Thermal Pipe Systems, Inc.

DUC-TITE® PIPING SYSTEM

FOR LOW TEMPERATURE HOT WATER
AND CHILLED WATER SERVICE

SPECIFICATIONS & DRAWINGS

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DUC-TITE PIPING SYSTEMS SPECIFICATIONS

DUC-TITE shall be used where specified for chilled water or low temperature hot water service using a rubber ring joining method. Unless otherwise specified, all pipe, fittings, valves and accessories shall conform to the requirements of ANSI B31.1 and shall be of the proper type for pressure and temperature of the cooling or heating water.

DUCTILE IRON CARRIER PIPE: Carrier pipe shall be Ductile Iron Pipe conforming to ANSI A21.51, and AWWA C151. Pipe shall be class 51 in sizes 3"∅ and 4"∅ and class 50 in sizes 6"∅ - 18"∅.

RUBBER SEALING RINGS: Rubber sealing rings for DUC-TITE Piping shall be as specified under AWWA C104.

CASING PIPE: The casing shall be **[Polyvinyl Chloride (PVC)]** pipe shall be of virgin PVC resin meeting the minimum classification requirements of ASTM D1784 or extruded, black, **[High Density Polyethylene (HDPE)]** conforming to ASTM D1248 and D3350. The casing and insulation system shall be suitable for H-20 wheel loading at three feet of cover. A two-foot burial depth may be acceptable when bedding and backfill materials meet highway requirements for stability and compaction. The thickness for PVC casing shall be as shown on page four. Consult manufacturer for HDPE dimensional data.

END SEALS: End seals for insulated DUC-TITE shall be compressed rubber.

POLYURETHANE FOAM INSULATION: The insulation shall be Polyurethane Foam conforming and shall meet the following specifications:

Type:	Two component urethane
Compressive Strength:	40 psi parallel min at 5% comp
Shrinkage:	None at 70°F
Free Rise Density:	2.0 to 3.0 lbs/cubic foot
Aged "K" (70°F - 72 hrs)	0.160 BTU•inch/hour•°F•ft2
Closed Cell Content:	90%

Insulation concentricity: Carrier Pipe shall be concentric to casing pipe. The allowable maximum deviation from centerline of carrier pipe shall be +\- 1\4 inch at the casing center point and +\- 1\16 inch at the end seals.

CASING-TITE SEAL: The Casing-Tite seal shall be a 30-mil high temperature tape. The Casing-Tite seal is required on low temperature hot water service and optional on chilled water service.

FITTINGS: Fittings shall be uninsulated and conform to the requirements of the latest revisions of ANSI/AWWA C153/A21.53 (compact type), ANSI/AWWA C110/A21.10 (conventional type) for push-on or restrained joint fittings, or ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 for mechanical joint fittings. Fitting sealing rings shall be furnished by the manufacturer.

WALL PENETRATION SLEEVES: Provide where piping passes through masonry or concrete walls, floors, and roofs. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be schedule 40 or standard weight coated black steel pipe or as specified by the Design Engineer. Space between piping or insulation casing, and the sleeve shall be sufficient to allow proper water tight sealing, but never less than 1/2". Sleeves shall be held securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Refer to typical detail of wall penetration as shown. In existing concrete manholes or building wall penetrations may be made using the "core drilling" method providing proper care is taken to drill the holes to the size needed and square to the line of the pipe.

WALL PENETRATION SEALS: All wall penetrations shall be sealed to prevent water from entering the building or manhole. The sealing material shall be as specified by the engineer.

DUC-TITE APPLICATION ENGINEERING

PIPE SYSTEM DESIGN: Standard design techniques and practices for DUC-TITE shall be used. Thermal Pipe Systems, Inc. Engineering Department may on request provide certain detailed design aspects of the piping for each project based on the project documents and drawings provided by the Design Engineer. It is understood that the project specifications and layout drawings will specify the type of service, the site and temperature and pressure classifications, soil conditions, and general path and elevations of the system, location and design of manholes, known obstacles, the size of the carrier pipe, and the maximum permissible heat losses. It is further understood that other requirements such as the type of pipe, the location size and capacity of valves, traps, pumps, anchors, controls, expansion devices and special structural elements will be provided by the design engineer. The design provided by Thermal Pipe Systems, Inc. and their engineers for the piping will be in accordance with ANSI B31.1 and good engineering practices.

