



WMU Design Guidelines Instructions: These guidelines are to be used by the Design Professional to inform the design process and outline WMU-specific desires for all University projects. These guidelines have been edited to reflect WMU preferences, and the intent is for the Design Professional to use this information to guide their normal specifications-writing process. Straying from what is indicated in the guidelines is not prohibited, but shall be discussed with WMU during the development of the project.

SECTION 33 6313 - UNDERGROUND STEAM AND CONDENSATE DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes underground piping outside the building for distribution of steam and condensate.
- B. Section includes underground precast concrete utility vaults.

1.2 DEFINITIONS

- A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.
- B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing steam piping systems with the following minimum working-pressure ratings:
 - 1. Steam Piping: 150 psig.
 - 2. Steam Piping: 250 psig.
 - 3. Condensate Piping: 150 psig
 - 4. Condensate Piping: 250 psig.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Underground steam and condensate conduit piping system.
 - 2. Underground precast concrete vault and manhole covers.
 - 3. Loose-fill insulation.
- B. Shop Drawings: For underground steam and condensate distribution piping. Signed and sealed by a qualified professional engineer.
 - 1. Calculate requirements for expansion compensation for underground piping.



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2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
3. Show pipe sizes, locations, and elevations. Show piping in trench with details showing clearances between piping, and show insulation thickness.
4. Installing Contractor shall excavate and field verify all indicated utility crossings prior to shop drawing approval.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from steam distribution piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing steam distribution piping.
- C. As-Built Drawings: Provide as-built drawings for underground piping in accordance with Division 1 requirements.
- D. Qualification Data: For qualified Installer.
- E. Welding certificates.
- F. Material Test Reports: For conduit piping.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- B. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31.9, "Building Services Piping and ASME B31.1, "Power Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping and ASME B31.1, "Power Piping," for materials, products, and installation.
- D. ASME Compliance: Safety valves and pressure vessels shall bear appropriate ASME labels.



1.7 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
 - 2. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <Insert **number**> days in advance of proposed interruption of utility.
 - 3. Do not proceed with interruption of utility without Owner's written permission.
 - 4. Do not proceed with interruption of utility without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

1.8 COORDINATION

- A. Coordinate pipe-fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 STEEL PIPES AND FITTINGS

2.2 FIBERGLASS PIPE AND FITTINGS

2.3 STEAM AND CONDENSATE CONDUIT PIPING SYSTEM

- A. Conduit Piping System: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.
 - 1. Manufacturers:
 - a. Perma-Pipe, Inc. Model Multi-Therm 750 Supreme.
 - b. Thermacore
 - c. Rovanco
- B. Carrier Pipe: 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.
- C. Carrier Pipe Insulation: Service pipe insulation shall be Pyrogel XT, a high temperature insulation blanket formed of silica aerogel and reinforced with a non-woven, glass-fiber batting. The insulation shall be held in place by stainless steel bands or staples installed not more than 18 inches apart.



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- D. Sub-Assemblies: 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.
- E. Pipe Supports: All outer conduits shall be supported to allow for continuous drainage of the conduit in place. Supports shall be the type where Pyrogel XT 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.
- F. Outer Conduit: Smooth wall, welded steel conduit of the thicknesses specified below:

<u>Conduit Size</u>	<u>Conduit Thickness</u>
6"-26"	10 Gauge

- G. Outer Conduit Coating: The exterior steel conduit surface shall be cleaned coated with Epoxy.
- H. Outer Conduit Coating: The exterior steel conduit surface shall be cleaned coated with [**Epoxy**][**Urethane Elastomer**][**Zinc**].
 1. The epoxy coating shall be a two part coating consisting of a base material and curing agent. The coated conduit shall be holiday tested at 1,000 volts to ensure a void free coating. Areas of the conduit not passing the holiday test shall be patch coated and retested.
 2. [**The urethane elastomer coating**] shall be a sprayable two component, aromatic, corrosion protection elastomeric coating. The coated conduit shall be holiday tested at 2,500 volts to ensure a void free coating. Areas of the conduit not passing the holiday test shall be patch coated and retested.
 3. [**The zinc coating**] shall be a high solids inorganic zinc rich coating that protects the steel galvanically. The zinc coating shall be a two part sprayable coating consisting of a liquid base portion and a dry powdered metal. The two components when mixed together can be spray applied. The dry film thickness shall be in a range of 2 to 4 mils.
- I. 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 fiberglass reinforced polymer (FRP) and shall be applied directly onto the urethane foam insulation. PVC or polyethylene jacket shall be allowed as an acceptable alternate. All straights and fittings shall be factory jacketed.
- J. 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 corona treated to guarantee bonding between the foam insulation and the outer jacket.
- K. Source Quality Control: Factory test the conduit to 15 psig for a minimum of two minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.



2.4 PRECAST CONCRETE UTILITY VAULTS:

- A. Precast Concrete Utility Vault: Shall be a 5000psi precast concrete design with reinforcement suitable to achieve AASHTO H-20 Traffic Rating for use recommendations for use under roadways. Walls shall be a minimum of 8" thick with suitable reinforcement and cored for each pipe penetration as required. Precast concrete lid shall be reinforced and supplied with a riser and two (2) 32" manholes cover equal to East Jordan 1040 frame with Type A solid cover. Any preformed joint shall have supplied and installed butyl rubber gasket such as Pro-Stik meeting all requirements of ASTM C-990 and AASHTO M-198. Exterior shall be coated with a minimum of 60 mils asphaltic coating. Vault shall be watertight design and installed per the precast concrete producer's recommendations. All piping penetrations shall have Link Seal assemblies installed, and all penetrations sealed watertight with a Carlisle membrane and AzoGrout 552 injection around all pipe penetrations.
- a. Vault shall be provided with recessed drainage sump 2' deep at a minimum area of 24" diameter. Provide with EJIW 6006 grate top, and 1 CYD of peastone.
 - b. EJIW cover shall be 1480A with WMU Custom logo with "STEAM" listed on the top line and "ESTABLISHED 1903" listed on the bottom line.

