SECTION 23 22 13.13

**UNDERGROUND STEAM and CONDENSATE PIPING**

**BASED ON DFD MASTER SPECIFICATION DATED 3/27/2024**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**P A R T 1 - G E N E R A L**

**SCOPE**

This section contains specifications for all hydronic heating & steam utility distribution systems for this project. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference

 Reference Standards

 Shop Drawings

 Quality Assurance

 Delivery, Storage, and Handling

 Design Criteria

 Welder Qualifications

PART 2 - PRODUCTS

 Direct-Buried Underground Heating Hot Water Conduit

PART 3 - EXECUTION

 Preparation

 Welded Conduit Joints

 Direct Buried Underground Heating Hot Water Conduit

 Construction Verification Items

**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Division 23 – Heating, Ventilating and Air Conditioning

Division 31 – Earthwork

Division 33 – Utilities

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

ASME B 31.1 POWER PIPING

**SHOP DRAWINGS**

Refer to division 1, General Conditions, Submittals.

Contractor shall submit information on factory supplied steam/condensate conduit systems and accessories, including but not limited to; conduit coating, conduit material specs, support assemblies, guide assemblies, anchor assemblies, end seals, gland seals, cathodic protection, etc. Contractor shall also submit information related to installation and maintenance instructions.

Contractor shall submit information on factory supplied direct-buried heating systems and accessories, including but not limited to; carrier pipe, insulation material, jacketing material, anchors, end seals, etc.

Contractor shall submit information that staff has been to the preinsulated pipe manufacturers field joint training and is accredited as a certified field installer.

Contractor shall submit preinsulated pipe manufacturers field representative certification.

Contractor to submit information related to materials specified in other associated sections, including but not limited to; piping material, welding specs and certifications, waterproofing, paint, insulation, etc.…

**QUALITY ASSURANCE**

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

**DELIVERY, STORAGE, AND HANDLING**

Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

Cover pipe and conduit or insulation/jacketing system to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, and conduit ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings and closure materials by storage inside or by durable, waterproof, above ground packaging.

Unload all underground conduit and direct-buried systems using manufacturer’s approved methods and rigging materials which may include exclusive use of fabric slings. Store so that all conduit and direct-buried systems can be visually inspected.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

**DESIGN CRITERIA**

Use only new material, free of defects, and meeting the latest revision of ASTM specifications as listed in this specification.

Install all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 100 psig unless specifically indicated otherwise.

The pipe system shall be designed WITHOUT the use of cold spring connections.

See Division 23 for other piping requirements.

**WELDER QUALIFICATIONS**

Welding procedures, welders, and welding operators for all building service piping and hot water piping less than or equal to 15 psig to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau.

Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

The A/E or DFD reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

WELDER QUALIFICATIONS

Welding procedures, welders, and welding operators for all steam system piping at service pressures above 15 psig to be qualified complying with the provisions of the latest revision of ANSI/ASME B 31.1-Power Piping or Section IX of the ASME Boiler and Pressure Vessel Code for boiler external piping.

Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.

Welder certifications are required to be renewed every three years. If qualification papers are needed on a project, verify that they are current.

The A/E or DFD reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

**P A R T 2 - P R O D U C T S**

**DIRECT BURIED UNDERGROUND STEAM/CONDENSATE/COMPRESSED AIR CONDUIT**

GENERAL: All underground distribution lines as shown on the contract drawings shall be Perma-Pipe MultiTherm 500, Thermacor DuoTherm 505, or Approved Equal. The system supplier shall have at least ten years of experience fabricating underground high temperature distribution systems. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition, and stamped by a Registered Professional Engineer.

SERVICE PIPE: Internal piping shall be standard weight carbon steel, except for condensate piping which shall be schedule 80. Pipe shall be butt welded for sizes 2.5 inches and larger and socket welded for 2 inches and below. Where possible, straight sections shall be supplied in 40 foot random lengths with 6 inches of piping exposed at each end for field joint fabrication. Pipe shall be ASTM A53 Grade B Type S Seamless or Type E ERW.

Only include the following sections if you have CA in the preinsulated sytem

COMPRESSED AIR PIPE

2" and Smaller: ASTM B88 seamless, type L, hard temper copper tube with ANSI B16.22 wrought copper pressure fittings

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

COPPER PIPE JOINTS

Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use AWS A5.8 BCuP: Flux and silver brazing alloy and silver brazing alloy AWS A5.8 BAg for copper to brass/bronze joints. Clean piping and fitting in accordance with CGA G 4.1.

Brazing alloy shall be 15% silver.

SUBASSEMBLIES: End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.