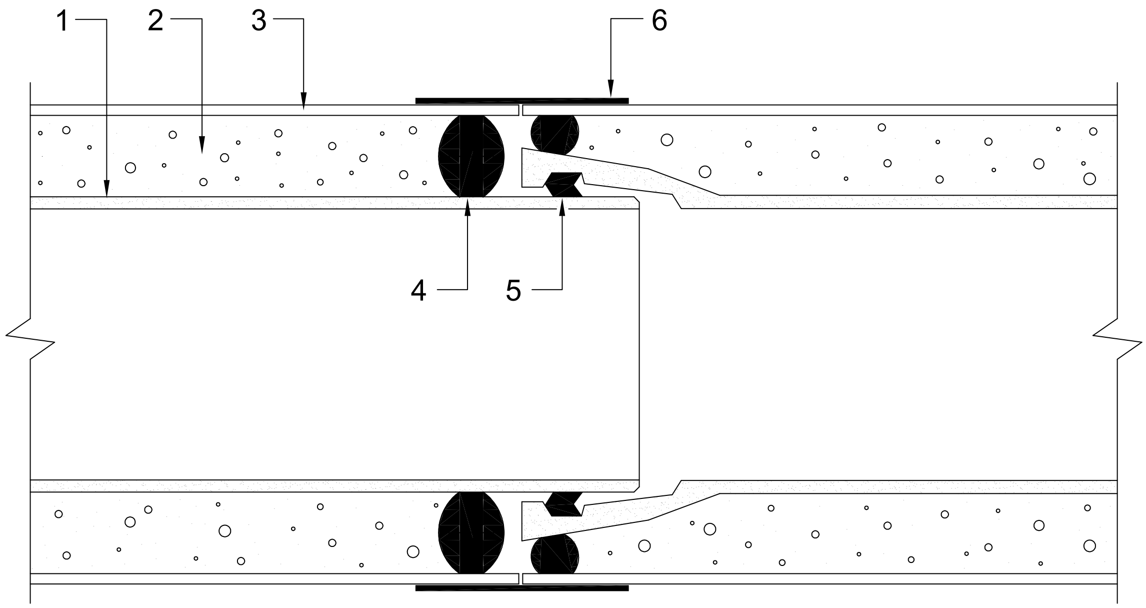
Fluid flow design will be based on Hazen-Williams formula with "C" Factor of 100, or a variation of the Euler formula for water flow.

INSULATION: Thickness of insulation for DUC-TITE pipe shall be as shown on the drawing on page four.

TEMPERATURE AND PRESSURE: The DUC-TITE piping system and all its components can be designed to operate up to 150 psig at 250°F, plus typical surges. It should be noted that at these temperatures and pressures, the pipe must be specified unlined and the sealing rings must be EPDM. It is the Design Engineer's responsibility to ensure the lining and ring specified will function properly at the temperatures and pressures used for a given project.

DIMENSIONS AND WEIGHTS of insulated DUC-TITE piping and fittings are as shown on page four. The DUC-TITE piping will be furnished in 18 or 20-foot lengths.

