District Heat
DISTRIBUTION MAINS STANDARDS

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INTRODUCTION

DU standards of construction shall be utilized for all facilities to be owned, operated and maintained by the utility, to include hookups from the utility facility to the demarcation point.

Generally, utility mains/distribution lines will be constructed by DU or by DU's contractor at DU expense. Thus, these standards will be followed by DU contractors. In rare circumstances, (with prior written approval of the utility), main/distribution facilities may be constructed by the Army's Facility Contractor for the utility, at DU expense. Thus, these standards will be followed by the facility contractor.

DU will be responsible for planning, designing and constructing utility water, wastewater, gas and heat mains and electrical distribution system improvements for new government facilities. This will require close cooperation and utility involvement in the government facility planning process. Without this coordination, facilities constructed will have no utility service.

Hookups from the utility main, whether the utility main is pre-existing or new, will be constructed by the facility contractor for the utility at utility expense and reimbursed to the facility contractor according to the reimbursement schedule found in the hookup standards.

The government, Army, or Corps of Engineer will not be responsible for design, construction, or oversight of any utility owned facilities, whether main/distribution, lines, or hookups.

The government facilities construction contractor will be responsible for construction of the hookup for the utility from the building to the utility main/electrical distributions system facility as described below:

> Water: The water hookup from the main to the shutoff valve inside the facility on the customer side of the meter. The utility will provide and install the meter.
>
> Wastewater: The wastewater hookup will be from the collection main to the cleanout, normally located about 5 feet outside the building foundation.
>
> Gas: The gas hookup will be from the gas main to the shutoff valve on the customer side of the meter. The utility will provide and install the meter.

Heat: The heat hookup will be from the heat main, either steam or hot water to the shutoff valve on the customer side of the meter. The utility will provide and install the meter.

Electric: The electric hookup will be from the transformer to the meter socket. The utility will provide and install the meter and the overhead service drop from the transformer to the service entrance mast.

Coordination will be necessary so that the appropriate meters are on hand for the facilities to be constructed.

The utility hookups to be owned by the utility but constructed by the facility contractor for the utility will be reimbursed to the contractor according to the attached schedule. Hookups will be inspected during construction by utility personnel and constructed according to the hookup standards.

The service line standards and utility facility standards are incorporated herein.

Service Line Reimbursement Schedule

Size	Lump Sum	Per Foot
Water Service		
¾”	$ 1750.00	$ 50.00
1”	1750.00	52.00
1- ½”	2000.00	55.00
2”	2000.00	65.00
3”	2500.00	70.00
4”	2500.00	75.00
6”	3000.00	110.00
8”	3500.00	120.00
Wastewater Service		

4”	$ 1500.00	$ 65.00
6”	1500.00	70.00
Steam Heat Service		
2” - S/1”-C	$ 2300.00	$ 200.00
4” - S/1”- C	5400.00	280.00
6” - S/2”- C	9400.00	370.00
8” - S/4”- C	9400.00	450.00
Gas Service		
¾”	$ 2300.00	$ 10.00
2”	400.00	15.00
Electric Service		
1-Ph	$ 2553.00	$ 0.00
3-Ph	4788.00	0.00

GENERAL

1.1 SCOPE

This Standard covers the acceptable design and construction features for the installation or repair of district heat steam and condensate **distribution mains**, and will serve as the official inspection guideline. Deviation from this Standard is permitted only by written consent of DU.

1.2 DEFINITIONS

In general, the following definitions apply to this Standard:

ADEC ..... Alaska Department of Environmental Conservation

AKDOL ..... Alaska Department of Labor, Mechanical Inspections Division, Boiler and Pressure Vessels

AMR ..... Automatic Meter Reader

ANSI ..... American National Standards Institute

ASME ..... American Society of Mechanical Engineers

ASTM ..... American Society for Testing and Materials

AWS ..... American Welding Society

Army ..... United States Army

BLDG..... Building

BTU ..... British Thermal Unit

CHPP ..... Central Heat and Power Plant

Designer ..... Any person who engineers or designs equipment or system(s) governed by this Standard.

DPW ..... Directorate of Public Works

DU ..... Doyon Utilities LLC (the Utility), the Doyon Utilities district heat system, and all systems under the control of Doyon Utilities LLC

°F..... Degrees Fahrenheit

FGA..... Fort Greely Alaska

FRP ..... Fiberglass Reinforced Plastic

Ft ..... Foot

FWA ..... Fort Wainwright Alaska

HDPE ..... High Density Polyethylene

Hr..... Hour

Hz ..... Hertz

IBC ..... International Building Code

IFC..... International Fire Code

IMC..... International Mechanical Code

Installer..... Any person or entity performing installation, excavation, insulation, or any other work related to complete or partial accomplishment of the reapir or new installation of DU district heat distribution mains.

LBS..... Pounds

NDE..... Non-Destructive Examination

NEC..... National Electric Code

NEMA ..... National Electrical Manufacturers Association

PCF ..... Pounds per Cubic Foot

PPM..... Parts per Million

PSI..... Pounds per square inch (pressure)

PVC ..... Polyvinyl Chloride

TEFC ..... Totally Enclosed Fan Cooled

UPC..... Uniform Plumbing Code

Utility..... Doyon Utilities LLC (DU), the Doyon Utilities district heat system, and all systems under the control of Doyon Utilities LLC

1.3 AUTHORITY

DU recognizes the most recent version of the IBC, IFC, IMC, UPC and NEC, as adopted and amended by local authorities, as a basis of establishing minimum standards of design and installation.

