For HYD-02	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-03	Hydrant Manifold Isolation Valve- For HYD-03	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-04	Hydrant Manifold Isolation Valve- For HYD-04	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-05	Hydrant Manifold Isolation Valve- For HYD-05	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-06	Hydrant Manifold Isolation Valve- For HYD-06	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-07	Hydrant Manifold Isolation Valve- For HYD-07	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.
CSTG-BV-08	Hydrant Manifold Isolation Valve- For HYD-08	Gate 6 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed.

CSTG-BV-100	Fire Water Loop Isolation Valve (below grade)	Gate 8 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed. Lock Open.
CSTG-BV-101	Fire Water Loop Isolation Valve	Gate 8 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed. Lock Open.
CSTG-BV-102	Fire Water Loop Isolation Valve	Gate 8 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed. Lock Open.
CSTG-BV-103	Fire Water Loop Isolation Valve	Gate 8 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed. Lock Open.
CSTG-BV-104	Fire Water Loop Isolation Valve	Gate 8 in	CL 150/ A216 WCB/ BW (SCH 40 BORE)	150 psig/ 140F/ Fire Water	Flexible Wedge OS&Y, UL/FM Listed, Lock Open.

15246 - Backflow Preventers Datasheet

General Requirements		
1	The backflow preventers shall be furnished as specified in the Mechanical Device List.	
Codes and Standards		
2	Backflow preventer	State or local jurisdiction, OSHA, ASME B31.1, AWWA C510 and AWWA C511 requirements, Local health requirements
3	Flanges	ASME B16.5 (Class 150; flat faced steel) ASME B16.1 (iron)
4	Threads	NSI/ASME B1.20.1
Materials		
5	Shutoff and check valves 2 inches (50 mm) and smaller	Bronze ASTM B61
6	Relief valves 2 inches (50mm) and smaller	Bronze ASTM B61 with stainless steel internals
Additional Requirements		
7	The size and type of inlet and outlet connections, and the design conditions shall be as specified in the Mechanical Device List.	
8	The backflow preventers shall be AWWA approved.	
9	Backflow preventers shall be of the reduced pressure type and shall be a complete assembly consisting of two independently acting spring-loaded check valves with an automatically operating pressure relief valve located between the two check valves.	
10	The unit shall include tight closing shutoff valves at each end of the preventer and shall be fitted with properly located test cocks. Test cocks shall facilitate testing of upstream check valve, relief valve, and downstream check valve.	
11	Operation of the backflow preventer shall be completely automatic. The design shall be such that each major component, such as a shutoff or check valve, may be removed or replaced individually. Major components, as well as internal parts of the different components shall be accessible for inspection, repair, or replacement without removing the entire device from the line.	
12	NSF 61 certification required	No
Accessories		
13	One test kit	Yes
14	Dielectric unions on all backflow preventers	Yes
Notes		
15	Note 1: Backflow Preventers shall be 8" Watts Series 774DCDA or approved equal.	

15921 - Piping Erection

15921.1 General

15921.1.1 Scope of Work

The work shall include erection of all piping, fittings, valves, supports, and piping specialties, as called for on the drawings and specifications, and by the codes and standards. Erection of piping systems designated by the system codes and indicated on the drawings listed in Article 15921.1.8 are included, except as otherwise specified herein. The Contractor shall furnish all required materials and perform all related work for completion of the work included under these specifications.

If furnishing any piping or fittings; installing insulation and lagging; furnishing and installing freeze protection, chemical cleaning, steam blow cleaning, trenching, and earthwork for underground piping; or furnishing and/or installing control and instrument piping is included in the Scope of Work, it shall be performed in accordance with separate sections included in these specifications:

Additional Scope	The additional Scope of Work for this package includes the following items:
System Name	System Code
Fire Protection Loop	CSTG
The systems listed above include the following:	
Above grade piping	Yes
Below grade piping	Yes
In addition to erection of the piping systems defined above, the Scope of Work includes the following services and materials:	
Routing of miscellaneous 2 inch (50 mm) and smaller pipe, fittings, and valves	No
Installation of instrument and control piping and tubing as indicated on the attachments	No
Hydrostatic testing of piping erected under these specifications	Yes
Furnish and properly dispose of water for hydrotest	Yes
Furnish chemicals for treatment of hydrotest water	Yes

Freeze protection required	No
Furnish and install piping insulation and lagging in accordance with Section 15080 - Insulation and Lagging	No
Furnish and install pipeline identification	No
Metal signs	No
Stencil	No
Adhesive labels	No

15921.1.2 Items Furnished by Others and Interfaces

Items furnished by others and not in this Scope of Work include the following:

Lockout/Tagout procedures

15921.1.3 Performance and Design Requirements

Not used.

15921.1.4 Codes and Standards

Work performed under these specifications shall be performed in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Installation of mechanical joint piping	ANSI/AWWA C111/A21.11
Field applied coatings for underground piping	AWWA C209
Repair of damaged shop applied coatings for underground piping	AWWA C203
Repair of damaged field applied coatings for underground piping	AWWA C209, Section 3.4
Polyethylene tubing for underground ductile iron pipe	
Material	ANSI/AWWA C105/A21.5
Installation	ANSI/AWWA C105/A21.5
Dimensions and installation of restrained push-on type joints	AWWA C606

15921.1.5 Materials

The following materials shall be used:

Flange bolting shall be furnished as indicated in the table below.