PRE-INSULATED DUC-TITE® PIPE

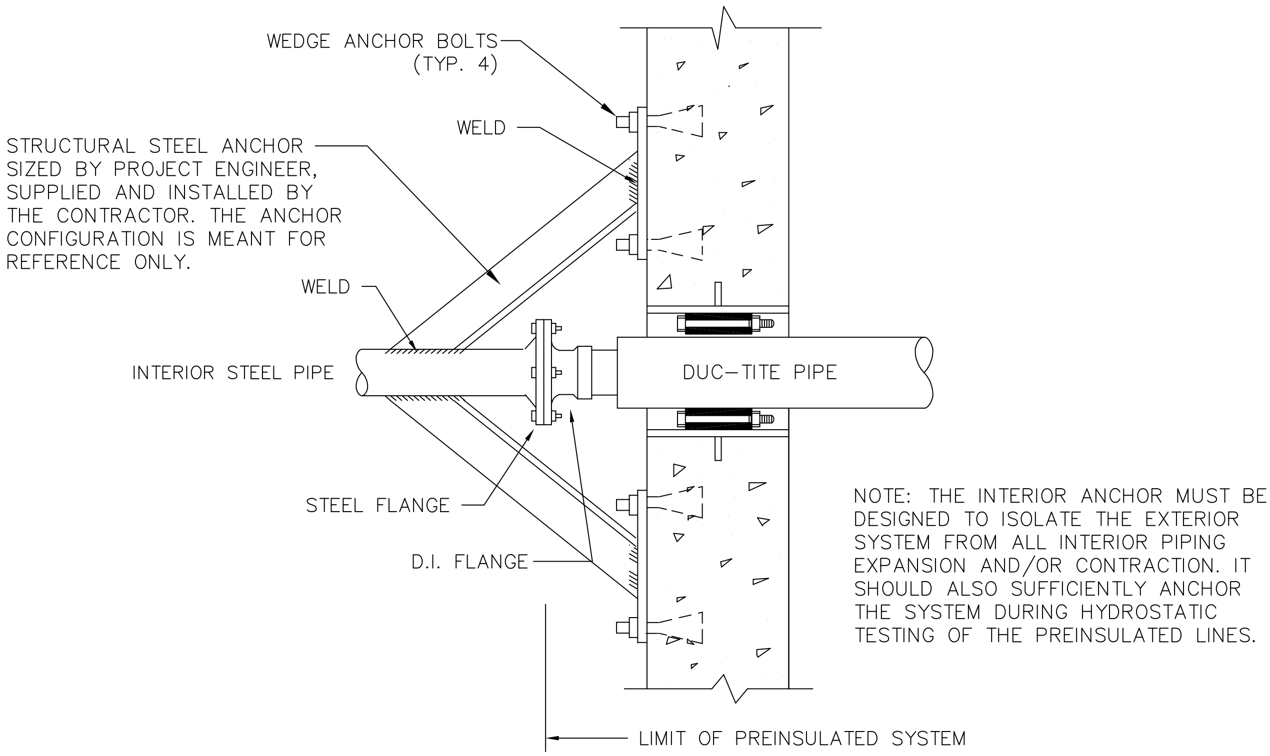


1) CARRIER: Ductile Iron
2) INSULATION: Polyurethane Foam
3) CASING: PVC or HDPE
4) END SEAL: Compression Rubber
5) SEALING RING: EPDM or SBR
6) CASING-TITE SEAL: 30mil H.T. Tape (optional for chilled water)

NOM. PIPE SIZE	CARRIER O.D.	CASING O.D.	THICKNESS		WEIGHT (LBS./18 FT.)
			PVC CASING	FOAM	
3	3.96	6.14	.12	.97	220
4	4.80	8.16	.16	1.52	265
6	6.90	10.20	.20	1.45	379
8	9.05	12.24	.24	1.36	538
10	11.10	14.28	.28	1.31	716
12	13.20	16.00	.25	1.15	872
14	15.30	18.70	.37	1.33	1,159
16	17.40	22.05	.43	1.90	1,446
18	19.50	24.80	.49	2.04	1,740

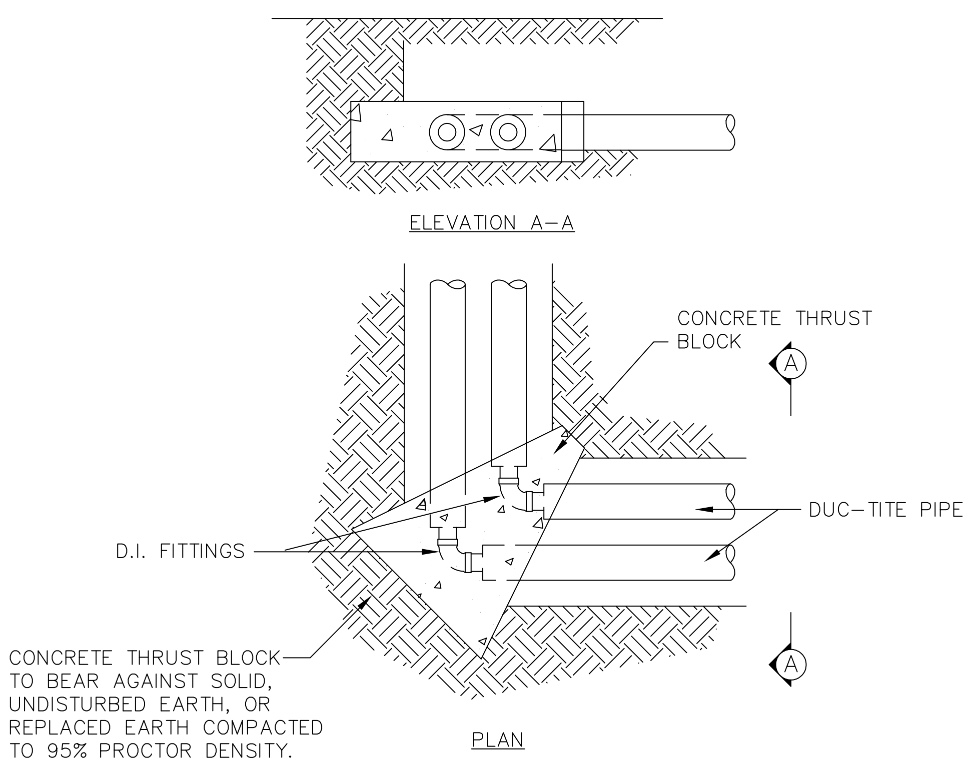
NOTE: Standard lengths are 18'-0" or 20'-0" for all sizes. All dimensions are in inches unless noted. Consult manufacturer for HDPE dimensional data.