In the event of conflicts between this Standard and other standards, the LOWER numbered standard below shall govern:

1 Alaska State Statutes, Specifically Title 18, Chapter 60, Article 3.

2 DU Construction Standard for District Heat Distribution Mains.

3 IBC, IFC, IMC, UPC and NEC, as adopted and amended by local authorities.

4 Other recognized standards and codes (Federal and State government regulations may supersede local codes).

5 Recognized good practices of this local area.

1.4 LIABILITY

DU assumes no responsibility or liability that is not required by law concerning the suitability or applicability of this Standard to the requirements of the Army.

1.5 INTENT

It is not the intent of this Standard to supersede codes or regulations.

This Standard is intended to:

1 provide Designers and Installers a basic guide for the design and installation of district heat distribution mains to ensure compatibility with DU’s system; and

2 protect the interests of DU, their Customers, and the Army by imposing uniform requirements for the installation and connection of all district heat distribution mains.

1.6 OWNERSHIP

The extent of ownership by DU is limited to the district heat distribution mains, and, where applicable, service tees, service isolation valves, service lines up to and including the district heat meter (including flanges for installation if required), and Automatic Meter Reader (AMR) equipment.

1.7 RESPONSIBILITY

The Designer and Installer are responsible for meeting the requirements of this Standard and all other applicable codes and regulations (see Article 1.3).

The Installer is responsible to obtain all necessary permits prior to beginning any construction activity.

The Installer is responsible for meeting the requirements of Construction Code of the Occupational Safety and Health Standards and the National Fire Protection Association (NFPA) Code.

The Installer will be held responsible for damage to DU facilities resulting from failure to comply with the requirements of this Standard.

SECTION 2 - GENERAL REQUIREMENTS

2.1 STANDARDS

Only work, materials, and tools meeting acceptable standards shall be permitted.

All work shall conform to the standards set forth in the most recent editions of the IBC, IFC, IMC, UPC and NEC, as adopted and amended by local authorities.

All work and materials shall be free of defects and leaks.

All materials used shall be new.

2.2 INSPECTIONS

DU shall inspect all district heat distribution main repairs and new installations. For the purposes of this Standard, the following procedures shall be used:

PLAN REVIEW: A comprehensive review of all plans and specifications for the proposed work must be completed by DU prior to issuance of a Notice to Proceed.

WELDING INSPECTION: In general, all welding inspection shall be conducted in accordance with the current edition of ASME/ANSI B31.1 Power Piping Code. This code specifies necessary inspection and examination requirements, and references the necessary AWS qualifications for inspection and examination.

HYDROSTATIC TEST: A hydrostatic test using water is required for new steam and condensate distribution mains. Test pressure shall be one hundred fifty (150) PSI for two (2) hours for new or repair work. DU personnel must witness such tests.

INSULATION: DU personnel must inspect all underground pipe insulation prior to backfill. The insulation outer coating shall be smooth and even, with no recesses that can hold or trap water. Upon approval of the insulation, the pipe shall be properly backfilled and compacted.

STREET EXCAVATION: Any portion of a district heat distribution main trench that crosses or enters a street, alley or other paved surface shall be backfilled and compacted in conformance with the appropriate DPW requirements (FGA, FRA or FWA). This work must be inspected by the appropriate DPW Office prior to installation of pavement.

IMPROPER CONNECTIONS: Any connection which can allow entry of untreated or contaminated water, or any other fluid, into the DU district heating system is prohibited.

2.3 LOCATION OF EXISTING UNDERGROUND UTILITIES

The Installer shall be responsible for determining the location of all underground utilities and shall be responsible for any damages to underground utilities caused by the work. Possible underground utilities to be located include, but may not be limited to: telephone lines, cable TV lines, electrical lines (including power for street lights), water and wastewater lines, district heat steam and condensate lines, gas lines, storm drains, etc.

Contact DU for a one (1) time final field locate and ground marking of all DU-owned underground utility features in the area of the excavation. Contact for this field locate must be accomplished at least twenty four (24) hours prior to the actual anticipated time of the beginning of excavation, and before 3 PM of the date of contact. DU requires that a disclaimer of liability be on file before any utility location work can be conducted. The first locate for DU-owned underground utility features is provided without charge. Once a field location has been provided, a fee will be charged if a subsequent locate is requested to reestablish a previously marked feature.

2.4 EXCAVATION AND SITE CONDITIONS

The Installer must obtain a Dig Clearance permit from the appropriate DPW Office (FGA, FRA or FWA) prior to beginning any excavation work.

The Installer is responsible to control the excavation work and to take proper safeguards to protect private and public property as well as to provide a safe workplace. All excavations shall conform to State (AKDOL) and Federal (OSHA) requirements. The Installer shall furnish all necessary construction and safety equipment including, but not necessarily limited to, shoring, de-watering pumps, excavation equipment, ladders, barricades, temporary fencing and signage.