Alloy steel bolting shall be used for joining all raised face, weld neck, alloy or carbon steel flanges when used in conjunction with spiral wound gaskets, regardless of the design pressure rating of the flanges. Carbon steel bolting may be used with raised face, weld neck, alloy or carbon steel flanges of Class 150 design pressure rating, provided that compressed fiber gaskets are used, but alloy steel bolting is acceptable as well. In general, carbon steel bolting should be used with all other flanges not constructed of stainless steel or "exotic" materials. Examples would include steel slip-on flanges, threaded steel or iron flanges, flanged connections making use of elastomeric gasketing, backing rings for HDPE piping joints, etc. Alloy steel bolting may be used in-lieu of carbon steel bolting in these cases as long as appropriate torquing procedures and values are utilized to ensure that the flanges, gaskets, and flange-to-pipe joints are not damaged by over-tightening.

Bolting for bolt diameters 1-3/4 inches (45 mm) and larger shall consist of threaded studs and two nuts. Bolting for bolt diameters less than 1-3/4 inches (45 mm) may be threaded studs and nuts or bolts and nuts. Bolts and nuts shall be heavy hexagonal heads conforming to the applicable standard.

Studs, Nuts, Bolts	
Carbon steel bolting materials	
Studs	ASTM A307 Grade B ASME SA-307 Grade B
Nuts	ASTM A563 Grade B ASME SA-563 Grade B
Bolt plating (applies to alloy and carbon steel bolting)	
Piping design temperatures less than 450° F (232° C)	Cadmium plating in accordance with ASTM B766 or zinc plating in accordance with ASTM A153
Nonmetallic flanges without backing ring	Follow nonmetallic flange manufacturer's recommendation

15921.1.6 Acceptable Subsuppliers

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Contractor wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Owner:

Component	Manufacturer
Shrink sleeves for underground piping	Raychem Corporation

15921.1.7 Test Requirements

The following testing shall be conducted in accordance with the specified source. This testing is to be considered part of the defined Scope of Work, and all associated costs are the responsibility of the Contractor. The Contractor is responsible for all costs associated with correcting deficiencies and retesting in the event of a test failure:

Tests	In Accordance With	Conducted By
Hydrostatic testing of underground fire protection piping	NFPA 24	Subcontractor

15921.1.8 Technical Attachments

Technical attachments relevant to the work under this section are listed in Section 01100.

15921.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 1400.

15921.2 Products

15921.2.1 Line Schedule

The Pipe Line List included with these specifications detail the requirements for the various major piping systems to be erected under these specifications.

The information included on the Pipe Line List designates the pipeline number; line description; nominal size; operating, design, and test pressures and temperatures; pipe material specification; insulation class; welding remarks; and special features.

15921.3 Execution

All piping, valves, fittings, and piping specialties shall be erected in accordance with the requirements of this section. Any piping installation not specified herein shall be performed in accordance with good engineering practice.

The drawings indicate the dimensions of the major lines. These dimensions are subject to change to accommodate the equipment, valves, and fittings actually furnished and the variations in equipment as actually installed. If the equipment, valves, fittings, and other components of the piping systems actually furnished differ in dimensions from those indicated, the piping systems shall be altered as required to accommodate these changes. If, due to some unforeseen circumstance, the installation of the piping as indicated would result in an interference, the modifications or corrections required to install the piping free from interferences shall be made.

15921.3.1 Not Used

15921.3.2 Not Used

15921.3.3 Not Used

15921.3.4 Piping in Existing Areas

Before installation of piping in existing areas, the routings of new piping to be installed shall be walked down and an Underground Utility Exploration shall be conducted to verify that the piping can be installed as designed without interference. If the piping as designed would interfere with existing facilities, the pipe routing shall be reviewed with the Engineer and shall then be altered or existing piping shall be relocated. All pipe routings shall be subject to acceptance by the Owner.

15921.3.5 Alterations and Cut-ins

All alterations and cut-ins to existing piping and equipment indicated on the drawings shall be made as specified herein and as required for proper installation of the new piping and equipment.

All cut-ins to existing Ductile Iron, Cast Iron, and HDPE piping shall be performed with installing a new FM rated Ductile Iron Tee with retrained mechanical joints. HDPE Mechanical Joint adapters shall then be used to mate with the new cut-in Tee.

Whether indicated on the drawings or not, existing miscellaneous piping shall be revised as required to permit installation, without interference, of new piping and equipment. Existing miscellaneous piping that interferes with walkways or presents an unsightly appearance after modification of existing buildings, structures, equipment, or piping shall be relocated as directed by the Owner. The alterations to existing piping shall include any required revisions, additions, or replacements of insulation and pipe supports.

Any piping materials and valves removed and not reused shall be disposed of as directed by the Owner.

All alterations and cut-ins to existing systems shall be made on a time schedule acceptable to the Owner.

After alterations and cut-ins to existing coated equipment or coated piping have been made, the damaged coating shall be repaired. All welds and sharp edges shall be finished smooth and all weld spatter shall be removed. The metal shall be prepared and the coating system applied in strict accordance with the instructions and recommendations of the coating manufacturer.

15921.3.6 Not Used

15921.3.7 Not Used

15921.3.8 Not Used

15921.3.9 Not Used

15921.3.10 Valve Installation

Excessive piping strains and bending moments on valves, especially Class 150 large steel gate valves and butterfly valves, shall be avoided. Excessive strains and moments will result in distorted valve seats.

