SECTION 33 61 13

**CHILLED WATER AND CONDENSER WATER UTILITIES**

**BASED ON DFD MASTER SPECIFICATION DATED 2/5/2024**

***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 State Facilities expects changes and comments from you.***

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

***A/E to include the following if concrete reinforced cylinder piping is used. This statement shall also be placed on Page A1, Invitation to Bid***

“Notice is hereby given in accordance with Section 16.885(10), Wisconsin Statues, that the Division believes that it is in the best interest of the State to contract for the following equipment from only one source, without the usual statutory procedures so that the equipment is compatible with existing 24” chilled water piping and laying schedules: Thompson Pipe and Precast reinforced cylinder pipe.

**SCOPE**

This section contains specifications for all underground chilled water and condenser water 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

Sleeves and Openings

PART 2 - PRODUCTS

 Direct Buried Underground Chilled Water and Condenser Water

 Valves, Valve Boxes and Pressure Taps

 Condenser Water (Underground gravity return piping)

 Vents and Relief Valves

 Bedding and Backfill

 Locator Tape

 Pipe Insulation

PART 3 - EXECUTION

 Preparation

 Bedding and Utility Cover

 Erection

 Copper Pipe Joints

 Mechanical Joint Pipe Connections

 Push-on Gasketed Joint Connections

 Water Systems

 Direct Buried Underground Chilled Water and Condenser Water

 HDPE Joining Methods

Joint Testing

 Sleeves

 Vents and Relief Valves

 Pipe Insulation

 Locator Tape

 Piping System Flushing

 Pipe Pre-Fill Inspection

 Filling System

 Piping System Leak Tests

 Construction Verification Items

 Piping System Test Report

 Piping System Flushing Report

**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Division 23 – Heating, Ventilating & Air Conditioning (Piping Sections)

23 05 23 – General-Duty Valves for HVAC Piping

23 07 00 – HVAC Insulation

23 25 00 – HVAC Chemical Treatment

31 23 16.13 – Trenching

33 08 00 – Commissioning of Utilities

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

***Edit the following list so only the standards that are needed in your spec are included in it.***

ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

ANSI A21.5 Polyethylene Encasement for Ductile-Iron Pipe and Fittings for Water

ANSI A21.10 Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in, for Water and Other Liquids

ANSI A21.11 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM B75 Seamless Copper Tube

ASTM B88 Seamless Copper Water Tube

ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe and Fittings for Water

AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in, for Water and Other Liquids

AWWA C111 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

AWWA C151 Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids

AWWA C301 Prestressed Concrete Cylinder Pipe

AWWA C301-99 Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type

AWWA M9-Current Edition Manual of Water Supply Practices – Concrete Pressure Pipe

AWWA C304-99 Standard for Design of Prestressed Concrete Cylinder Pipe

AWWA C504 Rubber Seated Butterfly Valves

AWWA C509 Resilient Seated Gate Valves

AWWA C550 Protective Interior Coatings for Valves and Hydrants

AWWA M41 Ductile Iron and Fittings Manual of Water Supply Practices

AWWA C600 Installation of Ductile Iron Water Mains and Appurtenances

**SHOP DRAWINGS**

Refer to division 1, General Conditions, Submittals.

Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

***Use the following paragraphs when the project involves central power plant work. Check with DFD engineering personnel to verify whether these paragraphs are needed on other projects.***

COPPER TUBE:

Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

VAULTS:

Submit manufacturer's preproduction (shop) drawings for any valve manholes or utility vault systems to the engineer for approval prior to the start of manufacturing.

PROJECT CLOSEOUT SUBMITTALS:

Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

Submit piping system test reports.

Submit pressure test logs for all joints tested for concrete pressure pipe.

**QUALITY ASSURANCE**

Order all copper water tube with each length marked with the name or trademark of the manufacturer and type of tube; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; all in accordance with ASTM B88.

Install pre-stressed concrete cylinder piping in accordance with AWWA M9 and Standard Specification for Sewer and Water Construction in Wisconsin.

Install ductile iron piping in accordance with AWWA M41 Ductile Iron and Pipe Fittings Manual of Water Supply Fittings.

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**

Contractor shall be at site the day of delivery to inspect shipments to ensure that the material is undamaged and complies with specifications.

Contractor shall be responsible for the unloading, protection, and manage owner pre-purchased material.

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

Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

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.

Construct all piping for the highest pressures and temperatures in the respective system in accordance with ASME B31, unless specifically indicated otherwise.

Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

**SLEEVES AND OPENINGS**

Refer to Division 1, General Requirements, Sleeves and Openings

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

***The following specifications are based on "normal" systems where the design system pressures for chilled water does not exceed 175 psig. If a specific application requires design pressures/temperatures beyond these limits (central plants or extensions from central plants, for example), contact DFD engineering personnel for assistance.***

##### DIRECT BURIED UNDERGROUND CHILLED WATER AND CONDENSER WATER

AIR VENT AND DRAINPIPE:3" and Smaller: Type K copper water tube, O (annealed) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast copper flared pressure fittings, ANSI B16.26.

6" to 36” Diameter:

Ductile iron pipe, mechanical joint, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical joint or fully restrained mechanical joint cement mortar lined compact fittings, Class 350, AWWA C153; rubber gasket joints with non-toxic gasket lubricant, AWWA C111. Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105. US Pipe (TR Flex or HDSS), McWane Ductile (TR Flex), ACIPCO (Flex-Ring). Grip type gasket restraint systems are not allowed. Rigid continuous mechanically restrained systems are not allowed.

***Where corrosive soil conditions exist, PVC or HDPE should be specified exclusively. These include highly alkaline soils, high salt (deicing) concentrations, cinder fills, waste dumps, peat bogs and swamps.***

 ***Evaluation of soil corrosivity for Ductile Iron pipe is described in detail in APPENDIX A of AWWA C105 Standard. The test method evaluates eight parameters: 1) resistivity, 2) pH, 3) redox (oxidation-reduction) potential, 4) sulfides, 5) moisture content, 6) soil description, 7) potential for stray current, and 8) experience with existing installations in the area.***

***Do not specify PVC or HDPE where ground is suspected of contamination by petroleum products or organic solvents.***

PVC pressure pipe, DR 18, Class 150, AWWA C900 and C905; with integral bell and elastomeric gaskets, ASTM D3139. Fittings and fitting polyethylene encasement to be same as noted above for ductile iron.

***NOTE: DO NOT design new CHWS systems with PVC pipe.***

Underground to Interior Building Entrance Piping: Ductile iron as specified above with factory threaded and machined flanges.

***NOTE: Engineer to discuss PCCP pipe with DFD PM PRIOR to design.***

 ***PCCP pipe is discouraged only use when required.***

36” and larger:

PRESTRESSED CONCRETE CYLINDER PIPE

Manufacturer: Thompson Pipe Group or approved equal.

AWWA C301, 200 psig working pressure, 80 psig surge pressure, 200 psig test pressure. Prestressed pipe shall be designed in accordance with the AWWA C304 standard. Bedding type to use for pipe design shall be Type R3 (150 Olander bedding support angle) as detailed in the AWWA M9 Manual. The unit soil density shall be 120 pounds per cubic foot. Unless otherwise specified, an AASHTO HS20 truck live load shall be considered in the pipe design. Standard lengths shall be 20 feet.

Fittings and Special Sections: AWWA C301 and AWWA M9 Manual. Provide special sections (closures, reducers, tees, shorts, elbows) as required to fit space requirements, facilitate construction sequence and plan profile and layout.

Provide dished bulkheads for testing or provide valves with flanges on end or piping.

Joints: Bell and spigot double rubber-o-ring gasket, each joint individually testable (“quick test joint”), cement-mortar grout joint. Each quick test joint shall bear an identification number for documentation purposes during field inspections. Flanged joints (FJ) to mate with flanged valves: Flange to mate with Class 250B underground valve. Coat steel flanges and mechanical joints with bitumastic coating. The installing Contractor shall coordinate between his flanged valve supplier and the flanged adapter fitting manufacturer to insure that the flanges will mate properly in the field. The exterior recesses of all restrained and non-restrained bell and spigot joints on prestressed pipe and fittings shall be filled with a portland cement grout immediately after installation. A foam-lined grout band, supplied by the pipe manufacturer, shall be provided for each unit as well as joint lubricant suitable for underwater conditions.

Prestressed Concrete Cylinder Pipe manufacturers be limited to "made in U.S.A. only".

THRUST RESTRAINTS FOR CONCRETE CYLINDER PIPE:

For concrete cylinder pipe provide, Snap Ring restrained joints, harness clamp restrained joints, or field welded joints where required by manufacturers Engineer. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it’s applied to.

##### HDPE 6 INCH AND LARGER

HDPE Pipe:The pipe and fittings shall meet the requirements of AWWA C906.

HDPE pipe shall be rated for use at a pressure class of 200 psi. The outside diameter of the pipe shall be based upon the IPS or DIPS sizing system.

HDPE pipe shall have the equivalent interior diameter of DI pipe design sizing.

***NOTE: If project is designed for HDPE ONLY remove the above sentence. If designed for DI with HDPE alternate, keep the above sentence.***

FITTINGS:

Butt Fusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE4710 or higher. Butt Fusion Fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All fittings shall meet the requirements of the most current AWWA C906 standard.