The Installer shall do all excavating, including hand excavation around the main lines as necessary to provide an excavation of sufficient extent to allow safe entry for the installation of all DU materials, equipment and insulation, and to provide adequate space for dewatering. In general, the entire surface of the DU distribution main at any tie-in point must be exposed for the entire circumference and for a length of not less than four feet (4'). The soil shall be removed to a minimum distance of twenty four inches (24") around all surfaces of the main.

The Installer shall take whatever action that is necessary to control and remove all standing and inflowing water from the excavation and properly dispose of it. Distribution main tie-ins will not be allowed in cases of improper excavation, excessive groundwater, or other unsafe conditions. In the event that a DU crew is dispatched to the jobsite and the requested work cannot be completed because of an improper excavation, excessive groundwater, or other unsafe conditions, the Installer may be charged for all DU expenses.

2.5 DAMAGE TO EXISTING EQUIPMENT OR FACILITIES

If any existing facility or equipment is damaged by action of the Installer or his agent(s), cease work and notify DU immediately. Failure to notify may expose the Installer or his agent(s) to increased liability and civil penalties.

The party causing such damage shall be responsible for all costs incurred to repair the damage and restore the facility or equipment to its prior condition. Any damage to the distribution main(s) will be repaired by DU personnel and may be billed to the Installer.

2.6 BACKFILL

Backfill the distribution mains trench by hand a minimum of twelve (12") inches above the pipes and compact as necessary. Backfill remainder of trench by mechanical means and compact as necessary.

2.7 COMPACTION REQUIREMENTS

Compaction in street right of ways must meet Army standards. Compaction beneath the DU main and to a point twelve (12”) inches above the main shall be ninety five percent (95%) or greater.

2.8 SYSTEM OPERATING PARAMETERS

The FWA CHPP provides steam to the FWA district heat system at a nominal temperature and pressure of 100 PSI and 440°F.

The FGA CHPP provides steam to the FGA district heat system at a nominal temperature and pressure of 60 PSI and 260°F.

2.9 SYSTEM CONTAMINATION

The DU district heat system is a closed system that operates on the principal that no material either leaves or enters the utility mains or service piping. The sole product is the energy that is delivered to each Customer.

Design or construction errors that allow foreign substances to be introduced into the district heat distribution mains can contaminate the entire system. Losses of thousands of dollars per hour can result from contamination because of the costs incurred in replacing ruined system fluid. DU reserves the right to seek compensation from Deisgners or Installers responsible for design or construction errors that cause system contamination.

2.10 SCOPE OF DOYON UTILITIES PERSONNEL WORK

DU personnel will conduct all tie-ins to existing steam and condensate distribution mains. This, together with the inspection of all materials and work, will constitute the scope of DU personnel work unless specific arrangements have been made in writing for DU to perform other work.

2.11 TIE-IN TO EXISTING DISTRIBUTION MAINS

Tie-in connections to existing district heat system distribution mains will be made during normal DU working hours. No person, other than DU personnel, shall cut or bore any holes in a district heat system distribution main or attempt to install a tie-in connection.

SECTION 3 - SPECIFIC REQUIREMENTS

3.1 PIPE MATERIAL

Pipe material shall be type AISI A106 (preferred), or AISI A53 (allowed) steel, seamless. Pipe thickness shall be Schedule 40 for steam piping and Schedule 80 for condensate piping.

Use of bronze bodied valves and equipment is restricted to low pressure condensate drains, instrument connections, and low pressure piping. Copper pipe shall not be used for condensate drains.

3.2 INSTALLATION METHODS

GENERAL:

Underground piping shall be installed with a minimum of four feet (4') of soil cover. If four feet (4') of soil cover cannot be provided, DU may authorize less cover provided that one inch (1") of additional insulation is furnished for all piping not located below pavement (i.e., street, alley, parking lot, etc.). All piping located below pavement shall have a minimum of four feet (4') of soil cover.

All underground pipes shall be suitably supported during installation, providing adequate support to prevent sags and to maintain proper grade.

All underground pipes shall be suitably anchored to restrict movement of the pipe during startup and shutdown to that allowed by expansion joints or loops.

All underground pipes shall be installed with sufficient provision for expansion and contraction so that the pipe will not be subjected to excessive stress during startup and shutdown.

All underground pipes shall utilize sufficient sealant and waterproofing at wall penetrations to protect the pipe and jacketing from intrusive water, and to prevent water from passing from the outside to inside the premises.

