Designation: F 690 – 86 (Reapproved 2003)$^{\epsilon 2}$

An American National Standard

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

This standard is issued under the fixed designation F 690; 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.

ϵ^1 NOTE—Keywords editorially added in November 2003.
ϵ^2 NOTE—Editorial changes were made throughout in December 2004.

1. Scope

1.1 This practice covers general and basic procedures related to the proper installation of thermoplastic, flexible, pressure piping, 36 in. nominal size and smaller, for underground irrigation systems. Because there is considerable variability in end-use requirements, soil conditions, and thermoplastic piping characteristics, it is the intent of this practice to outline general objectives and basics of proper installation and to provide pertinent references, rather than to prescribe detailed installation procedures.

1.2 This practice should not be used for installing thermoplastic underground sewer, drain, potable water, conduit, or gas service piping.

1.3 The values stated in inch-pound units are to be regarded as the standard. Values in parentheses are mathematical conversions to SI that are provided for informational purposes only and are not considered standard.

1.4 *This standard does not purport to address all of the safety problems, 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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 2487 Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

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

F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

3. Joints and Connections

3.1 Joints and connections shall be assembled to withstand the design working pressure for the pipeline without leakage, internal restriction or obstruction, which could reduce line capacity below design requirements.

3.2 All joining materials shall be of composition that will not damage the pipe and shall be recommended for use at the design pressure for the pipeline. Consult the manufacturer for design and installation recommendations and refer to Practice F 402.

3.3 When steel or other metallic joining materials, subject to corrosion, are used in the line, they shall be adequately protected by wrapping or coating with high quality corrosion preventatives. Wrapping or coatings that are applied on metallic surfaces should not be applied on plastic pipes and fittings unless it is first established by consulting the piping manufacturer that they have no detrimental effect on the plastic.

3.4 Joining specifications are listed under X1.1.3.

3.5 Manufacturers of joining materials should be consulted for specific assembly instructions not covered by existing specifications. When requesting information, the intended service application should be defined.

4. Trench Preparation

4.1 *Trench Depth*—In stable granular soils, which tend to be relatively smooth and free of all rocks and debris larger than ½ in. (13 mm) in sizes, excavation may proceed directly to final grade. Where rocks of other protrusions are encountered which may cause point loading on the pipe, the trench bottom should be overexcavated to permit installation of proper bedding (see Section 5).

4.2 *Trench Width*—The width of the trench at any point below the top of the pipe should be established with attention given to these considerations:

[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.

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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.

4.2.1 The wider the trench at the top of the pipe, the greater the earth load imposed on the pipe until the prism load has been achieved.

4.2.2 Trench width should allow sufficient and safe working room for proper alignment and assembly of the joints. Generally, a trench width at the top of the pipe of about 2 ft (600 mm) wider than the pipe diameter is adequate. However, for pipe with an 18-in. (457-mm) diameter and larger in a vertical-walled trench, a clearance of 3 ft (1 m) wider than the nominal pipe size may be needed. For sloped trenches, a minimum of an 18-in. (457-mm) greater trench bottom width than the pipe diameter allows sufficient width. If a wider trench becomes necessary, the enlargement should be restricted as much as possible to only that section above the top of the pipe.

4.2.3 Trench width should allow adequate room for snaking when recommended by the manufacturer or as may be required to accommodate thermal expansion or contraction.

4.2.4 Narrower trench widths may be utilized by joining the pipe above ground and lowering it into the trench, provided enough room is available in the trench for proper haunching. Precautions outlined in 5.2 shall be followed.

4.3 *Trench Depth*—The trench depth shall be established with consideration given to requirements imposed by foundation, bedding, pipe size, and cover.

4.4 *Foundation*—An adequate and stable foundation should be present, or provided, for proper support at the total trench load.

4.4.1 Foundation preparation is not necessary when smooth stable trench bottoms are encountered.

4.4.2 Foundation preparation is necessary when unstable trench bottom conditions are encountered. The designer should specify the stabilizing method and materials which will satisfactorily stabilize the encountered condition and provide adequate and permanent support.

4.5 *Bedding*—The bedding material should consist of gravel, sand, silty sand, silty gravel, or clayey sand in granular form and having a maximum particle size of ¾ in. (19 mm).

4.5.1 Bedding shall be provided whenever rock, hard pan, boulders, or other materials that might damage the pipe are encountered in the trench bottom at the established pipe grade.

4.5.2 When bedding is used, it shall be kept as nearly uniform in depth as possible to minimize differential settlement.

4.6 *Minimum Earth Cover*—Protection from traffic loading or frost penetration, or both should be considered when establishing minimum earth cover requirements.

