	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 02 00 00 Site Construction	Section: 02 71 50 Requirements for Steam Distribution
		Date: November 2023
		Author: Office of Facilities

PART 1 - INTRODUCTION

1.1 PURPOSE

This section contains the design criteria for exterior steam distribution systems. Section 15 11 00: Valves contains the design criteria for valves. Section 15 18 20: Steam and Condensate Piping contains the design criteria for internal piping systems.

PART 2 - GENERAL DESIGN REQUIREMENTS

2.1 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

Design all underground, high-temperature steam and condensate piping for a minimum of 225°F and 15 psig.

2.2 SUBMITTALS

Submit the following design and construction documents to Yale University.

A. Design Documents

1. Plan and profile views of all design drawings
2. Calculations for expansion loop of joint design

B. Construction Documents

1. Contractor welding and brazing certificates
2. Insulation test reports (received from the manufacturer)
3. A written report of hydrostatic test results

2.3 PRODUCT STANDARDS


Steam, pumped condensate, and high-pressure trap return piping must conform to the standards contained in the latest edition of ANSI B 31.1.

2.4 MANUFACTURERS

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

A. Underground, High-Temperature Steam and Condensate Piping

1. PERMA-PIPE (Multi-Therm 500)
2. THERMACOR (Duo-Therm “505)

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B. Slip Joints and Ball Joints

1. Yarway
2. Advanced Thermal Systems

C. Steam Traps


1. Armstrong International, Inc.
2. Velan
3. Spirax Sarco, Inc.
4. Yarway

2.5 MATERIALS

- A. The piping insulation must be a thickness recommended by the manufacturer for different pipe thicknesses.
- B. The outer layer of insulation for the PERMA PIPE System must be 1" thick polyurethane foam, bonded to the steel conduit and shall conform to ASTM C-591.
- C. The outer jacket must be a minimum of 0.175" fiberglass (FRP), applied directly to the polyurethane insulation for the PERMA PIPE System for black, HDPE for the THERMACOR system.
- D. Steel pipe must meet either ASTM A53 (seamless steel pipe) specifications or A106 (black steel pipe with plain ends) specifications depending the size of pipe.
- E. Steel flanges and flanged fittings, including bolts, nuts, and gaskets, must meet ASME B16.5 requirements.
- F. Condensate return piping shall be Schedule 30 PVC.

2.6 ACCESSORIES OR SPECIAL FEATURES

- A. All end seals, gland seals, and anchors must be designed and factory prefabricated to prevent the ingress of moisture into the system.
- B. All subassemblies must be designed to allow for complete draining and drying of the conduit system.
- C. Anchors must be manufactured to minimize the heat transfer from the carrier pipe to the jackets.
- D. The system shall be leak detection ready by means of a copper wire embedded in the foam insulation. An Ohm meter panel shall be included for continuous leak detection monitoring.

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2.7 SPECIAL REQUIREMENTS

Welding materials must meet ASME Boiler and Pressure Vessel Code requirements.


2.8 INSTALLATION GUIDELINES

- A. Where possible, provide a uniform pipe bedding of suitable on-site material. If suitable material is not available, backfill the trench with sand. Using a material similar to the bedding, backfill the entire trench width evenly in 6" lifts to 6" above the top of the pipe. Compact the lifts to at least a 95% Standard Proctor density, meeting ASTM D1556 standards at optimum moisture (or as recommended by the soils engineer). Backfill the remaining trench in lifts not to exceed 12" up to the sub-grade height for the surface condition encountered. Compact the lifts to a 95% Standard Proctor density, meeting ASTM D1556 standards at optimum moisture (or as recommended by the soils engineer). Backfilling and compacting above the subgrade must be determined by the soils engineer or by the recommended paving design for the project.
- B. Support all pipes with the outer casing at intervals of not more than 14'. Design these supports to enable continuous airflow and in-place conduit drainage. The straight supports must be designed to occupy not more than 10% of the annular air space. Supports must be of the type where insulation thermally insulates the carrier pipe from the outer conduit. Protect the surface of the insulation at the support by a sleeve not less than 12" long, fitted with a traverse and, where required, with rotational arresters.
- C. Conduit insulation must be spray-applied polyurethane foam, with a nominal density of 2 lbs/ft³ and minimum thickness of 1".
- D. Install high-temperature isolation gaskets on all carrier pipe between the anchor plate and thrust collars.
- E. On each side of any anchor plate, replace polyurethane foam insulation on the outer casing with calcium silicate insulation. To prevent corrosion, coat the portion of the anchor plate that protrudes through the jacket with fiberglass.
- F. End and gland seals must have steel end plates protecting the insulation on the outer casing, as well as the insulation on the carrier pipe and air space. The outer jacket at the end and gland seals must be reinforced with a steel backing sleeve. Replace the polyurethane foam insulation on the outer casing with fiberglass insulation at the end plate.

2.9 QUALITY CONTROL

Work on exterior steam distribution systems must conform to the following quality control standards.

- A. Testing Laboratory: Yale University will retain the services of a qualified, independent testing

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laboratory to perform soil compaction tests, as directed, during construction.

B. Testing Methodology and Extent

1. Perform hydrostatic tests up to a pressure of 270 psig on high-pressure systems and 190 psig on low-pressure systems. Yale University will retain the services of a qualified testing agency to x-ray 10% to 15% of all welded joints.
2. Visually inspect pipe insulation before jacketing, then perform an x-ray inspection of the entire pipe length to detect any insulation voids.

C. Contractor and Manufacturer Requirements

1. Contractors must provide certification that their operators have met ASME Boiler and Pressure Vessel Code: Section IX, Welding and Brazing Qualifications.
2. The manufacturer must test polyurethane foam for mechanical and thermal properties.

2.10 CLEANING AND ADJUSTING

After hydrostatic testing, and before operational testing, thoroughly clean piping with caustic soda, trisodium phosphate, or an equivalent chemical cleaner. Thoroughly flush the pipes with clean water.

2.11 STARTUP AND TRAINING

All water drained from the distribution system and the tie-ins during testing must be drained to the sanitary sewer, not the storm sewer.

Date	Description of Change	Pages / Sections Modified	ID
11/27/23	Template update	-	Office of Facilities