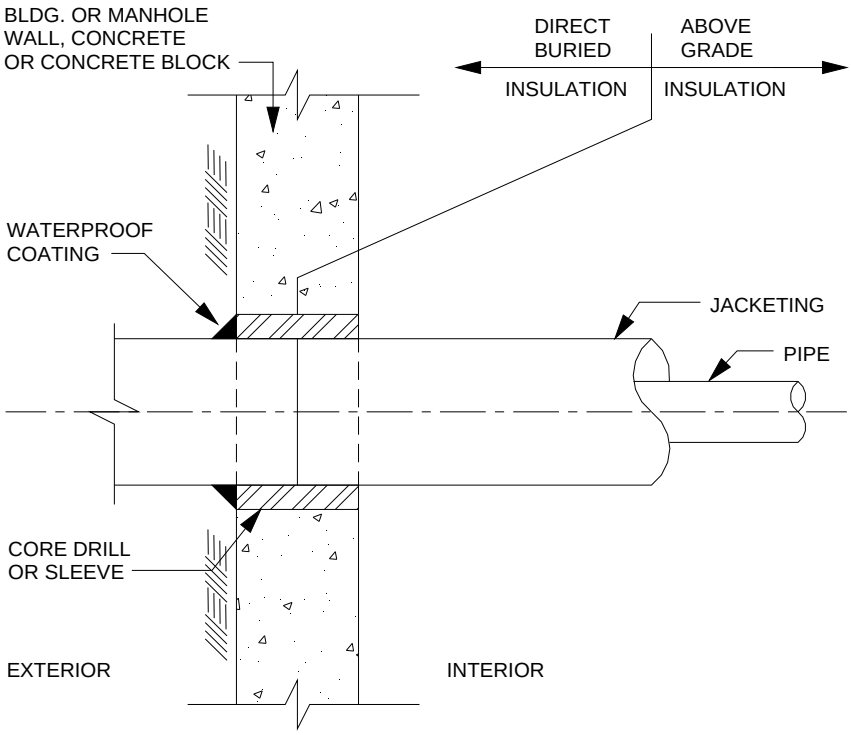

Fig. 1 - Pipe Wall Penetration

WELDING: All underground pipes shall be welded unless otherwise authorized in advance by DU. The minimum standards for the welding of steel pipe shall be those established by the ANSI standard code for Pressure Piping B31.1. All welding shall be performed in accordance with modern welding practice by experienced personnel. Welders shall be certified to the contractor's approved ASME welding procedures. Welding procedures must be qualified in accordance with ASME Section IX and submitted to DU prior to welding.

This procedure specification shall cover the Shielded Metal-Arc Welding of groove and fillet welding of carbon steel pipe and fittings in the horizontal and vertical fixed positions.

Base metals which are to be welded shall be wrought or forged materials conforming to the following:

Material	ASME Specifications
Carbon Steel Pipe	SA-106, Grade A
Carbon Steel Pipe Flanges	SA-181, Grade 1
Plate	SA-36
Butt Welding Fittings	SA-106, Grade A

Welding may involve any of the above materials singly or in combination with each other.

Filler metal shall be material which is deposited by welding electrodes and shall conform to ASME SFA 5.1, Class E6010.

Preparation of the Welding Groove:

1 The ends of the pipe to be welded shall be beveled. Beveling shall be by machine (preferred) or flame cutting provided that the surfaces are thoroughly cleaned from scale and oxidation per ANSI B31.1, Chapter 5, A.1.

2 Surfaces for welding shall be cleaned and shall be free from paint, oil, rust or scale before welding, except that a light coat of rust preventative preservative, which will not be detrimental to the finished weld, may be used.

3 Before welding, the piping or other equipment shall be carefully aligned so no part is offset with respect to the adjacent part by more than twenty percent (20%) of the pipe thickness. This alignment must be preserved during welding. All pipe materials to be welded shall be preheated to a minimum temperature of 50°F.

4 If tack welds are used, they shall be of the same quality and shall be made by the same procedure as the completed weld; otherwise the tack welds shall be removed during the welding operation.

5 Weld metal shall not project within the pipe beyond limits allowed by ANSI B31.1.

6 All welds that fail visual or NDE inspection shall be ground out and re-welded.

7 All weld areas and damaged coating areas shall be cleaned and coated with Scotchkote No. 306.

PIPE BENDS: Pipe bends may be used in all piping two inches (2”) and smaller in lieu of fittings. The bend radius shall not be less than five pipe diameters. Thinning at the bends shall not exceed six percent (6%) of wall thickness. Buckling, flattening, or other malformation of the bent pipe is not acceptable.

TAPS: Taps or socket welded piping branches two inches (2”) and smaller shall be made by welding extra heavy half couplings to the pipe, or by providing build up welded bosses and drilling and tapping same after welds are completed. Taps shall be made before piping is fitted into place. Burning or drilling of holes is not permitted after the piping has been fitted.

Taps for instrumentation wells and sockets shall be made in a location that permits easy installation of instruments for convenient observation and access from floor or platform elevations. Taps shall be located and spaced so that adjacent instruments and devices will in no way interfere with each other. Wells, sampling nozzles, and other required devices shall be installed in accordance with the manufacturer'' requirements.

ATTACHMENTS: Welded attachments for pipe hangars, insulation and instrumentation shall be shop fabricated with piping, and heat treated as necessary. Insulation support angles shall be furnished on vertical runs of pipe which require heat treatment of welds, and shall be spaced not more than twelve feet between supports.

PIPE SLEEVES: Pipes shall be routed through walls, floors, and roofs through steel pipe sleeves, except where framed openings have been specifically provided for pipes. Pipe sleeves shall be fabricated from standard weight steel pipe or from one quarter inch thick rolled steel plate and galvanized after fabrications. Oval cross section sleeves shall be provided wherever necessary to accommodate transverse movement of pipe due to thermal movement. The minimum radial clearance between the sleeve and the outer surface of the insulated pipe shall be one inch.

3.3 SEPARATION

Maintain a minimum horizontal separation distance of two feet (2'), center-to-center, between underground district heat (steam and condensate) distribution mains throughout their entire length.