PRE-INSULATED DUC-TITE® PIPE



TYPICAL ANCHOR AT WALL PENETRATIONS

NO SCALE



TYPICAL CONCRETE THRUST BLOCK AT ELBOWS

NO SCALE

DUC-TITE INSTALLATION SPECIFICATION

GENERAL: Installation of the DUC-TITE piping system shall be done in accordance with the appropriate publications including ANSI B31.1 and the following specifications and instructions. A Thermal Pipe Systems, Inc. field representative may conduct an installation clinic to pre-qualify contract personnel in the proper procedures for the installation.

Piping shall be accurately cut to dimensions established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation shall not be permitted. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints. Good workmanlike procedures shall be followed.

All piping, unless otherwise indicated, shall be pitched with a grade of not less than 1 inch in 40 feet toward the drain points when applicable.

Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign matter out of the system.

RECEIVING AND HANDLING SHIPMENTS

INSPECTION: Each Shipment shall be inspected upon its arrival at the site. The products are carefully loaded at the plant using methods acceptable to the carrier and it is their responsibility to deliver the pipe in good condition. It is the responsibility of the installing contractor to ascertain whether there has been any loss or damage. The carrier is the contractor's agent. Any pipe or equipment that arrives damaged or is lost in shipment shall be reported by the contractor.

Make overall inspection of the load. If load is intact, ordinary inspection while unloading should be enough to make sure that the pipe has arrived in good condition. It is the responsibility of the receiver to make certain that there has been no loss or damage. Note specifically that any end packaging should not show signs of damage. If the load has shifted, or end packing damaged, then each piece must be carefully inspected for damage. Specifically, the ends should be inspected for scars, nicks, etc. Other obvious damage is also cause for rejection. Check total quantities of each item against the tally sheet (pipe, fittings, etc.). Any damaged or missing items are to be noted on delivery receipt and the receipt returned to the carrier. Notify the carrier immediately and make claim in accordance with the carrier’s instructions. Thermal Pipe Systems, Inc. will assist, if necessary, in handling this claim. Do not dispose of damaged material - the carrier will notify you of the procedure to follow.

UNLOADING INSTRUCTIONS: The means by which the pipes are unloaded in the field is the decision and responsibility of the installing contractor. The use of forklift type equipment frequently simplifies and speeds up the unloading of larger sizes and usually provides extra protection against damage in handling. To prevent the possibility of the core pipe from shifting within the casing pipe, do not stand a length on one end or raise it vertically. Under no condition should a pipe be dragged along the ground. Do not lift fittings or pipe by inserting a bar, pipe, etc., inside of the core. Damage to the pipe may result. If any pipe is damaged in unloading and handling, mark the damaged area and set it aside. Thermal Pipe Systems, Inc. representative will determine whether damaged casing can be repaired in the field and will determine exact method for repair and instruct contractor in making repair.

COLD WEATHER HANDLING FOR PVC CASED PIPE: As the temperature approaches freezing, the flexibility and impact resistance of Duc-Tite pipe is reduced. PVC casing becomes hard and brittle in cold weather and will crack more readily if dropped or hit. Therefore, extra care should be used in handling during cold weather. Pipe at the bottom of a stack may become out-of-round due to the weight of material above it. At normal application temperatures, this corrects itself soon after the load is removed. Under freezing conditions, this recovery to full initial roundness may take several hours.