15921.3.11 Not Used

15921.3.12 Not Used

15921.3.13 Making Piping Connections

15921.3.13.1 Flanged Connections. The faces of all flanges and gaskets shall be wiped clean when making up flanged joints. The contact faces of all flanges shall meet squarely, and particular care shall be exercised in pulling up flanged joints to prevent overstressing of flanges or flange bolting.

The threads of all bolting shall be painted with a suitable thread lubricant before the joint is made. The lubricant shall be suitable for the operating temperatures involved.

Flange torque values shall be determined based on the following criteria:

The manufacturer's suggested torque values shall be followed for bolting to equipment.

Where no information on flange torque values is available, the Contractor shall determine torque values and submit them for review and acceptance.

The following defines three types of gaskets as defined in ASME VIII Division 1 Appendix 2 Mandatory Rules for Bolted Flange Connections with Ring Type Gaskets used on the majority of flanged piping systems addressed in this Specification:

Self-energized types such as o rings, elastomeric, other self-seating types such as red rubber below 75A Shore Durometer.

Low seating stress such as reinforced teflon, graphite and spiral wound with an approximate minimum design seating stress of 3000 psi.

Spiral-wound metallic high seating stress with an approximate minimum design seating stress of 10,000 psi.

The following may be used as a reference for torque values for flat face and raised face flanges.

PCC-1 Guidelines for Pressure Boundary Bolted Flange Joint Assembly indicates that the minimum and maximum loading requirements for bolting must be selected by the end user.

Per PCC-1, the maximum loading on bolts is typically in the range of 40% to 70% of the ambient bolt yield stress. The minimum loading on bolts is typically in the range of 20% to 40% of the ambient bolt yield stress.

The elastomeric gasket on flat face flanges should not protrude (extend) out beyond the flange after tightening. In some cases finger tight plus $\frac{1}{4}$ to $\frac{1}{2}$ turn with a wrench may control in lieu of torque values.

For typical torque values, refer to Article 15921.1.8 Technical Attachments.

Flanges shall use the following or similar approved criteria for bolting sequence of flanges.

Tightening method and load control techniques shall be completed with approved methods that utilize a single tool with one of the following methods; hand wrench, slug/hand wrench, impact wrench torque tools and tension tools.

The tightening sequence shall utilize an approved criteria similar to the five step increment rounds shown in Table 2 Torque Increments for Legacy Cross-Pattern Tightening Using a Single Tool and Table 4 Legacy Cross-Pattern Tightening Sequence and Bolt Numbering System When Using a Single Tool and Table 4.1 Alternative to Legacy Cross-Pattern Tightening Sequence and Bolt Numbering System When Using a Single Tool found in PCC-1.

Flange fit up shall meet the following tolerances:

Holes for bolts shall be within $\frac{1}{8}$ " (3 mm)

The flange faces shall be parallel with $\frac{1}{16}$ " inch/per foot (0.5%) measured across any diameter.

Gaps shall be within $\frac{1}{16}$ " (1.5 mm) plus space for any required gaskets.

Spiral wound gaskets in gas piping shall have inner retainer rings in accordance with ASME B16.20.

15921.3.14 Not Used

15921.3.15 Not Used

15921.3.16 Not Used

15921.3.17 Damage to Machined Surfaces

Special measures shall be taken to avoid damage to machined surfaces such as flange facings or pipe ends that have been prepared for welding. Any damage to welding ends shall be repaired prior to butting up for welding. If a flange facing is marred, scratched, or damaged to such an extent that, in the opinion of the Owner, the flange will be a cause for leakage, such flange shall be repaired or replaced.

When welding to equipment that is in the assembled condition, separate ground leads shall be attached to the equipment, pipes, or components to prevent stray welding currents from arcing the internals of the equipment. Wherever possible, the ground lead shall be 2/0 cable or larger directly and mechanically connected adjacent to the welding area and returned directly to the welding power source.

15921.3.18 Piping Isolation

All necessary flange isolating materials and insulated bushings, unions, and couplings shall be installed as indicated on the drawings and as required to properly isolate the piping. Bolting at insulated flanges shall consist of studs and nuts with sufficient stud length to allow at least one full stud thread protruding through each nut. Sleeves shall extend into the insulating washers. After installation, insulated flanges, bushings, unions, and couplings shall be tested to determine that the piping is properly electrically isolated to the satisfaction of the Owner.

The Contractor shall electrically isolate the designated piping from connecting piping and equipment, reinforcing steel, structural steel, the station grounding system, and other buried piping.

15921.3.19 Not Used

15921.3.20 Not Used

15921.3.21 Not Used

15921.3.22 Not Used

15921.3.23 Protective Coatings

Where indicated in the Pipeline List, protective coatings will be applied to the exterior surfaces of underground piping. Unless otherwise noted in the Pipeline List, the coatings will be shop applied, and the Subcontractor shall repair the coatings and apply field coatings to field installed joints and to areas not covered by shop coatings.

15921.3.23.1 Coating Repair. The method of field repair of damaged shop applied coatings shall be in accordance with the standard specified for the coating. The repair materials shall be the same as the original coating or as recommended by the coating applicator.

The method of field repair of damaged field applied coatings shall be in accordance with the specified standard. The repair materials shall be the same as the original coating or as recommended by the coating manufacturer.

15921.3.23.2 Handling of Coated Pipe. Coated pipe shall be handled at all times so as to prevent damage to the coating. Bare cables, chains, hooks, metal bars, or narrow skids shall not be permitted to come in contact with the coating during handling. Coated pipe shall not be handled when the ambient temperature is below freezing.