Markings for molded fittings shall comply with the requirements of ASTM D 3261. Fabricated fittings shall be marked in accordance with ASTM F 2206. Socket fittings shall meet ASTM D 2683.

Electrofusion Fittings - Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 or higher. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F 1055.

Flanges and Mechanical Joint Adapters (MJ Adapters) – Flanges and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher. Flanged and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206. Flanges and MJ Adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans. Markings for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261. Fabricated (including machined) flange adapters shall be per ASTM F 2206.

Van-Stone style, metallic back up rings shall be stainless steel, convoluted or flat-plate, back-up rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt-holes and bolt-circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C207 Class 150 Series B, D, or E. The back-up ring shall provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the back-up ring. The back-up ring, bolts, and nuts shall be protected from corrosion by a system such as paint, coal-tar epoxy, galvanization, polyether or polyester fusion bonded epoxy coatings, anodes, or cathodic protection, as specified by the project engineer.

Service connections shall be electrofusion saddles with a brass or stainless steel threaded outlet, electrofusion saddles, sidewall fusion branch saddles, tapping tees, or mechanical saddles.

For electrofusion saddles with threaded outlet the size of the outlet shall be one inch IPS unless a larger size is shown on the plans. Electrofusion saddles shall be made from materials required in part B. Electrofusion Fittings. For sidewall fusion saddles the size of the saddle shall be as indicated on the plans. The saddle can be made in accordance to ASTM D 3261 or ASTM F 2206. After installation, approximately ¼” of the PE pipe shall be visible beyond the saddle to confirm that proper surface preparation occurred. Saddle faces that do not provided ¼ inch of area beyond the saddle are not acceptable. Tapping tees shall be made to ASTM D3261 or D2683. Mechanical strap-on saddles can only be used where there use on PE pipe is approved by the mechanical saddle manufacturer. The body of the saddle shall be stainless steel, epoxy coated cast iron or brass. The gasket material and design must be acceptable for PE pipe. The outlet shall be threaded for one inch IPS unless a larger size is shown on the plans. Mechanical strap-on saddles will be installed per the manufacturer’s instructions.

**BEDDING AND UTILITY COVER**

See Section 31 23 16.13 – Trenching.

**BUTTERFLY VALVES:**

***A/E TO COORDINATE SELECTION PRESSURE RATING OF PIPING AND VALVE FLANGES WITH EACH FACILITY***

 ***[Note to the designer: specify the same make and model as used by the owner institution unless they are experiencing problems. Otherwise use the following specification. Verify pressure class with the institution, SOME locations with low working pressures may qualify for class 150B valves check with DFD engineer before specifying class 150B valves]***

***6” Is the minimum size for CHW distribution valves.***

6” thru 48”: Class 250B: Pratt HP (Groundhog), Keystone Dubex RMI , Mueller Line Seal XPII, or approved equal. Valve shall be: cast iron body; Disc: cast iron ASTM A-126B or ductile iron ASTM A-536 stainless steel shaft ASTM-564, Teflon, nylatron or acetate, bearings, Buna-N resilient seat. Disc with 316 stainless steel seat. Valve shall be leak tested in the closed position to 250 psi. Submit factory test data sheet with valve at shipment. Construct in accordance with AWWA-C504 for Class 250 B service. Valve interior and exterior surfaces coated with 8 mill thick epoxy coating in accordance with AWWA C504. Valves shall have MJ configuration, flanged valves are not allowed without written DFD approval.

***NOTE: valves over 48” only come with flanged connections. For those valves insert the following:***

Valves shall be flanged, Class 250B, ANSI B16.1. Provide flange bolts and nuts, two sets per valve.

Provide ASTM A307, Grade B7 bolts, with nuts conforming to ASTM A207. Nuts, bolts, studs, washers shall be 316 SS. Coat bolts with Never-Seez lubricating compound.

Threaded rods are not allowed.

**CHILLED WATER BUILDING ENTRANCE:**

Chilled Water Building Entrance Valves are defined as the first set of valves entering a building (Buildings with multiple service entrance pipes may have multiple Building Entrance valves) . These valves are intended to isolate the building from the distribution system.

3” and larger: Lug style, ASME class 150, ASTM 216 GR WCB (Carbon Steel) body that meets API 598 bi-directional bubble tight. Blowout proof stainless steel stem, stainless steel disc. Valve seat shall be resilient, renewable, have the seat retaining ring bolted to valve body. Bray Series 40, DeZurik BHP, Xomox Tufline, Keystone K-Lok Jamesbury Wafersphere or Cameron WKM.

Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.

Use threaded lug type valves for installation with class 125/150 flanges.