STORAGE: Store pipe on dunnage in a flat area. Support the barrel of the casing evenly. Bell and spigot ends should overhang dunnage. Store random lengths separately where they will be readily available. Individual lengths of pipe should be stacked in piles no higher than 5 feet. If pipe is to be stored outside for periods longer than 30 days, the pipe must be covered to protect it from prolonged exposure to the sun's rays. Cover with canvas or other opaque material. Do not use clear plastic sheets. Provide for natural air circulation under the sheets.

LOADING TRANSFER TRUCKS: Use trucks with long bodies so that pipe lengths do not overhang. Make certain truck bed is smooth, without cross-strips, bolt heads, or other protrusions that could damage the pipe. Short body trucks may be used if fitted with racks that properly support the pipe in a horizontal position. The rack should have supports spaced every 3 feet or less along the pipe lengths. Pad the contact areas to avoid damage to the pipe.

DISTRIBUTING PIPE ALONG TRENCH: Pipe lengths may be strung along the line of the trench to minimize additional handling during installation.

EXCAVATION: Excavation should consider the need for the thrust blocks at all fittings that are directly buried in the ground. The trench bottom must give uniform support along the entire length of any pipelines. Where several pipelines are in a common trench, the trench must be wide enough to maintain the specified distances between adjacent lines, generally a minimum of 6" in pipe sizes up to 6" diameter, and 12" minimum in sizes 8" and larger. The excavation should be in a straight line.

TRENCHING: Trenching shall follow the elevations provided by the Design Engineer on the contract drawings. The trench depth should always allow for a minimum cover height of 24" over the top of the casing pipe. Keep excavations free of water during construction. If the contractor determines it is necessary to remove unsuitable material to a depth greater than specified, refill over excavated area to the proper depth with specified bedding material compacted in 6 inch lifts to 95 percent of maximum density in accordance with ASTM D1557, Method D. Excavate and replace soil disturbed and weakened by the contractor's operations or soils permitted to soften from exposure to weather, with bedding material and compact with a plate-type vibratory compactor.

TRENCH WIDTHS: The width of the trench at the top of the pipe should be held to the minimum required for efficient and proper installation. The reason for this is to keep the earth load on the pipe as small as possible. The wider the trench at the top of the pipe, the greater the load on the pipe. But note that an increase in trench width above the top of the pipe, by stepping the sides or digging a wider offset trench, does not affect the earth load on the pipe. On the other hand, a trench that is too narrow will make assembly difficult and may reduce the rate and quality of installation. In addition, lack of ample room will limit the capability to properly backfill and tamp around the pipe. Although each job or portion of a job must be considered on an individual basis, as a rule, the following minimum trench widths at the top of the pipe are recommended: Minimum: one foot greater than the outside diameter of the casing. Where two or more pipes are in the same trench, use the distance between outside casing of the outside pipes plus one foot. Maximum: Use above method for minimum plus two feet.

PLACING PIPE IN THE TRENCH: The DUC-TITE pipe may be hand or mechanically passed into the trench. The latest state and federal safety regulations should be understood and observed. If slings are necessary use only canvas straps, do not use cable or chain slings.

BEDDING: Bedding material should be sand or other materials free of sharp objects, heavy clods, boulders or frozen lumps as specified by the Design Engineer. The approved bedding should be used 6" under, around, and over the pipe. Utilize good practices that apply to all buried pressure pipes.

ASSEMBLY:

1) Thoroughly clean out the bell. Remove all dirt, sand, mud, ice, excess paint or lining and any other foreign matter from the joint.

2) Clean off the spigot end, removing any dirt, foreign matter or excess paint. Make sure the plain end is beveled. File smooth any sharp edges which might damage the sealing ring.

3) Insert the sealing ring in its recess in the bell, with the large end of the gasket entering first. Make sure that the gasket faces in the correct direction and is properly seated. The sealing ring may be installed using a v-shaped fold. Use one hand to hold a loop in the ring, the other to tuck the bottom portion into its recess. After the ring is in place at the bottom, press the top portion into the recess. Pull the ring forward against the bell lip and check to be sure that it is completely seated all the way around.

4) Apply a thin coating of lubricant to the inside surface of the installed ring just prior to joint assembly. Make certain the entire inner surface of the gasket is coated. Also apply a thin coating of lubricant to the beveled portion of the plain end.