Coated pipe shall be carefully backfilled with proper backfill materials. No organic material such as sacks or wood blocks shall be allowed in the piping trench. No sharp objects such as stones shall be allowed to contact the coated pipe.

15921.3.23.3 Polyethylene Tube Protection. All ductile iron pipe that is installed underground shall be provided with seamless polyethylene tube protection. The tubing and installation of the tubing shall be in accordance with the specified standard.

15921.3.24 Underground Piping

Underground piping shall be installed as indicated on the drawings and as specified herein.

Excavation, trenching, embedment, and backfilling shall be in accordance with the requirements of Section 02200 - Earthwork.

15921.3.24.1 Blocking. Underground valves and hydrants shall be provided with suitable concrete support blocks placed against compacted subgrade.

The Contractor shall be responsible for all blocking, and blocking shall not be accepted as adequate until piping has been successfully hydrostatically tested as specified herein.

15921.3.24.2 Not Used

15921.3.24.3 Grade and Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Laser beam equipment, survey instruments, or other acceptable construction methods shall be used to maintain alignment and grade.

All trenches shall be so graded and pipe so installed that the pipe, when laid on the trench bottom as previously prepared and graded, will be in accurate horizontal and vertical position.

Terminal point flanges shall be installed such that they are no more than the greater of 3/64" per foot or 1/32" out of level.

All pipe shall be brought to the terminal points specified within the tolerances listed below. For mislocated terminal points, the Construction Manager shall determine the means for correction. Bending will only be permitted if approved by the Engineer.

Description	Erected Tolerance From Drawings
NPS 2 inch and smaller	+/- ½ inch
NPS 12 inch and smaller	+/- 3/8 inch
NPS greater than 12 inch	+/- ¼ inch

15921.3.24.4 Laying Pipe. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified for trench backfill. Under no circumstances shall pipe be laid in groundwater in excavated trenches, and no pipe shall be laid when trench conditions are unsuitable. Trench bottoms that become unstable shall be stabilized in accordance with the requirements stated in these specifications.

15921.3.24.5 Closures. When pipe laying is stopped at the end of the day, or for any other reason, the end of the pipe shall be closed with a watertight plug or bulkhead. All branch outlets shall be adequately sealed as soon as the special or fitting is laid. It is essential that mud, sand, or debris be excluded from the lines at all times.

15921.3.25 Not Used

15921.3.26 Mechanical Joint Pipe Installation

Mechanical joint pipe shall be assembled in complete accordance with the manufacturer's instructions and recommendations. If effective sealing is not obtained in the assembly of mechanical joints, the joint shall be disassembled, cleaned, and reassembled. Overtightening bolts to compensate for poor installation practice will not be permitted.

Cutting shall be performed in a neat manner, without damage to the pipe. Cuts shall be straight, smooth, and at right angles to the pipe axis. Ends of ductile iron pipe shall be cut with a saw or abrasive wheel.

15921.3.27 Not Used

15921.3.28 Installation of Restrained Push-on Joint Pipe

Where restrained push-on joints are provided, the joints shall be assembled in complete accordance with the manufacturer's instructions and recommendations and in accordance with the specified standard. If effective sealing is not obtained in assembly of a joint, the joint shall be disassembled, cleaned, and reassembled with a new gasket. Field grooving of pipe shall be permitted only on closure pieces. Field cut grooves shall be within the dimensional tolerances of the specified standard.

15921.3.29 Not Used

15921.3.30 Not Used

15921.3.31 Testing

Where required by Article 15921.1.1, materials and equipment tests shall be made by the Contractor as specified herein, as specified on the Pipeline List, and as required by code requirements and local and state regulations.

Water used to test other lines shall be clean, filtered, fresh water (service water or better) and shall be chemically treated to inhibit biological organisms. Treatment levels shall not exceed 2 mg/L of residual chlorine.

Testing water shall not be left to stagnate in the lines.

All materials, equipment, tools, instruments, blocking, bracing, bulkheads, blanking plates, and all labor required to complete the tests shall be furnished by the Subcontractor. Test water and chemicals shall be furnished by the Subcontractor or the Owner as specified in Article 15921.1.1.

If any tests reveal unsatisfactory materials or workmanship, such materials or installation shall be repaired or replaced to the satisfaction of the Owner.

15921.3.31.1 Pressure Testing of Piping. When a test pressure is specified for a piping system in the Pipeline List, the specified test pressure shall be applied to the system upon completion of erection. Where no test pressure is specified, pressure testing is not required for that system except as specified otherwise herein.

Testing shall be performed hydrostatically in accordance with ASME B31.1. Leaks shall be repaired and the system retested until accepted by the Owner as satisfactory.

All underground piping shall be given a hydrostatic test prior to covering the line.

Underground fire protection system piping shall be hydrostatically tested in accordance with the referenced standard in Article 15921.1.4. The maximum allowable leakage for joints and for components other than gaskets or joints shall be as specified in the referenced standard.

The test pressure shall not be applied until the components being hydrostatically tested and the pressurizing medium are at approximately the same temperature. All expansion joint control rods and attachments shall be properly adjusted before application of test pressure.

Before applying the test pressure, all air shall be expelled from the piping being hydrostatically tested. If required, taps at the high points of the piping systems shall be made and shall be plugged upon completion of the testing. The addition of high point vents on alloy piping shall be approved by the Engineer.