Provide ten-position lever actuators for valves 6" and smaller. Provide worm gear operators for valves 8" and larger.

Where butterfly valves are indicated or specified to be installed at the location of a flow sensing device, provide the butterfly valves with a memory stop.

GASKET:

PTFE, 250 psi rated gasket. Gore Series 800 Gasket or approved equal.

**VALVE BOXES:**

Provide buried service actuator for underground valves with worm gear operator. Valve box bell section shall sit on a stabilizer, BFVA from Adaptor Inc, Bingham & Taylor Buffalo box or approved equal.

Valve shall open by turning operating nut counter clockwise.

Valve boxes shall have removeable debris cap.

Valve boxes shall have a minimum 3.5” diameter metal (non-corrosive) Identification tag set flush in the concrete around the valve box. The tag shall identify the service, i.e. CHWS or CHWR and pipe size and have a unique valve number emblazoned on the tag. Letters shall be minimum 1” high. Berntsen International C35DB or approved equal.

Valve boxes shall have valve extension stems where the valve nut has more than 5 feet of bury depth. Stems shall be 1” minimum diameter solid metal and be removable from grade. Stems shall have standard 2” AWWA nuts. Stems shall be painted with corrosion resisting paint.

CHILLED WATER BALL VALVES (DRAINS):

2” and smaller: Two-piece bronze body; Class 600 WOG, threaded or soldered ends, as appropriate to the pipe material; solid stainless steel ball and stem. Chrome plated Stem and Ball are not acceptable. Full port; glass filled Teflon seat; threaded packing. Provide valve stem extension.

CORPORATION STOP VALVES (AIR VENTS):

2” and smaller: Bronze body ground hey valve, bronze plug, AWWA taper thread inlet and copper flare outlet nut connections, AWWA C8000. Ford, Mueller or A.Y. McDonald.

Make pressure taps with tapping sleeve and valve and with sleeve the size of the existing pipe. Provide valve the same size as the new pipe.

**CONDENSER WATER (Underground gravity return piping)**

10" and Smaller: Cast iron soil pipe and fittings, service weight (SV), coated, ASTM A74. Joints to be rubber gasket, ASTM C564.

**VENTS AND RELIEF VALVES**

Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

Automatic Air Vents: Val Matic Model 38 or approved equal. Maximum working pressure 300 psi, compound lever type, 1” inlet, ½” outlet, compound lever type, stainless steel trim and float, cast iron body and cover.

**LOCATOR TAPE**

***(Note to the designer: certain installations may warrant the use of a locator (either metallic or non-metallic) tape to facilitate finding the buried water piping again in the future for additional connections, to undertake repairs, or to warn operators if the pipe if it is likely to be in the area of future excavation. In installations were there are few or no valve boxes, or the alignment, between valve boxes is not straight, a locator tape should be used. Use metallic detectable tape where it is necessary to relocate the pipe after initial installation. Use non-metallic tape where it is intended only to alert excavators of the pipe's presence.)***

Provide [metallic detectable/non-metallic] locator tape, at minimum 6 inch width; meet APWA color code requirements for the type of material being conveyed in the pipeline (blue for water systems); with the legend "CAUTION: Buried Water Line Below"; suitable for underground use.

Non-metallic tape: EMMED, Co., Inc. Underground Warning Tape # UT27743-6; THOR Enterprises, Inc., ShieldTec; Marking Services, Inc., Underground Warning Tape # 52206; Carlton Industries, Inc. # 1667-6" standard; D & G Sign and Label Co., # 40406; Seton Name Plate Co., Marking Tape # 210 WAT; or approved equal.

Metallic and detectable tape: minimum of 6 inches wide, designed for 12" bury; THOR Enterprises, Inc., MagnaTec; Marking Services, Inc., Underground Warning Tape # 52219; Carlton Industries, Inc. # 1667DT6; D & G Sign and Label Co., # 40412; Seton Name Plate Co., Detection Tape # 6 WAT; or approved equal.

**PIPE INSULATION**

Provide piping insulation per Section 33 07 00.

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

**PREPARATION**

Remove all foreign material from interior and exterior of pipe and fittings.

Excavate trench in accordance with the applicable requirements of Section 31 23 16.13 – Trenching for utilities.

**BEDDING AND UTILITY cover**

See Section 31 23 16.13 – Trenching.

**ERECTION**

Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces.

Provide anchors, expansion joints, expansion loops, or mechanical joints with elastomeric elements so that piping may expand and contract without damage to itself, connecting building system.

***See comment on expansion provisions in Section 23 05 15.***

Install drains throughout the systems to permit complete drainage.