5) Guide the spigot end into the bell and compress the sealing ring by pushing the spigot into the bell socket. Keep the bell and spigot end in reasonably straight alignment during assembly. Use the spigot end marking stripe(s) to ensure proper spigot insertion into the bell.

6) Care must be taken during assembly to ensure that no dirt, sand, or other foreign matter enters the joint. Dig a bell hole if necessary.

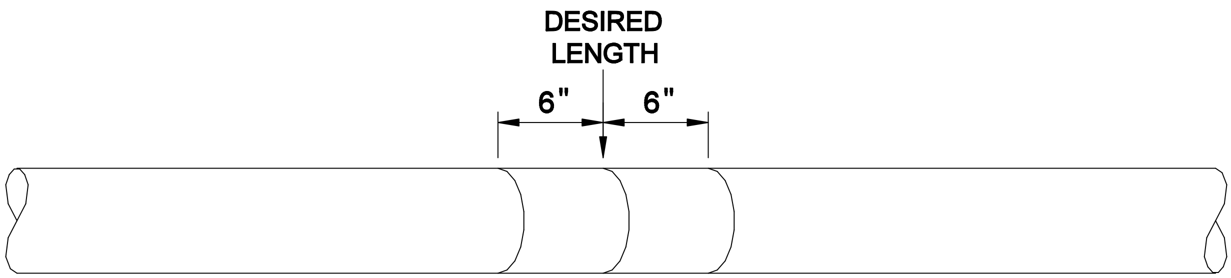
TESTING: All carrier pipe joints shall be tested in accordance with the contract specifications. If no test is specified, it should consist of a hydrostatic test of 150 psi or 1 1/2 times working pressure, which ever is greater, for a period of two hours.

BACKFILLING: Backfilling of trenches shall progress as rapidly as construction, testing, and acceptance of work permits. Uniformly compact and grade bottom of trenches. After installation of pipe and bedding material, backfill as follows: place initial backfill in layers to a depth of 12 inches over the top of the initial bedding. Compact the material to a density equivalent to the surrounding undisturbed soil or to 88 percent of maximum density (ASTM D1557, Method D), whichever is greater. Backfill remainder of trench in one-foot lifts and compact to 90 percent maximum density (ASTM D1557, Method D). For trenches excavated in roads, streets, or located under structures, place backfill in 6-inch layers to top of trench and compact each layer to at least 95 percent maximum density (ASTM D1557, Method D).

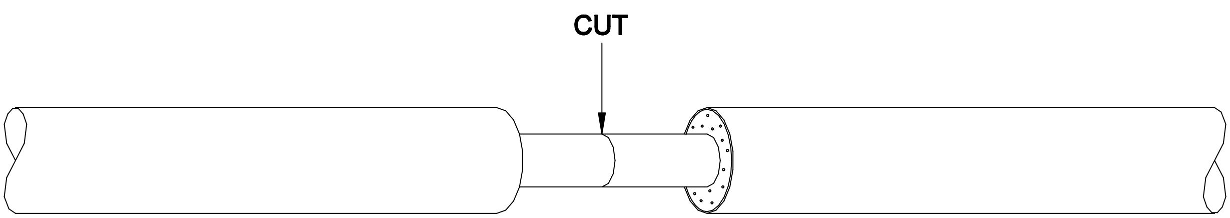
FLANGED JOINTS: Flanged joints shall be faced true, provided with gaskets, and made perfectly square and tight.

FIELD CUTTING PIPE TO A SPECIFIC LENGTH

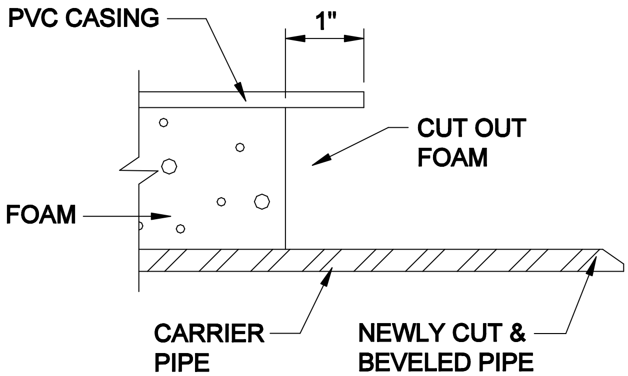
Determine the exact length of carrier pipe needed. Mark the casing at this point. Measure back 6 inches on both sides and mark the casing at these points using a wrap-around.

