UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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02/10

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USACE / NAVFAC / AFCEC / NASA | **UFGS-33 61 14 (February 2010)**

Preparing Activity: NAVFAC | **Superseding UFGS-33 61 14 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 33 61 14

EXTERIOR BURIED PREINSULATED WATER PIPING
02/10

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NOTE: This guide specification covers the requirements for exterior buried factory-prefabricated preinsulated water piping system.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: This guide specification includes requirements for hot domestic water piping, recirculating hot domestic water piping, chilled water piping, chilled-hot (dual temperature) water piping, and hot water piping from heat exchangers to each building. System design must conform to UFC 3-430-09, "Exterior Mechanical Utility Distribution."

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NOTE: On the drawings, show:

1. Configuration, slope, and sizes of each piping system;

2. Locations and details of expansion loops, thrust blocks, anchors, and connections between metal

flanges and plastic carrier piping;

3. Trench cross section, sand bedding, and depth of bury; and

4. Detail sections of piping through manholes, walls, floors, entrance to buildings, and watershed to aboveground piping.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.24	(2016) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME B31.1	(2020) Power Piping

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM D229	(2019) Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation
ASTM D1330	(2004; R 2010) Rubber Sheet Gaskets
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2996	(2017) Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

1.2 SYSTEM DESCRIPTION

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NOTE: For NAVFAC LANT projects that use the regional specifications, refer to NAVFAC LANT regional specification NFGS 23 73 33.00 22 HEATING, VENTILATING AND COOLING SYSTEMS.

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Provide [new and modify existing] exterior buried factory-prefabricated preinsulated water piping system to the first piping connection aboveground or within each building complete and ready for operation. Piping system includes [hot domestic water piping,] [recirculating hot domestic water piping,] [chilled water piping,] [chilled-hot (dual temperature) water piping,] [hot water piping,] and related work [from heat exchanges to each building]. [Hot domestic water piping within each building is specified under Section 22 00 00 PLUMBING, GENERAL PURPOSE.] [Chilled water piping, chilled-hot water piping, and hot water piping within each building is specified under] [Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS].

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Factory-prefabricated preinsulated water piping system

Preinsulated plastic pipe field joints

Show layout of piping system. Drawings must have Professional Engineer Seal.

SD-03 Product Data

Pipe, fittings, and end connections

Factory-prefabricated preinsulated water piping system

Plastic reinforced thermosetting resin (RTR) piping

SD-07 Certificates

Certification of welders' qualifications

SD-08 Manufacturer's Instructions

Installation manual for buried factory-prefabricated preinsulated water piping system

1.4 QUALITY ASSURANCE

1.4.1 Certification of Welders' Qualifications

Submit prior to site welding of steel piping; certifications shall be not more than one year old.

PART 2 PRODUCTS

2.1 BURIED FACTORY-PREFABRICATED PREINSULATED WATER PIPING SYSTEM

Piping (pipe, fittings, and end connections) system shall be suitable for working pressure of 862 kPag at 121 degrees C 125 psig at 250 degrees F, except plastic polyvinyl chloride (PVC) chilled water piping shall be suitable for working pressure of 862 kPag at 24 degrees C 125 psig at 75 degrees F. Piping system shall withstand H-20 highway loading with 600 mm 2 feet of compacted backfill over top of conduit. Mark each section of conduit with fabricator's name, product identification, and publications to which the items conform. Provide each section of carrier pipe including factory-applied insulation and conduit, with waterproof conduit ends at both ends of each section of carrier pipe, except for piping systems which have the field joints insulated and covered with waterproof shrink sleeves.

2.1.1 Factory-Applied Insulation

Polyurethane or polyisocyanate insulation, minimum density of 27.2 kg per cubic meter 1.7 pcf, rated for not less than 121 degrees C 250 degrees F, completely filling space between carrier pipe and conduit.