Maintain a minimum horizontal separation distance of four feet (4'), center-to-center, between a district heat distribution main (steam or condensate) and a water or sewer main or water or sewer service line, or other utilities.

aintain a minimum vertical separation of twelve inches (12") between the bottom and top of the insulation on a district heat distribution main (steam or condensate) and any crossing sewer main, sewer service line, or storm drain line.

3.4 PIPE FITTINGS

Underground valves and fittings shall be socket weld or butt weld type steel. Butt weld fittings shall be the same pipe schedule as the pipe. Socket weld fittings shall be three thousand (3,000) PSI Class conforming to ANSI B16.22.

Flanged connections are only authorized for connecting aboveground pipe and fittings. Flanged fittings may be weld neck, socket, or slip on type, and shall be raised face one hundred fifty (150) PSI Class, conforming to ASTM A105 and ANSI B16.5.

Screwed or threaded connections are only authorized for connections of interior aboveground piping of two inches (2") diameter or less, and are limited to low pressure drip legs, trap connections, instrument connections, and low pressure condensate or hot water piping. Screwed fittings shall be three thousand pound (3,000 LBS) forged steel conforming to ASTM Specification A105 and ANSI B16.11.

Butt welded fittings shall conform to ANSI B16.9. The material shall conform to A234 WPB. The wall thickness of the butt welding fittings shall conform to the schedule of the connecting pipe.

Welding tees shall be used for all socket welded piping and for all field fabricated branch tees in butt-weld end piping.

Welding outlet fittings shall be Bonney Forge "Weld-O-Let" or approved equal.

3.5 UNDERGROUND VALVES

All underground valves shall be one hundred fifty (150) PSI Class non rising stem gate valves with cast or forged carbon steel body, 500°F maximum working temperature, butt weld end connections, 416 SS stem with two Inches (2") operating nut, two part stem packing consisting of chevron packing rings and backup "O" rings suitable for steam service, iron bonnet gasket, and solid type semi steel sedge; Kerotest Manufacturing Corporation, Valve No. 1WS5HTP, no substitutions.

3.6 STEAM TRAPS

Steam traps are manufactured in a variety of types and sizes, and are generally selected in accordance with the recommendations of the heat transfer equipment manufacturer, and the trap manufacturer. Traps shall be selected to release sub-cooled liquid to minimize flashing in the condensate return system. Traps are recommended to be of carbon steel (ASTM A-216 WCB) construction with stainless steel internal components. Cast iron (ASTM A-278) bodied traps are acceptable, however should be restricted to low pressure service. Bronze bodied traps are not acceptable.

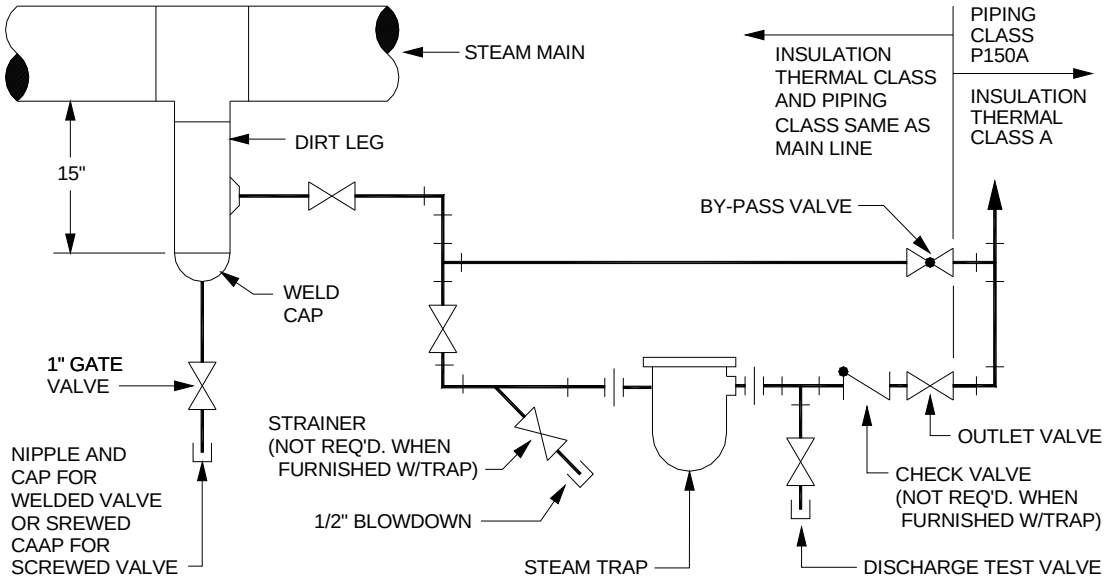

Fig. 2 – Recommended Steam Trap Piping

Steam traps shall be installed at each point of use and shall be selected and sized for the particular application. Traps that are integral with the body of the heat transfer equipment, and supplied by the original equipment manufacturer shall be installed with a shutoff valve placed at the outlet of the trap. In-line traps shall be installed complete with a strainer, suitable for preventing dirt and debris from entering the trap orifices and chambers, isolation valves upstream and downstream, and unions both upstream and downstream to allow easy removal for maintenance and replacement.

