

Thermal Pipe Systems, Inc.

COPPER-CORE® PIPING SYSTEM

**FOR DOMESTIC AND
HEATING HOT WATER SERVICE**

SPECIFICATIONS & DRAWINGS

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COPPER-CORE PIPING SYSTEMS SPECIFICATIONS

COPPER-CORE shall be used where specified for low temperature hot water, chilled water, or dual-temp services 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 heating or cooling water.

COPPER CARRIER PIPE: Carrier pipe shall be Type "K" hard drawn Copper and comply with ASTM B-88.

COPPER CORE COUPLING: The coupling shall be a grooved bronze coupling installed at the factory, as shown on page three.

RUBBER SEALING RINGS: The sealing rings shall be molded high temperature (HT) heat resistant Ethylene Propylene Diene Monomer (EPDM) using a properly vulcanized compound. The ring surfaces shall be smooth and free from all porosity and internal voids.

CASING PIPE: The casing shall be [**Polyvinyl Chloride (PVC)**] pipe 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 thickness for PVC casing shall be as shown on page three. Consult manufacturer for HDPE dimensional data.

RUBBER END SEALS: Rubber end seals for insulated COPPER-CORE shall be a high temperature (HT) heat resistant Ethylene Propylene Diene Monomer (EPDM) molded rubber compound. All surfaces shall be smooth and free of voids. End seals for 6"Ø shall be high temperature (HT) rubber with a compression type seal.

POLYURETHANE FOAM INSULATION: The insulation shall be Polyurethane Foam 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)	0.16 BTU-in./hour-°F-ft.2
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 plus or minus 1/4 inch at the casing center point and plus or minus 1/16 inch at the end seals.

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 the pipe OD and sleeve ID shall never be 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.

COPPER-CORE APPLICATION ENGINEERING

PIPE SYSTEM DESIGN: Standard design techniques and practices for COPPER-CORE 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.

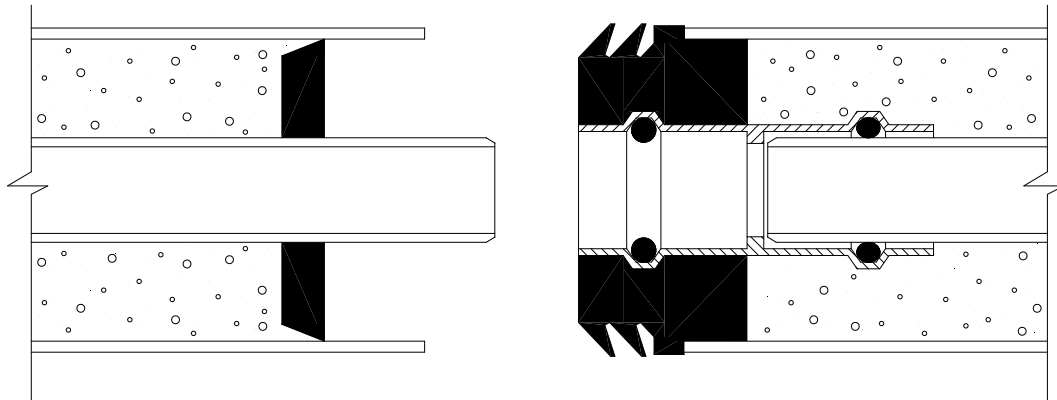
Fluid flow design will be based on Hazen-Williams formula with "C" Factor of 150, or a variation of the Euler formula for water flow.

INSULATION: Thickness of insulation for COPPER-CORE pipe shall be as shown on the drawings on page three.