4.6.1 For installations exposed to normal farm vehicle traffic, the minimum total cover should not be less than:

Pipe 1 to 2½ in. in diameter:	18 in. (450 mm)
Pipe 3 to 4 in. in diameter:	24 in. (600 mm)
Pipe 5 in. and larger in diameter:	30 in. (750 mm)
Pipe 5 to 18 in. in diameter:	30 in. (750 mm)
Pipe 18 in. and larger in diameter:	36 in. (900 mm)

4.6.2 The pipe line should be installed at sufficient depths to provide protection from traffic crossing, farming operations, and soil cracking. Load-bearing capabilities of installed pipe vary with type of pipe, type of backfill, soil conditions, and installation procedures. Consult the manufacturer for information on product response to expected maximum earth loading.

4.6.3 The trench depth shall be sufficient to ensure placement of the top of the pipe at least 10 in. (250 mm) below the known frost line. When conditions and design requirements prevent satisfaction of this requirement, system design and installation must ensure proper drainage in the low portions of the line.

5. Pipe Assembly and Installation

5.1 *Preparation of Joints*—Joint assembly shall be done in accordance with specifications listed under 2.1.3.

5.2 If the pipe is to be assembled above ground, it should be lowered into the trench, taking care not to drop it or damage it against the trench walls, nor to subject it or its joints to treatment, such as, dragging or excessive bending which could be injurious to the piping. With elastomeric seal joints, take care to avoid joint displacement and pull out. Allow heat-fused joints to cool or solvent-cemented joints to cure for the minimum prescribed time before moving the pipe. While moving larger diameter pipe lines, care should be taken to avoid excessive stressing of the joints.

5.3 Ensure that elastomeric seal joints are not installed so they remain excessively deflected. Consult the pipe manufacturer for maximum permissible joint deflection limits.

5.4 Changes in the grade and line of direction of the pipe shall be limited and shall be gradual enough so that the bending of the pipe will develop neither excessive diametrical expansion nor excessive bending stresses. At no time should the pipe be blocked or braced to hold a bend. Excess curvature can create stresses which could induce pipe failure under pressure. Consult the pipe manufacturer for recommended minimum pipe bending radius.

5.5 When installing pipe with elastomeric seal, flanged joints, or with any connector which protrudes beyond the pipe diameter, bell holes should be excavated in the bedding material or trench bottom to permit the pipe to be continuously supported. After pipe assembly and placement in the trench, each bell hole should be filled with bedding material and compacted if necessary to attain the same general density as the rest of the bedding.

5.6 It is advisable to permit newly installed pipe to cool to approximately ground temperature prior to backfilling. This will minimize the development of contraction stresses on the joints and, in the case of solvent-cemented connections, it will prevent the possibility of joint separation due to contraction forces acting on an incompletely cured bond. Typically, pipe will cool adequately soon after being placed on a shaded-trench bottom.

5.7 Where differential settlement could create concentrated loading on a pipe or joint, for example, at a point of connection of a buried pipe to a rigid structure, such as a manhole, manufacturer's recommendations should be followed to prevent, or to properly relieve, damaging and shearing forces. One technique is to use extra care when compacting the foundation and bedding under a rigid structure. Other techniques might include construction of a supporting structure underneath the joint and the pipe of about three diameters in cross section or the utilization of a flexible joint.

5.8 *Special Installation*—With certain pipes and in some soil conditions it is possible to install long lengths of pipe by the plowing-in technique. Consult the manufacturer for recommendations.

6. Thrust Blocking

6.1 When installing piping systems that include joints that are not self restraining (for example, elastomeric seal type) thrust blocking may be necessary at certain points in the system, such as changes in direction, in order to prevent possible disengagement of the fitting from the pipe.

6.2 Thrust blocking is required where line shift or joint separation at system operating pressure can be anticipated, that is, pump discharge, directional changes, reducers, and dead ends. Thrust blocking is essential to the proper performance of high pressure irrigation piping when the system includes non-self-restraining joints. (See Fig. 1.)

6.3 *Thrust Block Construction*:

6.3.1 The thrust block should be constructed of concrete having a compression strength of 2000 psi (14 MPa) or more. Wood blocking, or stone blocking with wood wedges, are not acceptable.

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

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

6.3.4 Before pressurizing the line, ensure that adequate time is allowed for the concrete thrust blocks to set.

7. Line Charging and Testing

7.1 If possible, the pipeline should be thoroughly inspected and tested for leaks before backfilling. When so testing, it is advisable to anchor the pipe by placing haunching and initial backfill up to about 6 in. (150 mm) over the pipe, taking care to leave all joints and fittings exposed for inspection.

7.2 *Line Charging*:

7.2.1 Before filling and proceeding to test, sufficient time should be allowed for solvent-cemented joints to cure or heat-fused joints to cool.