2.1.2 Factory-Applied Conduit

Conduit material, size, and thickness shall be as follows:

Carrier Pipe (mm)	Minimum Conduit Size (mm)	Minimum Conduit Thickness (mm)
50 mm	100 mm	1.5 mm
75 mm	150 mm	1.5 mm
100 mm	200 mm	2.0 mm
150 mm	250 mm	2.5 mm
200 mm	300 mm	3.0 mm
250 mm	350 mm	3.0 mm

Carrier Pipe (Inches)	Minimum Conduit Size (Inches)	Minimum Conduit Thickness (Inches)
2	4	0.060
3	6	0.060
4	8	0.080
6	10	0.100
8	12	0.120
10	14	0.120

a. Plastic PVC pipe conduit: ASTM D1784, Class 12454-B compound extruded seamless PVC plastic pipe.

b. Plastic RTR pipe conduit: ASTM D2996, filament-wound, fiberglass RTR plastic pipe, without liner.

c. Plastic RTR factory lay-up conduit: Conduit shall be machine-applied continuous rovings of fiberglass strands saturated with isophthalic polyester or epoxy resin filament wound in helical pattern directly to the outer surface of the pipe insulation. In lieu of minimum conduit size for each size of carrier pipe, provide minimum of 25 mm one inch thick insulation for 50 mm 2 inch carrier pipe and provide minimum of 38 mm 1.5 inch thick insulation for 75 mm 3 inch and larger carrier pipe.

2.1.3 Factory-Applied End Seals

Provide watertight end seal, or factory lay-up type end seal between carrier pipe and conduit. Provide sufficient surface bonding area between carrier pipe and conduit to ensure permanent watertight end seal suitable for use with temperature limits of carrier pipe.

2.1.4 Factory-Prefabricated Carrier Piping

Pipe, fittings, flanges, and couplings shall be marked with manufacturer's name, product identification, and publication to which items conform. Carrier piping shall be as specified in this section. Buried carrier pipe connections between straight sections of pipe beyond 1.5 m 5 feetexterior of buildings may be manufacturer's standard O-ring connections designed to absorb pipe expansion and contraction at working pressure of 862 kPag 125 psig with no leakage. Connections at elbows and tees shall be other than O-ring connections.

2.2 CARRIER PIPING

2.2.1 Copper Tubing

Provide copper tubing for hot domestic water piping, recirculating hot domestic water piping, chilled water piping, chilled-hot water piping, and hot water piping.

a. Copper tubing: Provide ASTM B88M ASTM B88, Type L or M copper tubing for buried factory-prefabricated preinsulated piping and for aboveground piping. Provide ASME B16.18 or ASME B16.22 solder joint fittings, unions, and flanges; provide adapters as required.

b. Solder for copper tubing: Provide ASTM B32, 95-5 tin-antimony solder or provide Plumbing Code approved lead-free solder.

c. Flanged connections: Provide ASME B16.24, Class 150, solder joint flat face flanged connections.

d. O-ring connections: Provide between straight sections of pipe beyond 1.5 m 5 feet of exterior of buildings.

2.2.2 Steel Piping

Provide steel piping for chilled water piping, chilled-hot water piping, and hot water piping.

a. Steel pipe: Provide ASTM A53/A53M, Type E (electric-resistance welded, Grade A or B), ASTM A53/A53M, Type S (seamless, Grade A or B), or ASTM A106/A106M (seamless, Grade A or B). Provide Weight Class STD (Standard) or Schedule No. 40 black steel pipe for welding end connections. Provide Weight Class XS (Extra Strong) or Schedule No. 80 black steel pipe for threaded end connections.

b. Steel pipe fittings: Provide ASME B16.9 buttwelding fittings of the same material and weight as the piping in which fittings are installed. Provide ASME B16.11 socket welding fittings.

c. Steel pipe flanges: Provide ASME B16.5, Class 150 flanges.

d. O-ring connections: Provide between straight sections of pipe beyond

1.5 m 5 feet of exterior of buildings.