SERVICE PIPE INSULATION: Service pipe insulation shall be rigid preformed mineral wool, minimum nominal density of 8 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F mean temperature, 0.30 at 200 degrees F, 0.38 at 300 degrees F, minimum compressive strength of 3 psi, maximum wicking of 1%, maximum water adsorption of 1% by volume, rated for service temperature range to 1200 degrees F.

Pipe insulation shall be pre-formed in two (2) half cylinder sections. Cut V-groove sheet insulation is not acceptable. The insulation shall be held in place by stainless steel bands installed not more than 18 inches apart. The insulation shall be a minimum of 2 inches thick.

***NOTE: AEROGEL insulation IS NOT ALLOWED***

PIPE SUPPORTS: All pipes within the outer conduit shall be supported to allow for continuous drainage of the conduit in place. Supports shall be the type where insulation thermally isolates the service pipe from the outer conduit. No calcium silicate or other type of insulation shall be allowed. The surface of the support insulation shall be protected by a steel sleeve not less than 12 inches long.

OUTER CONDUIT: The steel conduit casing shall be smooth wall, welded steel conduit of the thicknesses specified below:

Conduit Size Conduit Thickness

6”-26” 10 Gauge

28”-36” 6 Gauge

38”-42” 4 Gauge

Changes in casing size, as required at oversized casing to allow for service pipe expansion shall be accomplished by eccentric and/or concentric fittings and shall provide for continuous drainage.

OUTER CONDUIT INSULATION AND JACKET: Conduit insulation shall be spray applied polyurethane foam having a minimum density of 2 lbs/ft3 for the straight lengths and fittings. The insulation thickness shall be 1 inch maximum. The polyurethane foam shall have a maximum initial K value of 0.18, minimum density of 2 lbs/ft3 and a minimum closed cell content of 90%.

The outer jacket shall be 125 Mils thick extruded seamless HDPE.

PIPE WELDS

Primer: 450°F minimum continuous temperature rated corrosion resistant primer. Rustoleum High Heat Primer, V2100 or equal. 3 DMils thickness.

Finish coat: 450°F minimum continuous temperature rated corrosion resistant primer or paint. Rustoleum V2100 or equal. 3 DMils thickness.

DIFFUSION BARRIER: An aluminum diffusion barrier shall be applied on the outside of the insulation before application of the outer jacket. The barrier shall prevent the diffusion of the blowing agent out of the foam to prevent the foam from aging. The diffusion barrier shall be of composite construction with a minimum 12 micron aluminum layer sandwiched between two layers of polyethylene each a minimum of 50 microns thick. The polyethylene layers shall be heat treated to guarantee bonding between the foam insulation and the outer jacket.

OUTER JACKET SEALS: The pipe system shall utilize a two sleeve system for sealing of the outer conduit and diffusion barrier. The primary electrofusion sleeve will be an 24 inch long air testable field joint as stated below. The secondary sleeve will be the same as above but shall be 36 inchs long. Both sleeve layers shall be Manufactured by CANUSA-CPS and shall have a fully recovered thickness of 90mils minimum and be rated for 176 degrees F. The sleeves shall be 24 and 36 inches long minimum. Heat shrink or thermofusion seal shall meet or exceed EN489 (current version) requirements.

FINAL JACKET SEALING:

The top most jacket seal shall have all seam sealed with either liquid membrane or butyl tape.

Denso Butyl 35 Tape (4” width), or approved equal.

EXPANSION LOOPS or Z-BENDS: Installed in conduit sized to handle indicated pipe movement. Conduit fittings and straight sections to be large enough to allow expansion and contraction of the system without having the carrier pipe insulation touch the outer conduit.

Carrier pipe alignment guides shall be factory-installed to direct movement from expansion within conduit to aforementioned expansion loops or Z-bends.

END & GLAND SEALS: Terminal ends of conduit inside manholes, pits, or building walls to be equipped with end seals consisting of a steel bulkhead plate welded to the pipe and conduit. Where there is no anchor within five feet of a terminal end, equip conduit end with gland seal consisting of a packed stuffing box and gland follower mounted on a steel plate welded to end of conduit. End seals or gland seals to be equipped with drain and vent openings located diametrically opposite on the vertical center line of the mounting plate and shall be shipped to the job site with plugs in place. Terminate all conduits 2" beyond the inside face of manhole or building walls to protect any exposed piping insulation from damp-wall condensation.

WALL PENETRATION SEAL: Provide dual link seals within building wall or pit wall penetration to act as a moisture barrier. Pipe system manufacturer shall provide additional outer jacket stiffing in the wall penetration ends of the pipe to allow for link type seals to be effective in sealing. This stiffening shall be the same gage as the outer conduit and extend a minimum of 4 feet from the end of the wall penetration pipe.