Do not route piping through or above electrical equipment vaults, sub-grade switchgear rooms, or panelboards, including the required service space for this equipment, unless the piping is serving this equipment

***This requirement is based on NFPA 70-, 384-4 and 450-47.***

Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

**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 95-5 solder or brazing to secure joint as specified for the specific piping service.

Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

**Mechanical Joint Pipe Connections**

Comply with AWWA C600/C605 installation requirements and manufactures recommended installation procedures.

**EXISTING PIPE CONNECTIONS**

Where new pipe is connecting to existing pipe tapping saddles are not allowed. 4” and larger taps shall have a line size tee cut into the existing pipe then reducing down to the required pipe size.

**Push-on Gasketed Joint Connections**

Not Allowed.

**AIR VENTS**

Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

##### DIRECT BURIED UNDERGROUND CHILLED WATER AND CONDENSER WATER

Excavate to bottom of pipe bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface. Undercut the trench bottom as previously stated, and replace the undercut material with crushed stone chips where unstable soils or foundations exist in the bottom of the sewer trench

Tunnel or remove sidewalk and curb in areas of excavation to the nearest joint. Remove pavements, curbs and gutters to neat and straight lines to the limits of removal. Make sawcut lines parallel to existing joints, or parallel or perpendicular to pavement edges to form a neat patch. Carefully remove remaining pavement within the saw cut area. Leave existing base materials between the area disturbed by the work and the saw cut line undisturbed by the saw cutting, pavement removal, or pavement replacement processes.

Strip topsoil from area to be excavated, free from subsoil and debris, and store for later respreading.

At no time place excavated materials where they will impede surface drainage unless such drainage is being safely rerouted away from the excavation. Remove surplus excavated materials from site.

Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, valve pits and other work. Remove debris and rubbish from excavations before placing bedding and backfill material.

Provide shoring, sheet piling and bracing in conformance with the Wisconsin Administrative Code to prevent earth from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. Obtain general permit from the Wisconsin Department of Natural Resources district office for discharge of construction dewatering effluent. Obtain well permit from the Wisconsin Department of Natural Resources district office for dewatering wells discharging more than 70 GPM. Comply with permit requirements.

Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 1/2 cubic yard or more in volume.

Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base Bid.

Verify the locations of any water, drainage, gas, sewer, electric, telephone or steam lines which may be encountered in the excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of the excavation and cap.

Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits, trenches, and the entire subgrade area safe under all circumstances, at all times. No excavation shall be left unattended without adequate protection.

Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. (See Section 31 23 19 Dewatering)

Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on the plans.

Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.

Pipe shall not be laid in water and shall be protected from water until joints have been inspected and utility cover is a minimum 2-foot above the top of pipe.

Install temporary night pipe plugs to prevent the entrance of storm runoff, dirt, debris, and emergency use. Temporary plugs shall be installed at the end of each working day.

Install all piping, joints and fittings in accordance with the applicable standards and manufacturer’s instructions for the type of material and the installation situation (e.g. install mechanical joint pipe in accordance with AWWA C600, Install concrete pressure pipe and fittings in accordance with AWWA M9)

Install pipe to allow for expansion and contraction without stressing piping or joints.

Slope pipe and position drains at low points and vents at high points.

Do not use any pipe or fittings cracked or damaged in cutting or handling or otherwise not free from defects.

*A/E TO COORDINATE THE FLANGE RATINGS (CLASS) AND SELECTION OF PIPING AND VALVE FLANGES INSIDE BUILDING, TUNNELS AND VAULTS.*

All general contractor provided piping shall terminate inside at building, utility tunnel or vault with a class **[**250/125**]**, ANSI B16.1 flange.

Coat all flange bolts with Never-Seez lubricating compound.

The exterior recesses of all restrained and non-restrained bell and spigot joints on pre-stressed concrete cylinder pipe and fittings shall be filed with a Portland cement grout immediately after installation. The foam-lined grout band, supplied by the manufacturer, shall be positioned around and centered on the joint. This band shall be filled with a grout mix using one part Portland cement (ASTM C250 Type 1 or Type 2) to not more than three parts clean sand with sufficient water to achieve a pourable consistency. A stiffer mix of grout shall be applied to the immediate top of the joint to insure complete coverage of all exposed steel.

Install vents, vent piping, valves, and sleeves as indicated on plans.

Install sleeves, as indicated on plans.

Clean all pipe of any dirt and/or debris inside and out prior to wrapping with polyethylene wrap. Make joints in accordance with manufacturer's directions with due care to avoid damaging pipe and/or disturbing previously laid pipe.

Cut pipe only according to manufacturer's directions.