2.2.3 Plastic Reinforced Thermosetting Resin (RTR) Piping

Provide plastic RTR piping for hot domestic water piping, recirculating hot domestic water piping, chilled water piping, chilled-hot water piping, and hot water piping.

a. Plastic carrier pipe, fittings, and adhesive: Provide plastic carrier piping conforming to the Federal Agency Approved Brochure. Pipe, fittings, and adhesive shall be supplied by same manufacturer. Pipe, fittings, flanges, and couplings shall have end connections of the adhesive bell and spigot type. Threaded piping, including pipe, fittings, flanges, and couplings, will not be permitted.

b. Flanged connections: Provide flat face flanged connections between plastic piping and metal piping. Plastic flanges shall be suitable for connecting to ASME Class 150 flanges.

c. Plastic RTR piping sizes: When piping sizes other than 50, 75, 100, 150, 200 mm 2, 3, 4, 6, and 8 inches are indicated, provide next larger piping size. The connecting system piping shall be of the same size or increased to meet next size of RTR piping.

2.2.4 Plastic PVC Piping

Provide plastic PVC piping only for chilled water piping.

a. Plastic PVC carrier pipe, fittings, and cement: ASTM D1785pipe, ASTM D2466 socket type fittings, and ASTM D2564solvent cement shall be supplied by the same manufacturer. Pipe, fittings, flanges, and couplings shall have solvent cement socket end connections, except piping beyond 1.5 m 5 feet outside of buildings shall have O-ring connections. Plastic PVC piping shall be suitable for working pressure of 862 kPag at 24 degrees C 125 psig at 75 degrees F.

b. Flanged connections: Provide flat face flanged connections between plastic piping and metal piping. Plastic flanges shall be suitable for connecting to ASME Class 150 flanges.

c. O-ring connections: Provide between straight sections of pipe beyond 1.5 m 5 feet of exterior of buildings.

2.3 FLANGED CONNECTIONS

Provide ASME Class 150 flat face flanged connections.

a. Gaskets: ASTM D1330, except Shore A durometer hardness shall be 55 to 65, 3 mm 0.125 inch thick ethylene propylene. Provide one piece factory cut full-face gaskets.

b. Bolts: ASTM A193/A193M, Grade B7. Extend minimum of two full threads beyond nut with bolts tightened to required torque.

c. Nuts: ASTM A194/A194M, Grade 7, with Teflon coated threads.

d. Washers: Provide galvanized steel flat circular washers under bolt heads and nuts.

e. Electrically isolating (insulating) gaskets for connections between metal flanges: Provide ASTM D229 electrical insulating material of 1000 ohms minimum resistance. Provide one piece factory cut insulating gaskets between flanges. Provide silicon-coated fiberglass insulating sleeves between bolts and holes in flanges; bolts may have reduced shanks of diameter not less than diameter at root of threads. Provide 3 mm 0.125 inch thick high-strength insulating washers next to flanges and provide stainless steel flat circular steel washers over insulating washers and under bolt heads and nuts. Provide bolts 13 mm 0.5 inch longer than standard length to compensate for thicker insulating gaskets and washers under bolt heads and nuts.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 75 mm 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED PREINSULATED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.5 CONCRETE THRUST BLOCKS

Provide concrete thrust blocks as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Concrete shall be of 27.6 MPa 4000 psi minimum 28 day compressive strength, air-entrained admixture (0.13 kg per cubic meter) (3.6 ounces per cubic yard) with water-reducing admixture (0.81 kg per cubic meter) (22 ounces per cubic yard).

2.6 PIPE SLEEVES

Provide where piping passes entirely through walls and floors. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide 25 mm one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in masonry and concrete walls and floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of sleeves when cavities in the core-drilled hole are grouted smooth.

b. Sleeves in other than masonry and Concrete walls and floors: Provide 0.5 mm 26 gage galvanized steel sheet.