**P A R T 3 - E X E C U T I O N**

**PREPARATION**

Remove all foreign material from exterior of conduit straight lengths and fittings.

**DIRECT BURIED UNDERGROUND HEATING HOT WATER SYSTEM**

Install system where indicated on drawings and according to manufacturer's instructions.

The contractor shall retain a certified manufacturer field technician to observe, supervise and certify all field joints. Contractor shall submit manufacturer’s field technician qualifications for DFD approval prior to testing joint work.

NO FIELD JOINT SHALL BE MADE WITHOUT A FACTORY CERTIFIED TECHNICIAN PRESENT. Field joints that do not meet the manufacturer’s technician’s approval shall be remade until they are satisfactory. Additional labor, materials and manufacturer’s technician time required for additional time and repair to make a satisfactory joint shall be provided with no additional cost to the owner.

Handle all conduits according to manufacturer’s instructions with proper supports and proper rigging materials. Do not use chains or steel cables to handle conduits as damage could occur to jacketing material.

Carrier pipe joining shall be accomplished using an authorized butt fusion welding machine preheated to the correct pipe temperature for fusion welding. All heating surfaces shall be clean and free of dirt and residue before applying to ends of pipe to be joined. After heating, the softened ends are pressed together by the machine and held until the joint has hardened. Improperly accomplished, uneven, or joints with questionable appearance shall be cut out and re-accomplished. Joint review and approval shall be performed by DFD representative. Transitions to other piping materials shall be accomplished using suitable flanged or mechanical adapters. The contractor shall not insulate the carrier pipe until the field connection is tested and passed.

The installer shall then seal the field joint area with heat shrinkable adhesive backed sleeves. After the inner seal is applied the seams shall be covered with Denso butyl 35 tape. Once tapped, the outer seal shall be placed over the inner seal and heated. Once the outer seal is complete the seams shall be covered with Denso butyl 35 tape to complete the field joint.

The entire preinsulated pipe system shall be pressure tested end to end at the completion of the installation, just prior to GPC backfill. Test pressure and duration shall be 80 PSIG for 1 hour.

For daily work stoppage the contractor shall cover each exposed end of installed preinsulated pipe with a manufacturer provided cap. This cap is also known as a hat or boot. The cap shall be bolted on to ensure a watertight seal of the pipe system. This cap shall cover the entire end of the pipe to prevent any water from entering the preinsulated pipe system.

Manufacturer's representative to supervise and approve the installation of the system. Approval to be in the form of a manufacturer's certificate indicating that the installation has been made in accordance with his recommendations; include certificate(s) in the Operating and Maintenance manuals.

Backfilling shall not begin until the heat shrink sleeve has cooled and the seams sealed with tape All insulation and jacketing materials for the field joint shall be furnished by system manufacturer. Denso butyl tape shall be furnished by the MC.

Apply final jacket seal per manufacturers recommendations. Seal shall be free of voids, holes, damage, poor adhesion, or any method for water to pass the seal barrier. Seal shall extend beyond the seam for a minimum of 6 inches in both directions.

Contractor shall take care to always maintain the dry status of the preinsulated pipe.  If the preinsulated pipe becomes wet the contractor shall dry the preinsulated pipe until the certified factory representative is satisfied the system is again dry and will carry the full manufacturer’s warranty.  The contractor shall dry the wet system per the manufactures recommended procedures at no additional cost to the project.

Contractor shall coordinate the placement of the direct bury pipe with the GPC contractor.

Contractor shall be responsible for rigging the pipe sections into place. Rigging shall be in accordance with manufactures guidelines.

Contractor shall order additional field trim for each system as shown below:

|  |  |
| --- | --- |
| System Length | Additional Field Trim |
| <100 Feet | 5 Feet |
| 100-500 Feet | 15 Feet |
| >500 Feet | 20 Feet |

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 33 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01.

\*\*\*END OF SECTION\*\*\*

## State of Wisconsin

**Department of Administration Date**

**Division of Facilities Development Submitted:**

**Project Name:**

**Location: DFD Project No:**

**Contractor:**

 **□ STEAM □ CONDENSATE □ AIR**

##

###  Test Medium: □ Air □ Water □ Other

**Test performed per specification section No.**

**Specified Test Duration \_\_\_\_\_\_ Hours Specified Test Pressure PSIG**

**System Identification:**

### Describe Location:

####  Test Date:

####

#### Start Test Time: Initial Pressure: PSIG

**Stop Test Time: Final Pressure: PSIG**

#### Tested By: Witnessed By:

#### Title: Title:

#### Signed: Signed:

#### Date: Date:

**Comments:**