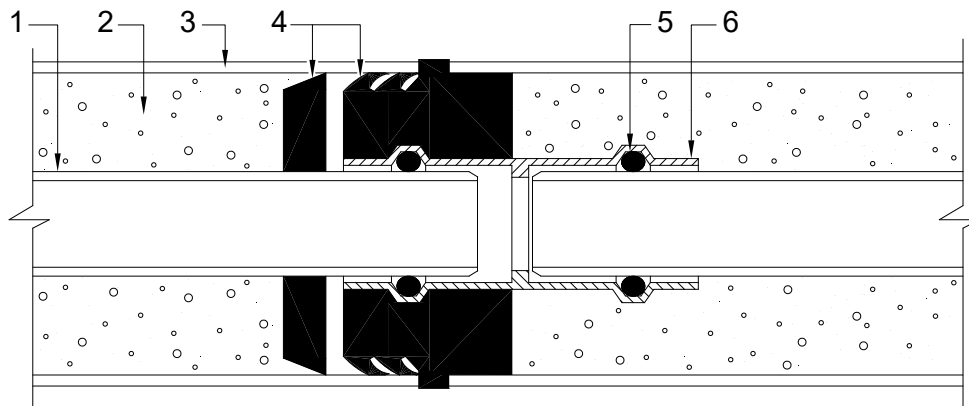
TEMPERATURE AND PRESSURE: The COPPER-CORE piping system and all its components are designed to operate up to 150 psig at 250°F, plus typical surges.

DIMENSIONS AND WEIGHTS of insulated COPPER-CORE piping system are as shown on page three. The COPPER-CORE piping will be furnished in 20-foot lengths.

PRE-INSULATED COPPER-CORE® PIPE



UNASSEMBLED JOINT



ASSEMBLED JOINT

- 1) CARRIER: Type 'K' Copper
- 2) INSULATION: Polyurethane Foam
- 3) CASING: PVC or HDPE
- 4) END SEALS: EPDM
- 5) SEALING RINGS: EPDM
- 6) COUPLING: Grooved Bronze

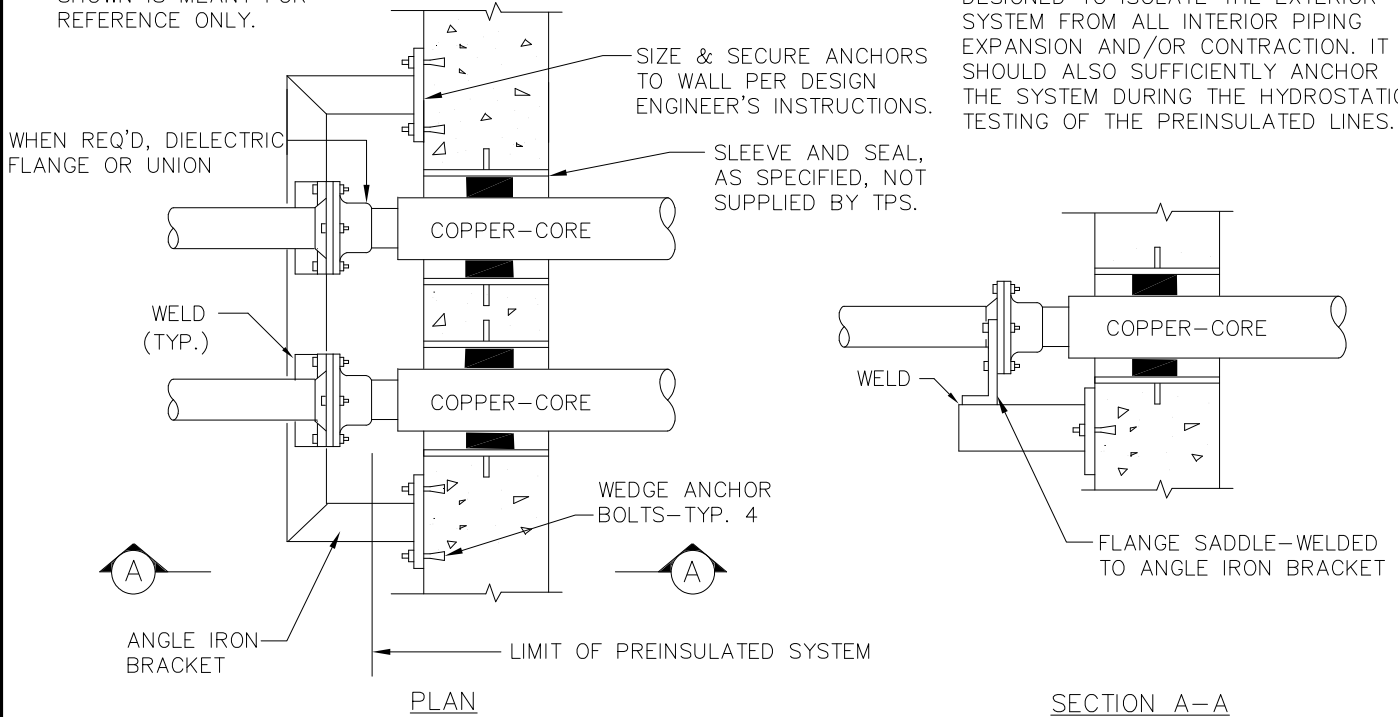
NOM. PIPE SIZE	CARRIER O.D.	CASING O.D.	THICKNESS		WEIGHT (LBS./20 FT.)
			PVC CASING	FOAM	
1	1.12	3.50	.06	1.13	35
1 1/4	1.37	3.50	.06	1.00	40
1 1/2	1.62	4.21	.12	1.17	54
2	2.12	4.21	.12	0.92	68
2 1/2	2.62	6.14	.12	1.64	97
3	3.12	6.14	.12	1.39	98
4	4.12	6.14	.12	0.89	158
6	6.12	10.20	.20	1.84	360