Where specified in Article 15921.1.1, piping installed under separate specifications shall be hydrostatically tested under these specifications. If defects are discovered in the piping that has been installed under separate specifications and tested under these specifications, the Contractor shall inform the Owner, who will instruct the installing contractor to return to the site and locate and repair all defects. All costs incurred as a result of defects in piping installed under separate specifications, including costs of subsequent retesting, will be borne by the Contractor who installed that section of pipe in which the leak was found.

Piping that must be hydrostatically tested, but would be adversely affected by rust as indicated in Article 15921.1.1 or as directed by the Engineer, shall have a rust preventive added to the test water and shall be forced-air dried after testing. The chemicals shall be added while the piping system is being filled. All temporary piping and equipment required for the addition of the chemicals shall be furnished.

All end closures shall be left in place to prevent foreign materials from entering the piping during other work. The low points of the piping shall be provided with drain taps and plugs. All plugs in the piping shall be seal welded.

15921.3.31.2 Underground Water Lines. All hydrostatically tested underground water lines shall be dewatered after the test to the extent necessary to lower the water level below the frost line. Where dewatering is not practical, other suitable methods shall be used to prevent freezing. These methods shall be acceptable to the Owner.

15921.3.32 Cleaning of Pipe

The inside and outside surfaces of all pipe, valves, and fittings shall be cleaned of all dirt, sand, loose mill scale, and other foreign materials immediately after removal from storage and before erection. All lines shall be thoroughly flushed or blown before being placed in service.

Water used to flush other lines shall be clean, filtered, fresh water (service water or better) and shall be chemically treated to inhibit biological organisms. Treatment levels shall not exceed 2 mg/L of residual chlorine.

Flushing water shall not be left to stagnate in the lines.

15921.3.33 Not Used

15921.3.34 Not Used

15921.3.35 Final Adjustment

After a period of initial operation, all flange bolting shall be checked for tightness, and all hangers readjusted.

15941 - Insulation and Lagging

15941.1 General

15941.1.1 Scope of Supply

Scope of supply shall include the following.

15941.1.1.1 Insulation and Lagging Overall Scope of Supply. Insulation and lagging materials shall be furnished as follows:

All above grade fire protection piping and associated appurtenances installed within this Scope of Work shall be insulated with 1" insulation per the specifications herein.

Contractor shall provide all materials and labor necessary to install a complete insulation system per these specifications.

Lagging shall be clearly marked by the Contractor to identify the piping as Fire Protection.

15941.1.1.2 Piping and Auxiliary Equipment Insulation and Jacketing Scope of Supply. Insulation and jacketing materials shall be furnished for the following:

All above grade piping.

All piping accessories, such as valves, strainers, and expansion joints, in piping systems for which insulation materials are being furnished.

Existing insulation and lagging which is damaged or removed by the Contractor during the performance of other work under this Contract.

Insulating cement in a quantity sufficient to allow elimination of gaps and voids under jacketing on insulated piping.

15941.1.3 Performance and Design Requirements

Performance and design requirements for the insulation and lagging materials to be furnished under this section of these specifications are indicated herein:

General Requirements	
Maximum surface temperature allowable for personnel protection	150° F (66° C)
Material Types	
Piping insulation materials shall be	Mineral fiber preformed pipe insulation
Auxiliary equipment insulation materials shall be	Mineral fiber block and board
Replacement insulation and lagging materials shall be	Equivalent to insulation and lagging used on newly insulated surfaces
Material Requirements	
Where mineral fiber blanket is furnished, it shall be provided	With woven wire mesh facing on both sides

Wire mesh for use with equipment which will have block insulation shall be	Stainless steel
Method of securing insulation to equipment shall be	Steel bands, welded studs, or impaling pins and speed washers, as determined by Contractor for each application
Jacketing for elbows shall be	Preformed aluminum elbows or field fabricated from aluminum sheet, at Contractor's option
A moisture barrier is required for jacketing for these systems or areas	All outdoor installations
Moisture barrier shall be	1.5 mil (0.040 mm) polyethylene and 40 pound basis weight (65.2 grams per square meter) kraft paper
Neoprene washers are required on screws for the listed jacketing	All outdoor installations

15941.1.4 Codes and Standards

Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Purchaser's specifications. In case of conflict, the latter shall govern to the extent of such difference:

Work	In Accordance With
Preformed calcium silicate insulation for piping	ASTM C533
Premolded calcium silicate block insulation for auxiliary equipment and flatwork	ASTM C533, Type I
Preformed mineral fiber pipe insulation	ASTM C547, Types II or III
Mineral fiber blanket insulation	ASTM C553
Mineral fiber blanket insulation (metal mesh covered) for piping and auxiliary equipment	ASTM C592
Mineral fiber block and board insulation for flatwork areas	ASTM C612
Preformed perlite insulation for piping	ASTM C610
Premolded perlite block insulation for auxiliary equipment and flatwork	ASTM C610
Rigid insulation for water resistant applications	Mineral fiber in accordance with ASTM C547, with moisture absorption in accordance with ASTM C209 and wicking in accordance with ASTM C800

Work	In Accordance With
Aluminum jacketing for pipe and auxiliary equipment	ASTM C1729, Alloy 1100 for preformed elbows, alloy 3003 or 3105 for pipe and auxiliary equipment
Insulating cement	ASTM C195

15941.1.6 Approved Manufacturers of Components

For the following components, only the listed manufacturers are recognized as maintaining the level of quality of workmanship required by these specifications. If the Supplier wants to propose a nonlisted manufacturer that is considered to provide an equivalent level of quality, this manufacturer must be identified and supporting testimony provided. Acceptance of the manufacturer as a substitute is at the discretion of the Purchaser:

Component	Manufacturer
Mineral fiber insulation	Delta "Rock Wool"; Fibrex; JM/Industrial Insulation Group, Roxul "ProRox"
Adhesive for elastomeric antisweat insulation	Armacell 520 Adhesive
Welded studs for attachment of insulation	Nelson
Preformed aluminum elbows for pipe jacketing	ITW Insulation Systems; General Aluminum Supply Company; RPR Products
Aluminum pigmented mastic	Foster No. 35-01
Joint sealant	Foster No. 30-45
Treated rigid fiber insulation	Owens-Corning
Inert organic free flowing particle insulation	Protexulate
Weatherproof coatings	JM/Industrial Insulation Group "Insulkote"
Strapping for support of insulation on vertical pipe runs	Acro Metal Stamping Co. "Acroflex"

15941.1.7 Not Used

15941.1.8 Not Used

15941.1.9 Supplemental Specifications

Technical supplemental specifications that are applicable to the work covered under this technical specification section are identified and included in Section 1400.

15941.2 Products

This article covers the design, performance, and construction requirements for insulation and lagging materials for piping and auxiliary equipment and for flatwork areas.

The scope of insulation and lagging materials to be furnished shall be as indicated under Article 15941.1.1. Scope may be specified by the Owner by means of drawings and other attachments or

may be as required by the Contractor's design if insulation is to be provided for Contractor-furnished piping and/or equipment items.

All insulation and lagging materials shall be asbestos free. Insulation materials shall be inhibited and of low halogen content so that the insulation meets the requirements of the standard specified in Article 15941.1.4 regarding stress corrosion cracking of austenitic stainless steel.

15941.2.1 Insulation Thicknesses

The insulation for piping accessories shall be of the same class as is indicated for the piping. Insulation materials for miscellaneous piping and equipment shall be suitable for the actual operating temperatures and shall, wherever possible, be of the same insulation class as insulated main piping and equipment operating under similar temperatures.

15941.2.1.1 Not Used

15941.2.2 Piping and Auxiliary Equipment Insulation and Jacketing

The Contractor shall furnish all insulation and jacketing materials for the piping and auxiliary equipment indicated in Article 15941.1.3.

Unless otherwise indicated in Article 15941.1.3, when the Contractor is providing replacement insulation and lagging materials for existing materials that were damaged or removed during the Contractor's construction activities, the new materials shall be equivalent to the original materials, except that all materials shall be asbestos free.

Except as specified otherwise, all miscellaneous materials required for complete field installation of insulation and jackets shall be furnished under these specifications. This shall include such items as insulating and finishing cements, sealers, plastic insulation materials, moisture barrier materials, wire, straps, bands, insulation lugs and special supports, pins, clips, meshes, jacket attachment screws, and neoprene washers.

15941.2.2.1 Piping and Auxiliary Equipment Insulation Materials. Where Article 15941.1.3 specifies calcium silicate, piping and auxiliary equipment insulation shall be calcium silicate block and pipe thermal insulation having a nominal density of 14 pounds per cubic foot (224 kg per cubic meter).

Where Article 15941.1.3 specifies perlite, piping and auxiliary equipment insulation shall be perlite block and pipe thermal insulation complying with ASTM C610 and having a nominal density of 15 pounds per cubic foot (240 kg per cubic meter).

Where Article 15941.1.3 specifies mineral wool, piping and auxiliary equipment insulation shall be mineral fiber blanket having a nominal density (without facings) of 8 pounds per cubic foot (128 kg per cubic meter).

Where Article 15941.1.3 specifies mineral fiber block and board insulation, the mineral fiber block and board insulation shall have a nominal density of 8 to 12 pounds per cubic foot (128 to 192 kg per cubic meter).

Mineral fiber preformed pipe insulation and fiberglass insulation shall be used on piping systems to be freeze protected, as indicated in Article 15941.1.3 and the attachments thereto. Mineral fiber preformed pipe insulation for this application shall have a nominal density of 8 to 10 pounds per cubic foot (128 to 160 kg per cubic meter). Fiberglass blanket shall have a minimum nominal density of 3.5 pounds per cubic foot (56 kg per cubic meter). When the contract includes insulation materials for freeze protected pipe, aluminum foil wrap shall be provided for a single wrap of foil over the heat tracing cable.

Antisweat insulation shall be flexible elastomeric cellular thermal insulation or fiberglass insulation.

Water resistant insulation shall be cellular glass, treated rigid fiber insulation, or inert free-flowing inorganic particle insulation, suitable for the piping design temperature. Treated rigid fiber insulation shall be in accordance with the standards indicated in Article 15941.1.4. Moisture absorption shall be less than 1 percent by volume. Wicking shall be 0 percent by volume. Inert organic free-flowing particle insulation shall be nonflammable and nontoxic.

Insulation for piping elbows and bends may be straight pipe insulation that can be cut into sections as required for a reasonably smooth contour, or specially molded insulating enclosures may be provided.

Piping and small diameter cylindrical equipment insulation shall be hollow cylindrical shapes split in half lengthwise or in curved segments. Large diameter cylindrical equipment and other items of equipment shall be insulated with block or scored block insulation as required to obtain a close fit to the contour. Molded fitting insulation may be used in lieu of fitting insulation fabricated from straight pipe insulation segments.