Cut polyethylene wrap approximately 2 feet longer than length of pipe section. Place pipe and carefully wrap in the trench on a compacted bed of sand or crushed stone. After assembling pipe joint, overlap polyethylene wrap approximately 1 foot and securely tape all joints, tears, and the pipe at 3 foot intervals. Wrap and tape all copper pipe connections for a distance of not less than 3 feet from the centerline of the water main. For fittings and valves, split the polyethylene wrapping tube and securely tape the flat piece in place.

Bed the pipe so as to not tear the polyethylene wrap.

***A/E to only include this section with consent from PM, thrust bock restraint is undesirable.***

THRUST RESTRAINT:

Securely block and wedge all bends, cap, plug, each joint and fittings, for piping systems 4” and larger, to solid undisturbed earth with approved precast or cast-in-place concrete thrust blocks. Secure with pipe Mechanical restraints (EBAA Iron Megalug, or approved equal) in accordance with AWWA C600 Section 3.8. for a minimum length of 40 feet, or to the next restrained fitting or bend, all bends and fittings that cannot be blocked.

Lay all pipes to line and grade shown on the plans with bell ends up hill. Lay with minimum [\_\_\_\_] feet of cover ***(note to the designer: do not specify less than six (6) feet of cover*** where there is no grade given for the water main on the plan sheets. Keep ends of the water lines sealed at all times to prevent the entrance of animals or foreign materials.

Where two (2) pipes are laid in the same trench, maintain a minimum spacing of one (1) foot between pipes. Provide clearances of not less than 8 feet horizontally and 18 inches vertically with the watermain under the sewer, and 6 inches vertically with the watermain over the sewer.

Bed piping and cover up to a point 12" inches above the top of the pipe with thoroughly compacted sand or pea gravel. Take care during bedding, compaction and backfill not to disturb or damage piping. Backfill above the bedding in lawn areas shall be thoroughly compacted excavated material free of large stones, organic, perishable, and frozen materials. Backfill above the bedding under existing and future utilities, paving, sidewalks, curbs, roads and buildings shall be granular materials, pit run sand, gravel, or crushed stone, free from large stones, organic, perishable, and frozen materials.

Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24" compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under pavements, curbs, walks and structures are not to exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90% density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction equipment contacts all areas of the surface of the lift.

Do not leave more than 100 feet of trench open without backfill above the bedding at any time. Backfill all trenches completely, or provide safety barrier fencing at the end of each work day.

Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

**HDPE JOINING METHODS**

SADDLE FUSION: Saddle fusion shall be done in accordance with ASTM F 2620 or TR-41 or the fitting manufacturer’s recommendations and PPI TR-41. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on this project. [Saddle fusion is used to fuse branch saddles, tapping tees, and other HDPE constructs onto the wall of the main pipe] (ASTM F905).

SOCKET FUSION: Molded socket fusion fittings are only to be used for joining of HDPE pipe from 1/2 inch to 2” in size. Socket fusion shall be done in accordance with ASTM F 2620 or the fitting manufacturer’s recommendations. Socket fusion is the process of fusing pipe to pipe, or pipe to fitting by the use of a male and female end that are heated simultaneously, and pressed together so the outside wall of the male end is fused to the inside wall of the female end. Qualification of the fusion technician shall be demonstrated by evidence of socket fusion training within the past year on the equipment to be utilized on this project. [Socket fusion is not widely used, and the specifier may decide to prohibit its use]

ELECTROFUSION: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence of

electrofusion training within the past year on the equipment to be utilized for this project.

MECHANICAL: Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, material type transition adapters (i.e. HDPE to DI) and fittings shall use mechanical joint adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.

 - Mechanical connections on small pipe under 3” are available to connect HDPE pipe to other HDPE pipe, or a fitting, or to a transition to another material. The use of stab-fit style couplings is allowed, along with the use of metallic couplings of brass and other materials. All mechanical and compression fittings shall be recommended by the manufacturer for potable water use. When a compression type or mechanical type of coupling is used, the use of a rigid tubular insert stiffener inside the end of the pipe is recommended.

 - Mechanical couplings that wrap around the pipe and act as saddles are made by several manufacturers specifically for HDPE pipe. All such saddles, tapping saddles, couplings, clamps etc. shall be recommended by the manufacturer as being designed for use with HDPE pipe at the pressure class listed in this section.

 - Unless specified by the fitting manufacturer, a restraint harness or concrete anchor is recommended with mechanical couplings to prevent pullout.

 - Mechanical coupling shall be made by qualified technicians. Qualification of the field technician shall be demonstrated by evidence of mechanical coupling training within the past year. This training shall be on the equipment and pipe components to be utilized for this project.

JOINT RECORDING: The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded either manually or by an electronic data logging device. All fusion joint data shall be included in the Fusion Technician’s joint report.

Buried HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.