NOTE: 6" Copper-Core will have a separate preinsulated bronze coupling. All dimensions are in inches unless noted. Consult manufacturer for HDPE dimensional data.

PRE-INSULATED COPPER-CORE® PIPE

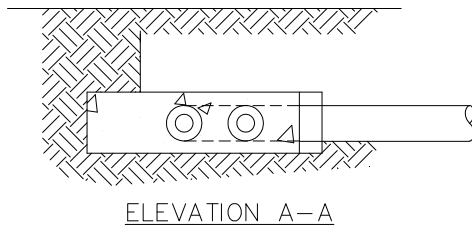
THE ANCHOR CONFIGURATION SHOWN IS MEANT FOR REFERENCE ONLY.

NOTE: THE INTERIOR ANCHOR MUST BE DESIGNED TO ISOLATE THE EXTERIOR SYSTEM FROM ALL INTERIOR PIPING EXPANSION AND/OR CONTRACTION. IT SHOULD ALSO SUFFICIENTLY ANCHOR THE SYSTEM DURING THE HYDROSTATIC TESTING OF THE PREINSULATED LINES.



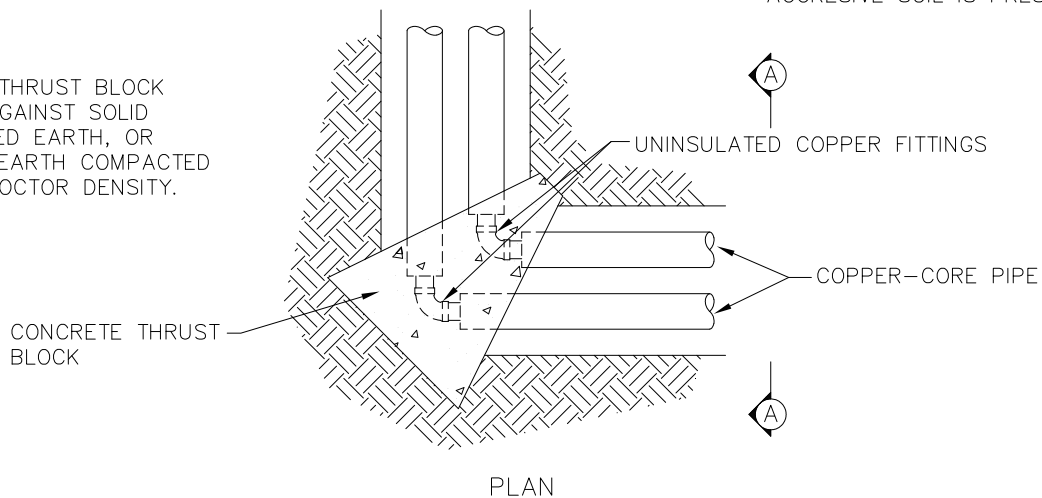
TYPICAL ANCHOR AT WALL PENETRATIONS

NO SCALE



NOTE: A PVC TAPE MUST BE SPIRALLY WRAPPED ONTO FITTINGS AND EXPOSED SPIGOTS WHERE AGGRESSIVE SOIL IS PRESENT.