Wire shall be used for securing insulation to piping smaller than 30 inches (750 mm) in diameter and shall be 16 gauge, ASTM A580 Type 302, Type 304 or Type 304L dead soft stainless steel wire. Straps or bands for securing insulation to equipment and to 30 inch (750 mm) and larger piping shall be 3/4 inch by 0.020 inch (20 mm by 0.5 mm) stainless steel.

Where Article 15941.1.3 indicates that welded studs are to be provided for attaching insulation to equipment, stud length shall be suitable for the insulation thickness. Where Article 15941.1.3 indicates that pins are to be provided for attaching insulation to equipment, pins for impaling mineral fiber insulation shall be 10 gauge steel wire in lengths suitable for the insulation thickness. Field welded studs or pins are not to be used on ASME Code equipment or piping; alternate means shall be provided for attachment of insulation to those items. Such alternate methods shall be described in the proposal data.

15941.2.2.2 Piping and Auxiliary Equipment Jacketing Materials. Pipe and auxiliary equipment jacketing shall be stucco embossed aluminum jacketing with a minimum thickness of 0.016 inch (0.4 mm). Aluminum sheets shall be machine rolled and formed to accurately fit insulation curvatures. Aluminum jacketing for elbows shall be preformed elbow jackets or shall be field fabricated from aluminum sheet, as indicated in Article 15941.1.3.

Aluminum jackets shall be provided with a moisture barrier attached to the inside surfaces of the jacketing in accordance with Article 15941.1.3.

Screws for attachment of aluminum jackets shall be stainless steel self-tapping screws. Screws shall be provided with neoprene washers where indicated in Article 15941.1.3.

Bands used to secure aluminum jacketing over insulation shall be 3/4 inch wide by 0.020 inch thick (20 mm wide by 0.5 mm thick) stainless steel. Jacketing shall be designed for a 2 to 3 inch (50 to 75 mm) lap at circumferential joints, or self-sealing bands using a suitable sealing compound may be used at circumferential joints.

Where indicated in Article 15941.1.3, the Supplier shall furnish a sufficient quantity of wire mesh and insulating cement to allow application of wire mesh and then two 1/4 inch (6 mm) coats of insulating cement over equipment which will be insulated with block insulation to provide a smooth, durable surface under jacketing.

15941.3 Execution

To prevent galvanic corrosion in locations where joints may be regularly wetted, care shall be used to prevent permanent contact of aluminum lagging with steel, copper, copper alloy, tin, lead, nickel, or nickel

alloy including Monel metal. Where it is necessary to attach the lagging to carbon steel or low alloy steel, the steel shall first be prime painted with zinc chromate and then painted with aluminum paint.

All equipment and structures shall be adequately protected from damage from insulation materials and construction activities. After completion of the work, all equipment and structures shall be cleaned, repaired, and restored to their original state. Any aluminum jacketing which becomes corroded, discolored, or otherwise damaged during installation shall be repaired by replacement of jacketing or other means acceptable to the Purchaser.

15941.3.1 Installation of Insulation and Lagging on Piping and Auxiliary Equipment

Insulation shall not be applied over damp, wet, or frosted surfaces. All surfaces to be insulated shall be clean and dry prior to application of the insulation, and all testing on the piping or equipment shall have been completed.

The Supplier shall coordinate his work with that of other contractors performing onsite work. If this Contract includes insulation for freeze protected piping, but the electric heating cable will be furnished and installed by others, the Supplier shall take particular care to coordinate with the work of the contractor installing the electric heating cable, in the best interest of the project. When electric heating cable is installed by others, the Supplier is responsible for periodically meeting with the electric heating cable installation contractor, to schedule coordination of insulation and lagging with electric heating cable installation. The insulation and lagging Supplier is responsible for ensuring that scaffolding or other access equipment is in place or available for their work, by coordinating with other site contractors or providing access equipment needed to perform their work.

15941.3.1.1 Piping Insulation. Calcium silicate and perlite piping insulation shall be applied with tight seams and joints using wire loops on 6 inch (150 mm) centers, or straps on 9 inch (225 mm) centers, where applicable. Wire loops shall be embedded flush into the outer insulation surface, the ends twisted, excess wire cut off, and the twisted ends embedded in the insulation. Straps shall be used on all piping 30 inches (750 mm) and larger. Cracks, voids, and depressions shall be filled with insulating cement suitable for the piping temperature. The surfaces shall be smooth and uniform before application of outer coverings.

Mineral fiber preformed pipe insulation and fiberglass blankets on piping shall be secured by using wire loops, straps, or 1 inch (25 mm) wide filament tape on 6 inch (150 mm) centers.

Double thickness insulation shall be applied with the longitudinal and circumferential joints of the two layers staggered. Each layer shall be separately wired or strapped as described above and all cracks, voids, and depressions shall be filled in the first layer before application of the outer layer.

Ends of pipe insulation shall be stopped a sufficient distance from flanges to permit bolt removal clearance.

Antisweat insulation for piping shall be applied in accordance with the manufacturer's instructions and recommendations. Elastomeric type antisweat insulation shall be attached by cementing, and all joints shall be completely sealed by use of the specified adhesive.

Angular link strapping in accordance with Articles 15941.1.5 and 15941.1.6 shall be installed on vertical piping runs to provide support of the insulation. The strapping shall be applied by cutting it to the appropriate length for the pipe diameter and bolting the ends together to cinch it to the pipe. For double layer insulation situations, the strapping for support of the outer layer shall be applied to the inner layer of insulation. Strapping shall be installed at intervals of 10 feet (3 meters), maximum.