Embedment material should be Class I, Class II, or Class III , materials as defined by ASTM D-2321 Section 6. The use of Class IV and Class V materials is not recommended, however it may be used only with the approval of the engineer and appropriate compaction.

Pipe bedding shall be in conformance with ASTM D2321 Section 8. Compaction rates should be as specified in ASTM 2331.

Hydrostatic leakage testing is recommended and shall comply with ASTM F 2164, ASTM F 1412, AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2.

Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

LAWN WORK:

See Division 32 – Plantings – Seed or Sod.

CONCRETE CURB AND GUTTER WORK:

See Division 3 – Concrete

***Add the following section ONLY if using PCCP***

**PCCP JOINT TESTING**

Manufacturer’s “Quick Test” connections for all pre-stressed concrete cylinder pipe field joints.

For concrete cylinder pipe with testable joints perform the following:

* Inspect each length of pipe
* Test each joint with 50 psig of compressed air
* Maintain a written log of all tests, including date of test, name of tester, air test pressure, length of test
* Install plugs on test ports
* Contractor shall have a written confined space entry protocol on site at all times.
* All personnel shall wear self-contained air testing equipment.
* Contractor shall provide a written report of the inspection of the interior of the piping. The report shall include inspection of each length of pipe and each joint as described in the laying schedule. Include name and signature of person performing the test.

Turn logs over to construction representative.

**SLEEVES**

Pipe sleeves in new poured concrete construction shall be cast - in -place, schedule 40 hot dip galvanized steel pipe (sized to allow insulated pipe to run through sleeve unless otherwise noted. Provide a modular wall and casing sleeve with 316 stainless steel bolts and nuts.

**VENTS AND RELIEF VALVES**

Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item.

Brass nipples shall be used only, steel nipples are not permitted.

**VALVES**

Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve. Valves shall be plumb and square to the pipe system. Valves shall be wrapped in polyethylene wrap.

**VALVE BOXES**

Install valve boxes as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. Valve boxes shall be square and plumb to the pipe system.

Valve boxes shall be adjusted to have the valve box elevation match finished grade.

Valve box extension stems shall be installed so the valve nut is no more than 5 feet below grade. The riser stem shall be removeable from finished grade (no set screw on the valve nut).

Valve box stabilizers shall be set to ensure no material can migrate from backfilling around the valve nut.

Extensions shall raise the valve nut to 4 feet below grade.

**PIPE INSULATION**

Where the insulation of pipelines is called for on the plans, or is ordered by the Construction Representative, install insulation in accordance with specification section 33 07 00.

**LOCATOR TAPE**

Install pipeline locator tape directly over pipeline, and 12" below finished grade or the bottom of any pavement base course.

**PIPING SYSTEM flushing**

Flush all sections of underground chilled water and condenser water piping. When possible, utilize hydrants or other large diameter orifices to complete flushing and achieve 2.5 fps water velocity. If needed, utilize services or temporary connections to complete flushing.

If a fire hydrant is used as the source of water, Contractor shall contact ***<insert Municipal Water Utility contact or Facility contact or Physical Plant contact name and phone>*** to obtain a hydrant connector with backflow prevention. Hydrants shall only be operated in a manner to prevent damage to the hydrant and the surrounding area. Hydrants shall not be operated in a partially open condition as this will damage the valve and cause leakage.

***Verify ownership of the fire hydrants on the route of the chilled water and whether the owner will allow the contractor to operate the hydrants. Verify that municipality or institution staff has hydrant connectors with backflow prevention available for contractors.***

All chilled water and condenser water piping shall be flushed for a minimum of 10 minutes, or as necessary to obtain a sediment-free sample.

Utilize diffusers, hoses, settling basins, flocculent bags and other devices as necessary to prevent erosion and other damage to the site and downstream areas. Water may discharge to the storm sewer after sediment has settled out or is no longer visible in the flowing water.

Contractor shall be responsible for providing all necessary fittings, valves, joint restraints, hydrants and other materials necessary to conduct flushing.

If flushing is not practical, the contractor shall sewer jet clean and video record the pipe. The pipe shall be cleaned until it is free of debris.

Submit reports documenting flushing.

**PIPE PRE-FILL INSPECTION**

Prior to filling system a final physical inspection of new pipe over 30” in diameter shall be performed to assure the following:

* Pipe cleanliness.
* Determine if there are any observed leaks.
* Confirm all quick test plugs have been filled.
* Assure there are no significant cracks or damage to internal pipe lining.
* Entrance points for inspection shall be at the ends and branch connections prior to closing of pipe system.
* Inspection shall be performed by a representative of the pipe manufacturer.
* Contractor shall have a written confined space entry protocol on site at all times.
* This contractor shall allow access to piping and provide fans for ventilation of the pipe during this inspection.
* All personnel shall wear self-contained air testing equipment.
* Correction of any deficiencies found in this contractor’s work during the inspection shall be the responsibility of this contractor.
* Contractor shall provide a written report of the inspection of the interior of the piping. The report shall include inspection of each length of pipe and each joint as described in the laying schedule.