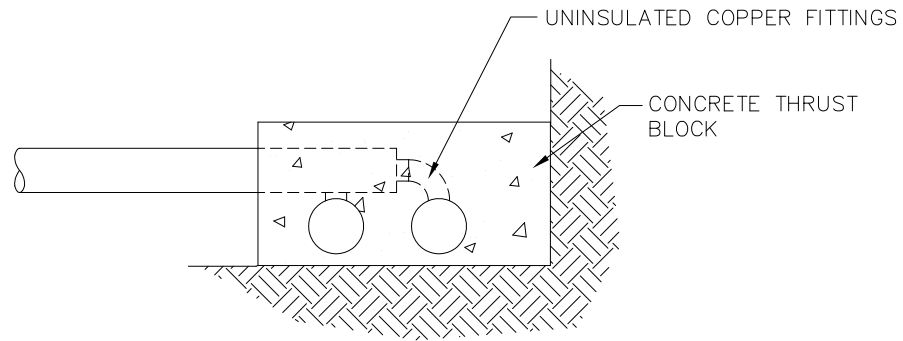
CONCRETE THRUST BLOCK TO BEAR AGAINST SOLID UNDISTURBED EARTH, OR REPLACED EARTH COMPACTED TO 95% PROCTOR DENSITY.



TYPICAL THRUST BLOCK AT ELBOWS

NO SCALE

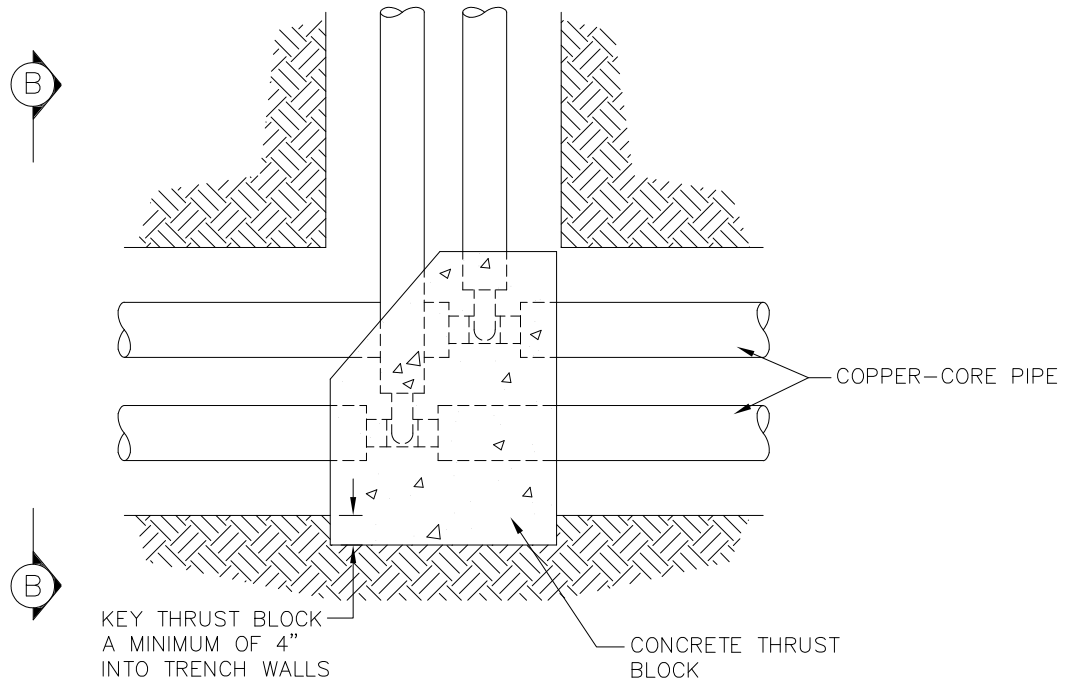
PRE-INSULATED COPPER-CORE® PIPE



ELEVATION B-B

CONCRETE THRUST BLOCK TO BEAR AGAINST SOLID UNDISTURBED EARTH, OR REPLACED EARTH COMPACTED TO 95% PROCTOR DENSITY.