2.7 ESCUTCHEON PLATES

Provide split hinge type metal plates for piping entering walls and floors in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide

paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of exterior buried factory-prefabricated preinsulated water piping systems shall be in accordance with manufacturer's installation manual. Welding of steel piping including qualification of welders shall be in accordance with ASME B31.1, metallic arc process. Deviations shall not be permitted unless authorized in writing by Contracting Officer. Install piping straight and true to bear evenly on sand bedding material. Installation and field assembly of plastic RTR piping shall be in accordance with the Federal Agency Approved Brochure.

a. Cleaning of piping: Keep interior and ends of new piping and existing piping affected by the Contractor's operations, cleaned of water and foreign matter during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

b. Demolition: Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.2 FIELD JOINTS

a. Carrier piping joints without concrete anchor: Pressure test and approve piping joints. Provide joints with polyurethane or polyisocyanate insulation of same type and thickness as insulation on carrier piping. Provide waterproof shrink sleeves to cover insulation and overlap not less than 150 mm 6 inches of each end of conduit section.

b. Carrier piping joints with concrete anchor: Pressure test and approve piping joints. Provide each elbow and tee with concrete anchors (thrust blocks). Provide waterproof end seals between carrier piping and conduit adjacent to each carrier pipe fitting. Encase carrier pipe fitting and at least 50 mm 2 inches of each end of conduit with a minimum of 150 mm 6 inches of concrete.

3.3 BURIED FACTORY-PREFABRICATED PREINSULATED PIPE INSTALLATION

a. Assembly and alignment: Assemble carrier pipe and fittings according to manufacturer's installation manual; assemble plastic RTR piping in accordance with the Federal Agency Approved Brochure. Maintain proper alignment during assembly of joints.

b. Bedding: Accurately grade trench bedding with a minimum of 150 mm 6 inches of manufactured or natural sand. Backfill sand to a minimum of 150 mm 6 inches above and below conduit. Lay bedding to firmly support conduit along entire length.

c. Concrete thrust blocks: Encase each elbow and tee of carrier pipe in thrust block with minimum of 0.28 square meter 3 square feet of thrust-bearing surface cast against undisturbed soil, minimum pipe-to-bearing surface single dimension of 250 mm 10 inches perpendicular to bearing surface, and minimum volume of 0.25 cubic

meter 9 cubic feet, except as indicated otherwise. Disturbed soil under and around thrust blocks shall be compacted.

3.4 FIELD QUALITY CONTROL

Before final acceptance of work, test each system to demonstrate compliance with contract requirements. Thoroughly flush and clean piping before placing in operation. Flush piping at minimum velocity of 2.4 meters per second 8 fps. Correct defects in the work and repeat tests until work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for tests.

a. Field tests of carrier piping: Do not cover carrier piping joints with insulation or concrete anchors (thrust blocks), until carrier piping joints pass field tests.

b. Hydrostatic pressure test: Test piping system at 1379 kPag 200 psig for minimum holding period of 2 hours during which time pressure shall not drop more than 28 kPa 4 psi; test plastic RTR piping in accordance with Federal Agency Approved Brochure. Pressure drop greater than 28 kPag 4 psicorrected for temperature variation constitutes failure. Valve off piping system and disconnect method of piping system pressurization before starting the 2 hour pressure holding period. During hydrostatic pressure test, examine piping system for leaks. Repair leaking joints, replace damaged and porous pipe and fittings with new materials, and repeat tests.

c. Thrust blocks: If O-ring connections are used, provide temporary thrust blocks prior to hydrostatic pressure testing of piping system. Place bedding and backfill around center portion of piping system, leaving thrust blocks and field joints clear for observation. After successful completion of hydrostatic pressure test, cast concrete thrust blocks.

d. Field inspections: Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.5 DISINFECTION

Disinfect new hot domestic water piping under Section 22 00 00 PLUMBING, GENERAL PURPOSE.

-- End of Section --