**FILLING SYSTEM**

Notify Owner system is ready for filling.

Owner will provide water to fill system from the central plant.

Contractor shall open all isolation valves prior to filling system.

Contractor shall provide all venting of system during filling.

Provide final inspection and repair any leaks which are observed on pipe sections after system is filled to “system fill pressure”. (Approximately 70 psig).

**PIPING SYSTEM LEAK TESTS**

Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

Provide all piping, fittings, blind flanges, and equipment to perform the testing.

Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are detected for fusion bonded piping or leakage rate is greater than calculated below for mechanical joints, repair the area with new materials and repeat the test; caulking will not be acceptable.

Do not insulate pipe until it has been successfully tested.

For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

***Revise the following test pressure upward if necessary for the specific project. Test pressure for chilled water piping connected to the UW-Madison underground distribution system to be 200 psig.***

***Consultant must verify that all system components have been designed for these test pressures; contact DFD engineering personnel if there are questions.***

System Pressure Medium Duration

Direct Buried Underground Chilled Water\*\* 150 psig Water 2 hr

Direct Buried Underground Chilled Water\*\*\* 200 psig Water 2 hr

Condenser water 150 psig Water 8 hr

Condenser water (underground pressure pipe) 150 psig Water 8 hr

***\*\*Verify operating system pressure with DFD and specify test pressure accordingly. Several state agencies have systems that operate at higher pressures and require test pressures in excess of that scheduled above.***

***\*\*\*Alternate for Heating and Cooling Facility Distribution***

Test pressure shall not vary more than 5 psig during duration of test

All pressure tests are to be documented on a Division of State Facilities form included in this specification.

On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

LEAKAGE AND PRESSURE TESTING:

All piping systems shall be hydrostatic pressure and leak tested in the presence of the Construction Representative at: pressure from the above table, or twice the normal operating pressure, whichever is greater for the period as noted above. All necessary testing equipment shall be furnished by the Contractor. The contractor shall repair and/or replace any defective watermain pipe or fittings, and repair any breaks which may occur during or as a result of the test. Testing shall be in accordance with AWWA C600 and AWWA M41.

DI and PCCP pipe shall use the McWane double bump test procedure.

***If using HDPE use this pressure test note.***

*HDPE shall use a straight test pressure (no double bump in pressure) for the 2 hour time frame. The HDPE test shall have the same three pressurize and fill events the same as DI. The only difference is HDPE pipe test will not increase in pressure.*

MCWANE DOUBLE BUMP TEST PROCEDURE:

Fill and vent the pipe.

Increase the pressure to set point (i.e. 200 PSIG) from the table above.

Let pipe set for 30 minutes.

Repressureize pipe to initial set point, measure and record the amount of water required to get to set point (i.e. 200 PSIG).

Increase pressure by 50 PSIG (i.e. 250 PSIG), let pipe set for 30 minutes.

Repressurize pipe to second set point, measure and record the amount of water required to get to set point (i.e. 250 PSIG).

Increase Pressure by 50 PSIG (i.e.300 PSIG), let pipe set for 30 minutes.

Repressurize pipe to second set point, measure and record the amount of water required to get to set point (i.e. 300 PSIG).

If water volume required to restore the set point pressure is equal or less than in the previous test the system is tight, and no water is leaking. If the amount of water required to restore the set point pressure of the pipe is increasing. the pipe is leaking and shall be repaired. Once the system is repaired, repeat the test procedure until the system is watertight. Additional testing shall be performed at no additional cost to the project.

# CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

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

## PIPING SYSTEM TESTING REPORT

## State of Wisconsin

**Department of Administration Date**

**Division of State Facilities Submitted:**

**Project Name:**

**Location: DFD 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:**

**PIPING SYSTEM FLUSHING REPORT**

## State of Wisconsin

**Department of Administration Date**

**Division of State Facilities Submitted**:

**Project Name:**

**Location: DFD Project No:**

**Contractor:**

**System Identification (check one):**

**❒ Chilled Water**

**❒ Condenser Water ❒ Other**

**Describe procedure:**

**Flush Date:**   **Start Time:**   **Stop Time:**

**Pressure of Water Source:**  **PSIG Describe water source and method of connection to source: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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#### Flushed By: Witnessed By:

#### Title: Title:

#### Company: Agency:

#### Signed: Signed:

#### Date: Date:

**Describe results:**