NOTE: A PVC TAPE MUST BE SPIRALLY WRAPPED ONTO FITTINGS AND EXPOSED SPIGOTS WHERE AGGRESSIVE SOIL IS PRESENT.



PLAN

TYPICAL THRUST BLOCK AT TEES

NO SCALE

COPPER-CORE INSTALLATION SPECIFICATION

GENERAL: Installation of the COPPER-CORE 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 were carefully loaded at the plant using methods acceptable to the carrier and it is his 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 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. A 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 COPPER-CORE 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. It should be noted that when PVC pipe is stored outside and exposed to prolonged periods of sunlight, an obvious discoloration of pipe can occur. This coloration is a surface layer of hardened plastic and does not inhibit the long-term properties and performance of the pipe. A method of protecting pipe during long exposures (several months) to sunlight is to cover it with canvas or other opaque material. Do not use clear plastic sheets and be sure to provide for 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.

EXCAVATION: Excavation should consider the need for the thrust blocks at all fittings that are direct 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" is sufficient. 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. 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.

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

PLACING PIPE IN THE TRENCH: The COPPER-CORE 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 buried pressure piping.

ASSEMBLY :

- 1) Be sure all surfaces are clean and that the "o"-ring is properly seated in the bronze coupling.
- 2) Check that the exposed end of copper pipe is clean and does not have any nicks, burrs or scratches that could damage the rubber ring during assembly. The packaging is designed to protect these ends and should not be removed until pipe is ready to be installed.

- 3) Dig a slight bell hole to keep the joint area clean and free of loose soil during assembly.
- 4) Apply the lubricant supplied to the copper ends and to the inside of the casing pipe just enough so it will slide easily together.
- 5) Before assembling the joint, lay a small wire across the fins and hold in place while the joint is being assembled. This will permit the escape of air in the joint cavity.
- 6) Start the spigot end into the bell by hand, and then holding the length straight, push it home until the casings butt with a bar and block. After assembly is complete, withdraw the wire.

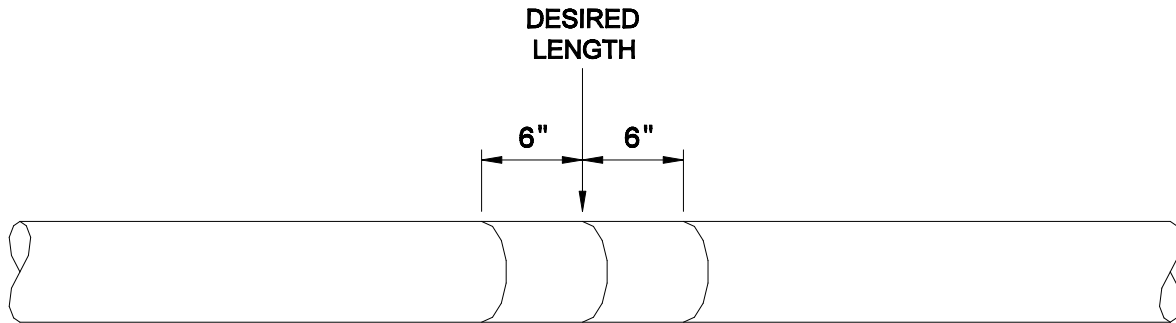
TESTING: All carrier pipe joints shall be tested in accordance with the contract specifications. If no test is specified, it should consist of a hydrostatic test of 150 psi or 1½ times working pressure, whichever is greater, for a period of two hours. It should be noted that the diameters involved with COPPER-CORE are comparatively small and the volume of water involved in testing may be small. Therefore, entrapped air, temperature changes and slight movements of the pipe can cause great variations in test pressures. These factors should be taken into consideration and care should be taken to minimize their influence on the test results.