3.7 STRAINERS

Strainers shall be installed with each trap or control valve, or upstream of any equipment that is recommended by the manufacturer. Strainers shall be Y-type and sized to pass the full flow of the equipment that is protected by the strainer. Strainers may be either carbon steel, or cast iron bodies, but shall be specified to match the material specification of the protected equipment. End connections may be either flanged, or screwed, but shall be specified to match the end connections of the protected equipment. The strainer shall be specified with a removable type 304 stainless steel screen that will retain particles larger than five one-hundredths inch (0.050”). Each strainer shall be furnished with a blow-down connection, and shall be installed with a blow-down valve.

3.8 INSULATION

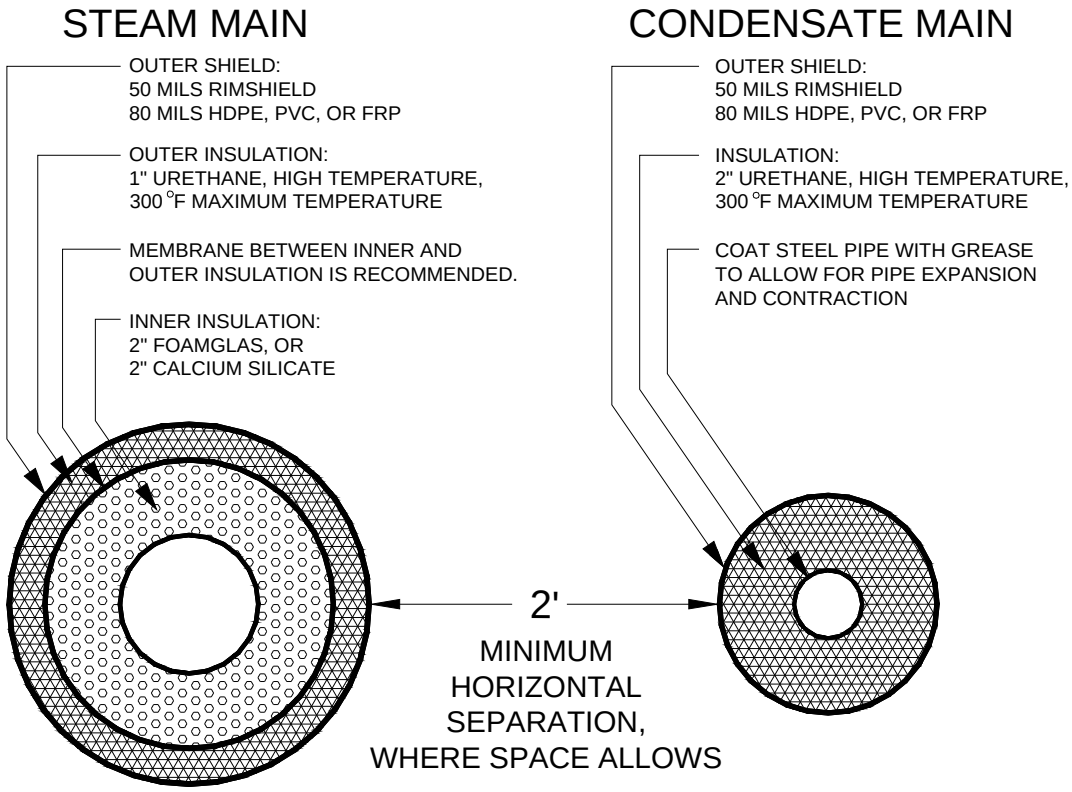

Fig. 3 – Insulation of Direct Bury Steam and Condensate Distribution Mains

All underground district heat distribution main piping shall be insulated. Each steam and condensate pipe shall be separately insulated and coated to minimize the possibility of a damaged line damaging an adjacent line. The insulation system shall comprised of a first layer of material suitable for the temperature level of the service piping, and a second layer suitable to attain the temperature performance of the insulation system. The insulation system shall be covered with an impermeable and corrosion resistant outer shell. The insulation system shall be designed to provide a maximum heat loss of sixty (60) BTU/Hr/Ft on the hottest pipe, based on a five feet (5') depth of bury, and a soil temperature of +20°F.

INSULATION PRODUCTS:

CELLULAR GLASS (PREFERRED): This system is preferred for steam systems, because of the low permeability of the cellular glass foam to steam, or water if the system becomes damaged. The insulation needs to be selected to provide the necessary heat transfer limit, and to also limit the interface temperature between the insulation materials to the high temperature limit of the Urethane foam, usually 300°F for high temperature foam. Cellular glass pipe insulation shall be closed cell in structure, rigid, impervious of moisture, meeting ASTM C552-88, preformed in shapes and sizes to completely enclose the piping, fittings, and valves, such as Pittsburgh Corning Corporation's "Foamglas" or approved equal. Cellular glass insulation jacketing shall be a flexible self sealing protective foam shall be as manufactured by Pittsburg-Corning, and shall be installed with the manufacturers standard asphalt coating.

In order to achieve the thermal performance required for steam and condensate service this insulation will be installed in conjunction with urethane foam and coating.

