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An American National Standard

Standard Practice for Underground Installation of Thermoplastic Pressure Piping[1]

This standard is issued under the fixed designation D 2774; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

In general, thermoplastics pressure piping materials behave as ductile materials under load, meaning that they can undergo considerable deformation without damage. Piping made from such materials has the ability to bend under a load without breaking and to deform in other ways, while offering continued resistance. This flexibility allows ductile thermoplastic pipe to activate through pipe deformation lateral soil forces which create a pipe/soil system capable of safely supporting–even in pipes subject to little or no internal pressure–the earth and superimposed loads which are encountered in most pipe installations. However, proper installation techniques are required to ensure that the necessary support at the bottom and passive soil pressures at the sides of the pipe are developed and maintained.

Soils in which trenches are dug shall be examined and identified and the trenches prepared and backfilled in accordance with sound bedding procedures and this practice.

1. Scope

1.1 This practice governs procedures and references ASTM specifications for underground installation of thermoplastic pressure piping, 63-in. (1372-mm) nominal size and smaller. It is beyond the scope of this practice to describe these procedures in detail since it is recognized that significant differences exist in their implementation depending on kind and type of pipe material, pipe size and wall thickness, soil conditions, and the specific end use.

1.1.1 This practice assumes that over the range of anticipated operating conditions, including maximum external loading and minimum internal pressure, the soil/pipe system will offer sufficient structural stability to resist possible excessive diametrical deformation, or even collapse. In cases, particularly with large diameter thinner-walled pipe, for which the validity of this assumption may be in question, the selection of pipe and recommended installation conditions shall be determined by a qualified engineer.

1.1.2 Specific pipe characteristics and end-use requirements shall dictate addition to, or modification of the procedures stated or referenced herein.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Sections 10 and 11.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 1600 Terminology Relating to Abbreviations, Acronyms, and Codes for Terms Relating to Plastics

D 2487 Test Method for Classification of Soils for Engineering Purposes

D 2488 Practices for Description and Identification of Soils (Visual-Manual Procedure)

F 412 Terminology Relating to Plastic Piping Systems

2.2 *AWWA Standard:*

C 651 Standard for Disinfecting Water Mains[3]

[1] This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61 on Water Pipe.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Water Works Association, 6666 W. Quincy Ave., Denver, CO 80235.

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Terminology F 412, unless otherwise specified. Abbreviated terms are in accordance with Terminology D 1600. Installation terminology used in this practice is illustrated in Fig. 1.

3.1.2 The term pipe refers to both pipe and tubing, unless specifically stated otherwise.

3.1.3 *protective sleeve, n*—a short section of pipe installed over system piping where there is a transition from relatively rigid piping or structure to relatively flexible piping or structure to protect the transition region from excessive bending or shear stresses. For example, protective sleeves are installed at connections between plastic or non-plastic mains and plastic lateral branch or service lines (such as service or branch connections to tapping tees or saddles), where plastic pipe enters or exits a casing, or where plastic pipe penetrates a building or vault wall.

4. Significance and Use

4.1 This practice may not apply to products which shall be subject to failure at relatively low strains. For low ductility materials, the installed pipe/soil system shall be sufficiently rigid to prevent pipe deformations which could strain the piping material beyond its safe strain limit.

5. Joining

5.1 Plastic pipe shall be joined together or to other pipes of dissimilar material using a number of different techniques. Commonly used procedures, joining materials, and fittings are defined by various standards. (See Appendix X1.) The technique used shall be suitable for the particular pipes being joined to one another. Manufacturers shall be consulted for specific instructions not covered by existing specifications. When requesting information, the intended service application shall be made known.

