SECTION 23 22 13.16

**UNDERGROUND HOT WATER HEATING PIPING**

**BASED ON DFD MASTER SPECIFICATION DATED 12/20/2023**

***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 Steam/Condensate/Compressed Air Conduit

PART 3 - EXECUTION

 Preparation

 Welded Conduit Joints

 Steam and Steam Condensate

 Direct Buried Underground Steam/Condensate/Compressed Air Conduit

 Construction Verification Items

**RELATED WORK**

Section 01 91 01– Commissioning Process

Division 3 – Concrete

Division 7 – Thermal and Moisture Protection - Elastomeric Sheet Waterproofing

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, rust and scale, 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 125 psig unless specifically indicated otherwise.

Use only long radius pipe fitting elbows having a centerline radius of 1.5 pipe diameters.

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 steam 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.

Before any metallic welding is performed, the Contractor shall submit his Standard Welding Procedure Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-322.

The Contractor shall maintain a complete set of welder qualification documents at the jobsite, including Test Records and Continuity Records for each welder.

The A/E or DFD reserves the right to test the work of any welder employed on the project, at the Contractor's expense. Testing will include a visual examination of the pipe and weld and may include radiography of any suspect welds. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project. Any welds deemed unacceptable will be repaired at the contractor’s expense.

**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 Themacor, PermaPipe or Approved Equal.

CARRIER PIPE: 4” and smaller:

Heating Hot Water: HDPE Raised temperature (PERT) Rated for continuous service of 180°F at 100 PSIG.

CARRIER PIPE: 5” and Larger:

Shall be HDPE Raised temperature (PERT), conforming to ASTM-3350 SDR-11 wall thickness in standard IPS sizes. Continuous operating temperature up to 180°F at 100 PSIG.

INSULATION:

Insulation shall be 1” of Polyurethane closed cell insulation. 2-3 Lbs/CuFT density. Insulation shall confirm to ASTM C-591. Maximum operating temperature of 250°F

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.

***Only include the following section if you have CA in this preinsulated system***

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.

SUBASSEMBLIES: End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system.

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.

***Only include the following section if you have CA in this preinsulated system***

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.

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 single sleeve system for sealing of the outer conduit and diffusion barrier. The sleeve shall be 36 inchs long. Sleeve shall be Manufactured by CANUSA-CPS and shall have a fully recovered thickness of 90mils minimum and be rated for 176 degrees F. The sleeve shall be 36 inches long minimum. Heat shrink sleeve seal shall meet or exceed EN489 (current version) requirements.

FINAL JACKET SEALING:

The jacket seal shall have all seams sealed with either 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.

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 STEAM/CONDENSATE/COMPRESSED AIR SYSTEM**

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

The contractor shall provide a separate mock up test field joint section. This field joint is intended to be a learning joint. This joint shall be joined, completely tested and jacketed in the field with a certified manufacturer’s field technician observing and instructing the process. Permanent field joints shall not be completed until the manufacturer’s technician approves the contractor’s test joint.

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.

The contractor shall not insulate the carrier pipe until the weld is tested and passed.

Insulation shall then be poured in place into the field joint area. All field-applied insulation shall be placed only in straight sections of pipe. Field insulation of fittings is not acceptable.

Once the outer seal is complete the seams shall be coated with liquid waterproofing membrane or Denso Butyl 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. Refer to section 23 for pressure testing details.

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 the liquid membrane or wrapped with tape All insulation and jacketing materials for the field joint shall be furnished by system manufacturer. Liquid membrane or 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 maintain the dry status of the preinsulated pipe at all times.  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 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: DFDM Project No:**

**Contractor:**

 **□ HVAC □ Refrigeration □ Controls**

##  □ Power Plant □ Plumbing □ Sprinkler

###  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:**