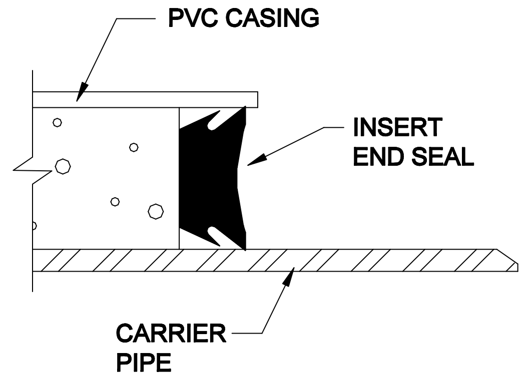


Use a fine-tooth carpenters handsaw or PVC saw to cut the PVC or HDPE casing. Remove the casing and cut off the insulation. Be careful not to damage ductile iron carrier pipe during this operation. See illustration below.



Mark, cut, and bevel the Ductile Iron pipe at the desired length. Remove any burrs. Make sure cut is square. Thoroughly clean all insulation from the spigots. Remove the insulation between the casing and the carrier pipe to a distance of one inch. Insert the rubber end seal between the casing and the carrier pipe using the handle of a hammer or screwdriver to push the seal all the way. Silicone caulking may be used in lieu of the rubber end seal.





THRUST BLOCKS: Thrust blocks must be installed wherever the pipeline changes direction or size as at tees, elbows or reducers or at any point that develops thrust such as at a valve or similar equipment. The above situations may occur either where the fittings etc., are directly buried in the soil, or are in a manhole.

Thrust blocks must be designed for maximum anticipated operating or test pressure. If it is anticipated that pressures higher than normal operating pressures will be used at some later date, thrust blocks to accommodate such pressures should be installed initially. Size and type of thrust blocks depend on pressure, pipe size, and the type of soil. This information shall be supplied by the Design Engineer. Where a thrust block serves more than one line, the block must be designed to resist the sum of the thrusts of all the lines involved. Thrust blocks should be poured on and against undisturbed soil or soil tamped to 95% proctor density.

Thrust blocks shall be installed using concrete having a compressive strength of 3,000 psi minimum ultimate 28 days compressive strength, air entrained, with water reducing admixture. Where the soil bearing value is less than 1000 pounds per square foot, Thermal Pipe Systems, Inc. will make the necessary calculations and recommendations as to how the fitting should be thrusted. Where special thrust provisions are needed, Thermal Pipe Systems, Inc. will recommend the necessary design.

CAST IRON FITTINGS:

The table below gives the thrust load at any fitting in lbs. at 100 psi* pressure:

Size (in.)	Tee	90° Elbow	45° Elbow
3	1,232	1,742	943
4	1,810	2,559	1,385
6	3,739	5,288	2,862
8	6,433	9,097	4,923

10	9,677	13,685	7,406
12	13,685	19,353	10,474
14	18,385	26,001	14,072

*For pressure other than 100 psi increase loads proportionately (example: for 150 psi multiply by 1.5; for 200 psi multiply by 2.0; etc.)

NOTE: Dead End and Anchor loads are equal to tee shown above.

The approximate safe bearing loads of various soils given in the following table are for horizontal thrusts when the depth of cover over the top of the pipe exceeds two feet.

These loads are estimates only. Actual soil and safe bearing loads should be determined by the Design Engineer.

SOIL	SAFE BEARING LOAD lbs./sq. ft.
Muck, Peat etc.*	0
Soft Clay	1,000
Sand	2,000
Sand & Gravel	3,000
Sand & Gravel Cemented with Clay	4,000
Hard Shale	10,000

*All thrusts are resisted by piles or tie rods to solid foundations, or by removal of muck or peat and replacement with ballast of sufficient stability.

START UP PROCEDURE: Start up procedure shall conform to generally accepted practices and be done in a workman-like manner. The line shall be filled from any available low-pressure source. The water can be introduced from lines in service directly through valved connections, or temporary connections to taps made in the new line. If possible all such connections should be made at the lowest point in the line to avoid air entrapment. All valves and other control points in the line that are open as the line filling begins should be closed gradually to avoid the possibility of water hammer.