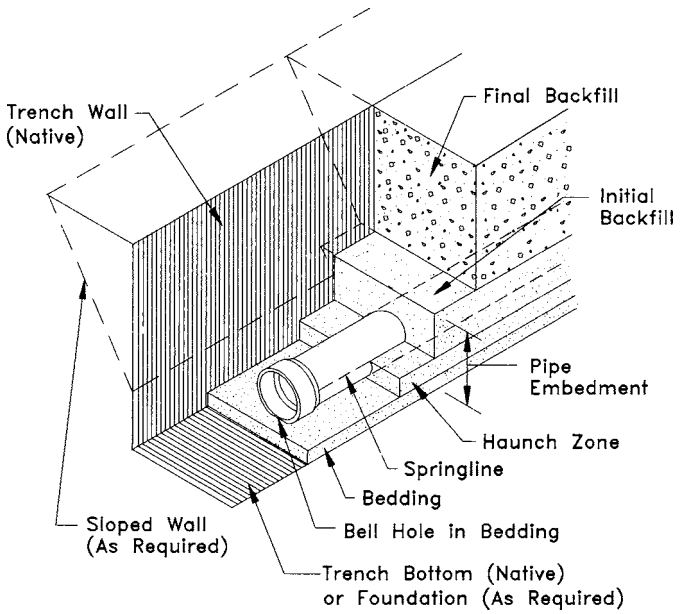

FIG. 1 Installation Terminology

5.2 Skill and knowledge on the part of the installer are required using recommended techniques to obtain quality joints. Training of new installers shall be made under the guidance of skilled individuals. Detailed written procedures and visual aids used to train personnel are available from piping and joining equipment manufacturers.

5.3 The use of fittings and joining procedures which are not covered by a recognized standard is subject to the judgment and discretion of the purchaser. Each fitting and joining procedure used shall be qualified by investigation, testing, and experience to establish its suitability and safety for the intended service. Fittings and joints shall have long-term pressure capabilities equal to or greater than the system's maximum anticipated sustained operating pressure.

5.3.1 Thrust transmitting joints such as heat fused or solvent cemented, shall be capable of restraining maximum anticipated pipe pull-out forces generated by any unbalanced forces from internal pressure or pipe expansion/contraction, or both.

5.3.2 Gasketed and other non-thrust transmitting joints shall be restrained by means of properly engineered external restraints (thrust blocks) or joint restraint devices (see 7.3).

NOTE 1—Where there are unbalanced momentum forces and thrust is transmitted through the joints, consideration shall be given to the design capacity of each joint in the system to safely resist maximum anticipated axial thrust (see 7.3). Where a piping section having thrust transmitting joints is connected to a piping section having non-thrust transmitting joints, measures shall be taken to anchor or restrain the end of the thrust transmitting joint section against longitudinal movement so that contractive forces shall not be transmitted and cause disjoining of non-thrust transmitting joints.

6. Trenching-Recommended Installation Procedure

6.1 *Trench Stability*—During trench excavation, ensure that the trench sides shall be stable under all working conditions. The trench walls shall be sloped or appropriate supports provided to comply with all applicable local, state, and federal requirements for safety.

6.2 *Trench Width*—The width of the trench at any point below the top of the pipe shall be sufficient to provide adequate room for each of the following requirements: (*1*) joining the pipe in the trench if this is required; (*2*) snaking of small-diameter, heat fused or solvent cemented pipe from side-to-side along the bottom of the trench, when the effects of contraction are not otherwise accommodated; (*3*) filling and compacting the side fills; and (*4*) checking the elastomeric seal joints. Minimum trench widths shall be permitted to be utilized with most solvent-cemented and heat-fused pressure pipe materials by joining the pipe outside the trench and lowering the pipe into the trench after adequate joint strength has been attained (see 10.4). This practice shall be permitted to be used for gasket joint pipe, with manufacturers approval, providing care is taken to not disassemble the joints during lowering.

6.3 *Trench Bottom*—The trench bottom shall be prepared for the direct replacement of the pipe and shall be continuous, relatively smooth, free of rocks, and provide uniform support. For bell-ended or coupled pipe, suitable "bell-holes" shall be provided at each joint to permit the joint to be assembled and the pipe to be supported properly.

6.3.1 Where ledge rock, hardpan, or boulders are encountered, it shall be required to pad the trench bottom with a bedding of at least 4-in. (100-mm) thickness of compacted granular material. In situations where rapid movement of water takes place through this bedding, the granular material used shall have gradation that prevents loss by migration of any pipe embedment material (see 9.8).

6.4 *Trench Depth and Pipe Cover*—Excavation for pipe trenches shall be to the lines, grades, and dimensions shown on the contract drawings. Sufficient cover shall be maintained to adequately reduce the traffic or other concentrated and impact loads.

6.4.1 Reliability and safety of service shall assume major importance in determining minimum cover for any intended service. Local, state, or federal codes shall also govern. Pipe intended for winter water service shall have a minimum cover equal to or greater than the maximum expected frost penetration depth.

6.4.2 A minimum cover of 24 in. (610 mm) for pipe shall be required when subjected to heavy overhead traffic. In areas of light overhead traffic a minimum cover of 12 to 18 in. (305 to 457 mm) is required.