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 of the initial bedding. Compact the material to a density equivalent to the surrounding undisturbed soil or to 90 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).

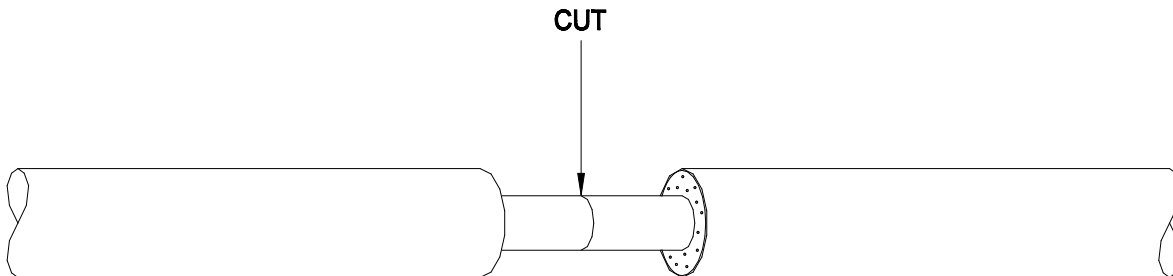
FLANGED JOINTS: Flanged joints shall be faced true, provided with gaskets, and made perfectly square and tight.

FIELD CUTTING PIPE TO A SPECIFIC LENGTH

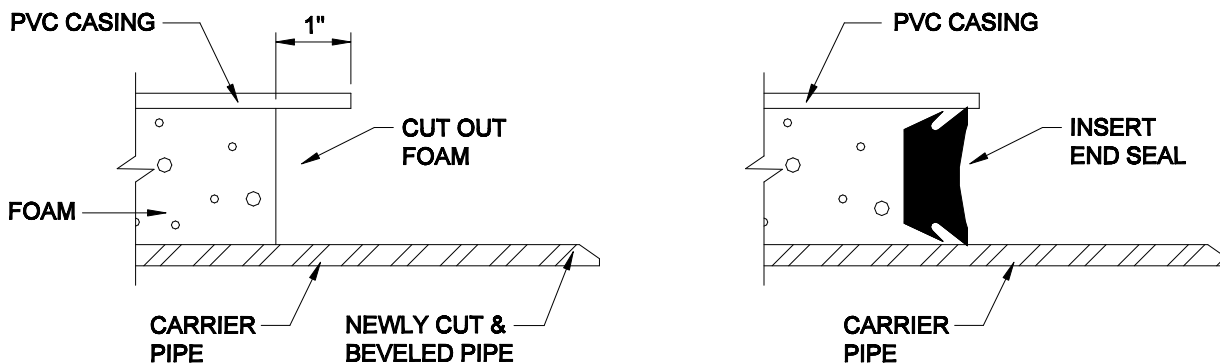
Determine the exact length of carrier pipe needed. Mark the casing at this point. Measure back 6 inches on both sides and mark the casing at these points using a wrap-around.



Use a 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 copper carrier pipe during this operation. See illustration below.



Mark, cut, and bevel the copper pipe at the desired length. Make sure cut is square. Remove any burrs or ridges on the pipe. Using a utility knife, remove the insulation between the casing and the carrier pipe one inch in from the face of the PVC or HDPE casing as shown below. 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 and 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 of 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 a concrete having a compressive strength of not less than 3000 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 thrust. Where special thrust provisions are needed, Thermal Pipe Systems, Inc. will recommend the necessary design.

COPPER CORE FITTINGS:

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

Size (in.)	90° Elbow	45° Elbow	Tee
1	115	60	80
1 1/4	175	95	125
1 1/2	250	135	175
2	425	230	300
2 1/2	675	370	480
3	960	525	680
4	1695	925	1200
6	3998	2165	2828

*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 slowly from any available low-pressure source. The water can be introduced from lines in service directly through valved connections, or by 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.