CALCIUM SILLCATE (ALTERNATE): This system can be used for underground piping in lieu of cellular glass, provided that moisture can be effectively kept out of the insulation envelope, because it is not considered to be as moisture resistant as cellular glass. Calcium silicate shall be rigid, preformed, asbestos free, heavy density conforming to ASTM C 533, such as Owens-Corning Kaylo or approved equal.

In order to achieve the thermal performance required for steam and condensate service, this insulation will be installed in conjunction with urethane foam and coating.

MINERAL FIBER (ALLOWED, BUT NOT RECOMMENDED FOR UNDERGROUND PIPE): This system has been used in the Fairbanks area since the mid 1970's and offers superior thermal performance. However, the lifespan of this system can be drastically reduced due intrusive water permeating the fiber layer and deteriorating the external urethane shell, resulting in subsequent severe damage to the total insulation system. Use of this insulation system will be authorized by DU only after consultation with the Customer and discussion of risks and alternatives.

Mineral fiber pipe insulation shall be heavy density, conforming to ASTM C 547 Class 2 for use up to 650°F, complete with all-service jacket, self sealing lap, such as made by Owens-Corning ASJ/SSL-11 or approved equal. Circumferential self sealing butt laps shall be used where necessary.

Mineral fiber block insulation used for tanks, receivers, and exchangers shall be six (6) PCF fiberglass block conforming to ASTM C 612, Class 3 for use up to 850°F, with factory applied all service jacket. Insulating cement shall be mineral fiber thermal insulation cement in accordance with ASTM C 195.

In order to achieve the thermal performance required for steam and condensate service at reasonable cost, this insulation has been normally installed in conjunction with urethane foam and coating.

URETHANE FOAM: Urethane Foam shall be rigid closed cell two component spray type for use up to 300°F, such as PDL 4034-2.5, or approved equal.

WATERPROOF URETHANE COATING: The external surface shall be coated with a two component elastomer polyurethane, fifty (50) mils in thickness, such as PDL Rimshield 11, or approved equal.

PREINSULATED PIPING SYSTEMS: Pre-insulated piping systems are available in a variety of configurations, and can offer many advantages over field or shop fabricated systems. If the Customer requires a pre-insulated system, the desired system shall meet the minimum requirements stated elsewhere in this Standard, and a meeting shall be held between the Customer, the Installer, and DU to identify and resolve issues that may exist which would affect the compatibility of the proposed system with the DU district heat system. Prior to the meeting, the Customer must obtain the following information from the pipe system supplier:

Pipe Description: _____

Pipe Diameter: Supply: _____ Return: _____

Pipe Manufacturer: _____

Pipe Material Specification*: _____

Insulation System Description: _____

Insulation Material Specification*:

(Inner): _____

(Outer): _____

Outer Covering (Type): _____

Calculated Heat Loss: (BTU/HR/FT) _____

*Note: All spec. descriptions shall be both generic name of material and ASTM, ANSI or AISI spec. number to which the product conforms.

INSULATION INSTALLATION:

Install insulation in accordance with the manufacturer's recommendations. No insulation shall be applied to joints, fittings, or valves until all testing is complete.

Installation of Rigid Insulation and Jacketing:

1 Piping sections may be completely pre-insulated in the shop and transported and installed in the field with joint insulation installation in the field. Such pipe must be clearly marked "TOP" on the final product prior to loading and transport to prevent accidental improper support positioning at installation.

2 Apply to clean, dry piping, fittings and valves.

3 Use pre-formed insulation except where formed pieces are unavailable from the manufacturer. The insulation nominal inside diameter shall match the piping nominal outside diameter.

4 Miter insulation or use preformed fittings sections for all elbows.

5 Insulate valves, flanges and fittings with a combination of block and preformed insulation as required.

6 Support insulation with factory applied integral self sealing jacketing or sixteen gauge stainless steel wire on twelve inch maximum centers.

7 The insulation jacketing shall be wrapped in a snug, wrinkle free manner. The jacket shall overlap itself to seal both horizontally and circumferentially.

8 Insulate valve bonnets to stuffing box bolts or bonnet nut. Fill irregular surfaces with insulating cement and finish similar to other pipe insulation.

9 Provide insulation supports at twelve feet maximum between supports for vertical pipe insulation. Supports shall have ½" maximum insulation cover.

10 Circumferential jacket seams shall be sealed by overlapping an adjacent self sealing jacket.

11 No insulation or jacketing shall be applied during periods of precipitation or to damp or wet piping.

12 Special oversized insulation techniques may be required by the insulation manufacturer at bends or loops. If required, the oversize insulation nominal inside diameter shall be no less than one inch larger than the piping outside diameter. Piping support within the oversized section shall conform to the manufacturer's recommendations. On vertical sections, insulation batts, six inches (6") in length shall be secured to the pipe by use of two strands of sixteen gauge (16 ga.) stainless steel wire so as to provide the necessary centering of the oversized insulation.

Installation of Urethane Foam Insulation:

1 Urethane foam material shall be applied according to the manufacturer's instructions.

2 Urethane foam material shall be spray applied to the rigid insulation jacketing, clean pipe, valves and fittings, structures free of loose dirt, debris, or other foreign material. Field applied foam shall overlap previously installed foam by a minimum of six inches.

3 No foam shall be applied during periods of precipitation or to damp or wet surfaces, or in contact with standing or flowing water.