6.5 *"Trenchless'' Installation*—Some types of thermoplastic pressure pipe shall be permitted to be installed using methods that do not require excavation.

7. Pipe Placement

7.1 *Pipe Joint Assembly*—Pipe assembly shall be conducted in accordance with the manufacturer's published recommendations. Above ground joining of pipe joined by solvent cementing, heat fusion or some other thrust transmitting connection shall be permitted. After the joint is appropriately "cured" (see Section 10) the pipe is lowered into the trench. This practice shall be permitted to be used for gasket joint pipe, with manufacturers approval, providing care is taken to not disassemble the joints during lowering.

7.2 *Pipe Bending*—Assembled thermoplastic pipe may be bent longitudinally if the bending radius is within limits prescribed by the manufacturer. There shall be two limits, one for pipe without joints and the other for pipe sections with joints.

7.3 *Thrust Restraint*—When installing piping systems with joints that cannot transmit the anticipated maximum longitudinal thrust, thrust restraint shall be required at changes in direction, or terminal ends, to prevent joint disengagement.

7.3.1 Where the piping system employs non-self restraining joints (for example, elastomeric seal bell and spigot type joints) at points where line shift or joint separation at system operating pressure can be anticipated, that is, pump discharge, directional changes, reducers and dead ends, thrust restraint shall be is required to prevent joint disengagement and ensure the proper performance of the pressure piping system.

7.3.2 Where the piping system employs self-restraining joints (for example flanges, heat fusion, mechanical joint restraint or solvent cement joints) at these points in the system, thrust blocking shall is not be required for thrust restraint.

7.4 *Thrust Restraint Methods*—Thrust restraint shall be achieved by use of mechanical thrust restraint devices or by use of concrete thrust blocking.

7.4.1 *Mechanical Thrust Restraint Devices*:

7.4.1.1 Devices used for thrust restraint of PVC pipe shall conform to Standard F 1674.

7.4.1.2 Consult device manufacturer for design assistance.

7.4.2 *Cast In Place Concrete Thrust Block Construction*:

7.4.2.1 The thrust block shall be constructed of cast in place concrete having a compression strength of 2000 psi (14 MPa) or more. Precast concrete blocking, wood blocking, or stone blocking with wood wedges, are not acceptable.

7.4.2.2 The thrust block acts as an anchor between pipe or fitting and the solid trench wall. The size of the thrust block shall be adequate to prevent pipe movement at the point of thrust. Consult the system designer.

7.4.2.3 The thrust block cavity shall be hand dug into undisturbed soil and framed, with soil or wood to hold freshly poured concrete. The earth bearing surfaces shall be undisturbed.

7.4.2.4 Before pressurizing the line, adequate time shall be required for the concrete thrust blocks to gain sufficient strength.

7.4.2.5 Precast concrete thrust blocks shall not be used in direct contact with thermoplastic fittings for buried pressure piping systems.

7.5 *Protecting Transition Regions*—A transition region between relatively rigid piping or structures and relatively flexible piping is subject to intensified localized bending or shear stresses, especially during soil consolidation after initial installation. In these transition regions, plastic pipe is protected against excessive stresses with a protective sleeve and stable bedding and backfill, or with stable bedding and backfill. The preferred practice is the combination of a protective sleeve and stable bedding and backfill.

7.5.1 Protective sleeves are usually plastic tubes, either extruded for the purpose or cut from lengths of plastic pipe, but they shall be permitted to be any material of sufficient strength and durability. Protective sleeves extend from rigid piping of structure across the transition region and along the plastic pipe for a length that ensures that plastic pipe at the transition region is not subject to excessive stress. The protective sleeve is appropriately secured to remain in place during backfilling. Where plastic piping penetrates a building or a vault wall, one end of the protective sleeve shall be embedded in the wall.

7.5.2 The diameter, wall thickness and length of the protective sleeve provide greater bending and shear resistance than the plastic pipe it protects. The inside diameter of the protective sleeve has minimal clearance to the plastic pipe or the connection (including any protective coating over the connection). The wall thickness of the protective sleeve shall be adequate to protect against shear and bending The protective sleeve is of sufficient length (typically 12 in. (305 mm) or longer) to cover the transition region, and extend such that the opposite end rests on undisturbed foundation soil or stable bedding soil beneath the plastic pipe. Additional information is available from manufacturers.

7.5.3 A protective sleeve shall be permitted to be split longitudinally for installation purposes, provided it is designed for long term structural integrity as a longitudinally split