2.5 UNDERGROUND PRE-INSULATED VENT PIPING SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings (Perma-Pipe Polytherm) or a comparable product by one of the following:
- 1. PERMA-PIPE, Inc.
 - 2. Rovanco Piping Systems, Inc.
 - 3. Thermacor Process, L.P.
- B. Description: Factory-fabricated carrier piping with insulation and exterior jacket.
- C. Carrier Pipe: Schedule 40 ASTM A 53/A 53M, black steel with plain ends. 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. Leave 6 inches of piping exposed at each end for field joint fabrication.
- D. Carrier Pipe Insulation:
- 1. Polyurethane Foam Pipe Insulation.
 - a. Thermal Conductivity (k-Value): 0.13 at 75 deg F.
 - b. Dry Density: 4 lb/cu. ft. nominal.
 - c. Thickness: 1 inch.
- E. Jacket: Manufacturers standard waterproof jacketing material.
- F. Fittings: Factory-fabricated and -insulated elbows equivalent to the pipe.
- G. Accessories:
- 1. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.



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- H. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. See Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

3.3 PIPING INSTALLATION

- A. The installer shall handle the system in accordance with the directions furnished by the manufacturer and as approved by the Owner and Engineer.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- D. Remove standing water in the bottom of trench.
- E. Backfill:
 - 1. A 4 inch layer of sand or fine gravel shall be placed and tamped in the trench to provide uniform bedding for the system. The entire trench shall be evenly backfilled with a similar material as the bedding in 6-inch compacted layers to a minimum height of 6 inches above the top of the insulated piping system. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil.
 - 2. For additional requirements, see Section 31 2000 "Earth Moving".
- F. Maintain minimum 6-inch clearance between the pipes in same trench.
- G. Bed the pipe on a minimum 6-inch layer of granular fill material with a minimum 6-inch clearance between the pipes.
- H. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- I. Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.
- J. Install piping at uniform grade of 0.2 percent downward in direction of flow or as indicated.



- K. Install condensate piping at uniform grade of 0.4 percent downward in direction of flow or as indicated.
- L. In conduits, install drain valves at low points and manual air vents at high points.
- M. Install components with pressure rating equal to or greater than system operating pressure.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. See Section 23 0500 "Common Work Results for HVAC" for sleeves and mechanical sleeve seals through piping vault walls.
- Q. See Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- R. Secure anchors with concrete thrust blocks. Concrete is specified in Section 03 3000 "Cast-in-Place Concrete."
- S. Connect to piping where it passes through piping vault walls. Piping inside the vault is specified in Section 23 2213 "Steam and Condensate Heating Piping."
- T. Connect to steam and condensate piping where it passes through the building wall. Steam and condensate piping inside the building is specified in Section 23 2213 "Steam and Condensate Heating Piping."

3.4 LOOSE-FILL INSULATION INSTALLATION

- A. Do not disturb the bottom of trench; otherwise, compact and stabilize it to ensure proper support.
- B. Remove standing water in the bottom of trench.
- C. Bed the pipe on a minimum 6-inch layer of granular fill material with a minimum 6-inch clearance between the pipes.
- D. Form insulation trench by excavation or by installing drywall side forms to establish the required height and width of the insulation.
- E. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.
- F. Place insulation and backfill after field quality-control testing has been completed and results approved.
- G. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors. See Section 03 3000 "Cast-in-Place Concrete" for concrete and reinforcement.



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- H. Wrap piping at expansion loops and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.
- I. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.
- J. Remove temporary hangers and supports.
- K. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils thick, and empty loose-fill insulation bags on top.
- L. Manually backfill 6 inches of clean backfill. If mechanical compaction is required, manually backfill to 12 inches before using mechanical-compaction equipment.

3.5 JOINT CONSTRUCTION

- A. See Section 33 0500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Join pipe and fittings according to the following requirements and Section 23 2213 "Steam and Condensate Heating Piping."
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Piping Joints: Assemble sections and finish joints with pourable or split insulation, exterior jacket sleeve, and apply shrink-wrap seals.

3.6 IDENTIFICATION

- A. Install continuous detectable plastic underground warning tapes during back filling of trenches for underground steam and condensate distribution piping. Locate tapes 6 to 8 inches below finished grade, directly over piping.



3.7 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Factory-trained field technical assistance shall be provided for the critical periods of the installation; i.e., unloading, field joint instruction and testing.
 - 2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Prepare steam and condensate piping for testing according to ASME B31.1 and ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Isolate equipment. Do not subject equipment to test pressure.
 - c. Install relief valve set at pressure no more than one-third higher than test pressure.
 - d. Fill system with temperature water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - e. Use vents installed at high points to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
 - 2. Test steam and condensate piping as follows:
 - a. Subject steam and condensate piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
 - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
 - 3. Test conduit as follows:
 - a. Seal vents and drains and subject conduit to 15 psig for four hours with no loss of pressure. Repair leaks and retest as required.
- E. Prepare test and inspection reports.

END OF SECTION 33 6313