Elbows and Bends. Insulation on elbows and bends shall be cut into sufficiently short sections to form a reasonably smooth exterior. After the insulation is in place, it shall be coated as required with insulating

cement to form a smooth surface. If specially molded insulating enclosures are provided for elbows and bends, they shall be installed in accordance with the manufacturer's recommendations.

Flanges. Flanges shall be insulated by means of a series of blocks of insulating material fastened around the flange by wire loops. Blocks of insulation shall be long enough to overlap the adjacent pipe insulation an amount equal to the thickness of the adjacent pipe insulation. Insulating cement shall be applied as required to obtain a smooth finish. As an alternate, sectional pipe insulation of proper diameter may be used. Flange coverings shall be sufficiently thick to be equal in all respects to that of the piping. All flanges shall be left uncovered until the pipe and equipment have been in service a minimum of 10 days and until all flange bolts at leaking flanges have been retightened.

Valves and Specialties. All valve bodies, fittings, drip pockets, separators, strainers, and special equipment shall be insulated in the manner and thickness as specified for the line in which they are located, except that plastic cement may be used in lieu of rigid insulation in such places where the proper curvature can be better obtained. Plastic materials shall be equal in insulating properties to the insulation specified.

Where small valves are included in valve bypass lines, and the operators of such valves would be buried in the main piping insulation, boxouts or cutouts shall be provided to allow access to and operation of the valve handles.

Thermowells shall be completely buried within the piping insulation. Insulation thickness around the well shall not be reduced.

Trap bodies and unions in trap piping shall be left uncovered. Insulation shall be tapered to a neat finish at these points so that the traps may be removed without damage to the insulation.

Voids Under Jackets. Insulation shall completely fill all spaces under jackets, so there are no voids under the jackets. Insulating cement shall be used where required to fill such voids. At flanges, valves, and specialties, fiberglass insulation may be used in conjunction with insulating cement to fill voids.

Hanger Rods. Where hanger rods project into the insulation, the insulation shall be cut back to allow free movement of the hanger rod and then sealed.

15941.3.1.2 Not Used

15941.3.1.3 Not Used

15941.3.1.4 Jackets. All piping and auxiliary equipment insulation, except elastomeric antisweat insulation installed indoors, shall be completely covered with jackets so there is no exposed insulation.

Moisture Barrier. Jacketing with a moisture barrier of the type specified shall be used on piping where so indicated in Article 15941.1.3.

Attachment. Bands or screws shall be used for attachment of jackets.

Screws shall be placed in such locations and numbers as required to produce tight joints without bellying. The spacing of fasteners shall be as uniform as practicable and on centers not exceeding 6 inches (150 mm), except where piping insulated outside diameters are smaller than 9 inches (225 mm), where spacing shall be on centers not exceeding 4 inches (100 mm).

Bands shall be spaced on not less than 12 inch (300 mm) centers.

Joints. Wherever possible, joints shall be lapped a minimum of 2 inches (50 mm). Self-sealing bands which provide a positive seal utilizing a nonsetting sealer may be used over circumferential joints of piping and small diameter cylindrical equipment jacketing. Joints in out-of-doors locations shall be placed so as to shed water. Longitudinal joint outer laps shall have a 3/8 inch (10 mm) turnback edge.

Butt joints in aluminum jackets, such as at piping tees, shall be made using a rolled seam.

Openings in out-of-doors jackets for piping connections, supports, or access shall be flashed and weatherproofed.

Joints and openings in out-of-doors jackets that cannot be effectively sealed against entry of moisture by flashings or laps shall be weatherproofed by application of joint sealer.

Cement on fittings, piping, and valves shall be dry before installing aluminum jackets.

Radius Bends and Elbows. All insulated long radius bends shall be jacketed using spiral wrapped aluminum strips, individual mitered segment gores cut to fit the insulation shapes, or two-piece preformed metal elbows where these can be fitted. Jacketing shall be applied in either instance over a continuous freshly applied coating of aluminum pigmented mastic. Jacketing strips shall be attached using screws as herein specified.

Piping elbows shall be jacketed with preformed elbows if furnished or with mitered segment elbow jackets field fabricated from pipe jacketing.

End Covers. Exposed ends of piping insulation shall be provided with flat covers attached by a rolled seam.

15941.3.1.5 Patching. If existing refractory and insulation adjacent to new construction work is damaged or otherwise deteriorated to a condition requiring repairs to achieve a durable finished job, such areas shall be repaired or replaced as acceptable to the Purchaser.

15941.3.1.6 Removable Insulation Covers. Removable insulation covers for feedwater heaters will be fabricated in half sections and shall be held in place with adjustable straps.

Removable insulation covers for pumps shall be secured using stainless steel lacing hooks and wire. The lacing hooks shall be placed on 4 inch (100 mm) centers, 2 inches (50 mm) from the edge at closing points.

15941.3.1.7 Provision for Expansion. Joints in piping and equipment insulation and jacketing shall include provisions for expansion to prevent damage to the insulation. Expansion spaces shall be of sufficient gap and provided in sufficient number to absorb the expansion and contraction movements of the piping and equipment. Expansion spaces shall be tightly packed with compressible mineral fiber wool insulation. Expansion spaces on double layer insulation shall be staggered.

Jacketing joints shall be lapped and sealed with nonsetting cement, or shall be provided with self-sealing bands or other acceptable provision made which will absorb the relative jacket movement.

Joints at insulated flanges, fittings, valves, and specialties may serve as expansion joints through the use of nonsetting cement where one size of insulation nests over the other.