4 Uncoated pre-insulated (shop fabricated) pipe shall be protected by covering with a drape that will prevent insulation damage due to sunlight until installed in the trench. Insulation damaged during installation shall be reinsulated.

5 Prior to application of urethane foam to condensate or hot water piping, the piping surface shall be thoroughly coated with high temperature grease such as Shell Darina. Pre-engineered piping systems designed to function without the use of the high temperature grease maybe use with written approval from DU.

6 Urethane foam insulation shall be completely coated by a fifty (50) mil thickness of polyurethane coating specified above.

3.9 COMMISSIONING

PRESSURE TESTING: Prior to tie-in to existing DU district heat distribution mains, all new distribution main piping and equipment shall be pressure tested with water. The test pressure shall be one hundred fifty (150) PSI for a minimum duration of two (2) hours. Install caps, blind flanges, or plugs as necessary at the ends of each test section. Testing against closed valves is not recommended. All pipe and fittings shall be free of any drips or leaks during visual inspection. The pipe shall be maintained at the test pressure for at least two (2) hours during which time pressure readings to the nearest one (1) PSI shall be noted at fifteen (15) minute intervals. If no perceptible pressure loss is recorded during the test interval, and no visual evidence of leakage exists, the pressure test will be considered acceptable.

FLUSHING: After successfully pressure testing the system, the pipes and fittings shall be filled with a five percent (5%) solution of trisodium phosphate, allowed to stand for two hours, and then flushed clear using potable water. DU will provide a suitable potable water connection if one is not available on-site. Following the potable water flush, the system shall be slowly filled with steam or hot water as appropriate, and continuously drained to remove residual contamination.

TIE INS: Tie in welds will be visually inspected by DU at a minimum, but are subject to NDE examination at the option DU. NDE examinations will be at contractors expense.

CONDUCTIVITY TEST: Immediately after energizing the installed piping, the Installer shall withdraw a sample of condensate from the connected piping drain and submit the sample to DU for contaminant testing. The sample shall not contain more than ten (10) micro-ohms of conductivity, or 0.02 PPM of iron. The Installer shall flush the piping from inside the Customers facilities until the contamination is reduced to the necessary limits.

3.10 VALVE BOXES

Each underground valve shall be made accessible by installation of a valve box. DU will furnish valve boxes. The valve box shall be installed by the Installer during backfill and repaving. The status of valves shall be checked by both the Installer and DU prior to final adjustment of the valve box. Field swing ties shall also be taken at this time. Upon completion of the final checks, the valve box shall be plugged, and the valve box top shall be set to one inch (1”) below final grade (before pavement) and then paved over to prevent intrusion of surface water.

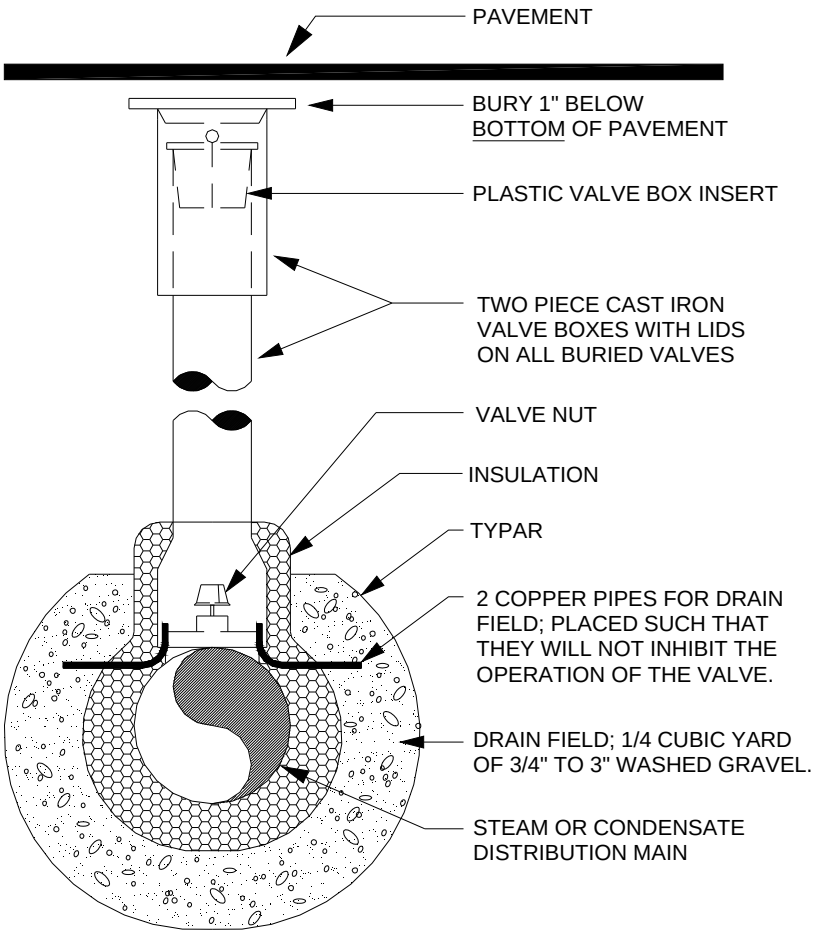

Fig. 4 - Valve Box Detail