7.2.2 With valves at ends and high points open, the pipelines should be slowly filled with water, limiting the flow velocity to 1 ft/s (0.3 m/s) to prevent surge, or water hammer, and air entrapment.

7.2.3 Ensure that all entrapped air is released from the line while filling. The system should include appropriate air and vacuum relief valves for proper function during operation after installation.

7.2.4 The pipeline should be filled but not pressurized until the engineer is ready to witness or conduct the pressure test.

7.3 *Inspection and Repairs*—The line should be pressurized to 125 % of the system's design operating pressure, for the time necessary to check all joints but not to exceed 1 h. While under pressure, inspect all joints for leaks. Any leaks found should be repaired, and the line recharged and retested.

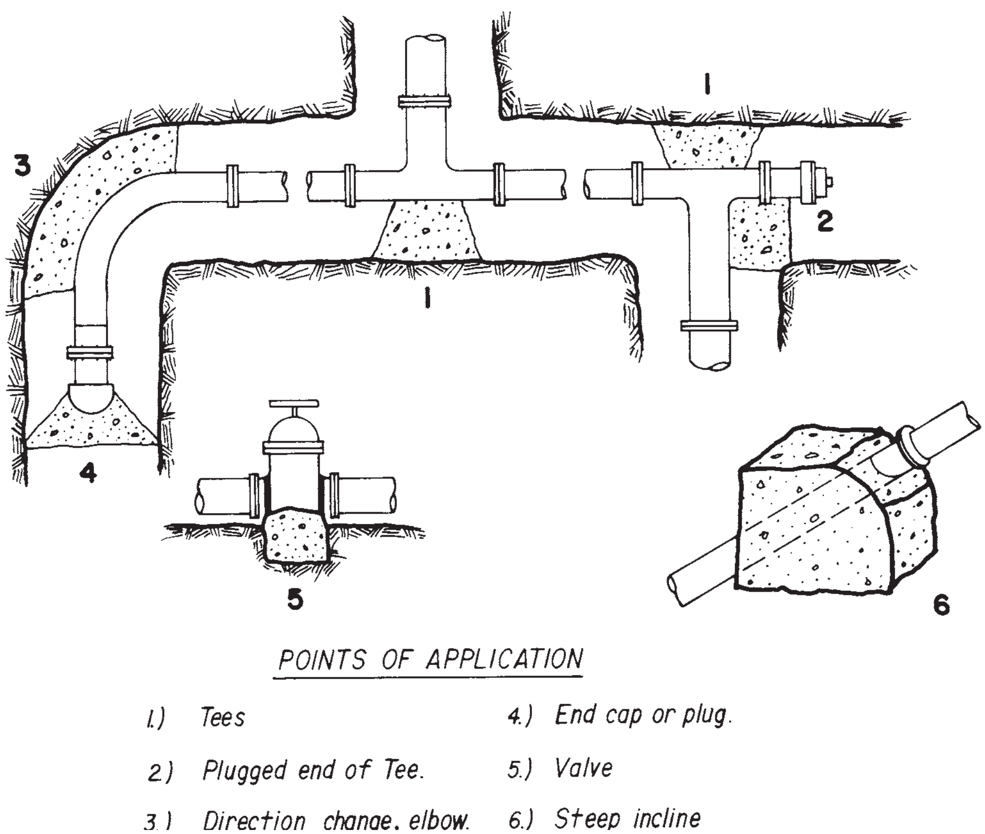

FIG. 1 Types of Thrust Blocking

8. Backfilling Procedures

8.1 *Haunching and Initial Backfill*—This practice covers those thermoplastic piping products which may be deflected considerably, without structural damage. The flexibility of the pipe enables it to utilize the passive resistance of the soil to support loads externally applied to the pipe. The resistance of the soil is affected by the type of soil, its density and moisture content. Therefore, the higher the soil resistance, the less the pipe will deflect. Proper techniques for pipe embedment are necessary to ensure that the passive soil resistance required to prevent excessive pipe deflection will be developed and maintained. The designer will determine the minimum material requirements and extent of compaction depending on pipe selected and the end-use conditions. The following embedment materials are recommended (see Classification D 2487 and Practice D 2488 for classification of soils):

(1) Coarse-grained soils containing less than 5 % fines, such as clean (that is, essentially silt free) gravels or sands (the maximum density will be obtained by saturation and vibration).

(2) Coarse-grained soils containing some fines, between 5 and 12 % (the maximum density may be obtained by either tamping or saturation and vibration).

(3) Coarse-grained soils containing more than 12 % fines, such as silty gravels, clayey gravels, silty sands, and clayey sands (the maximum compaction will be obtained by tamping).

(4) Fine grained inorganic soils (silts or clays) with low liquid limits, including some silts, silty or clayey fine sands, clays, gravelly clays, sandy clays, silty clays, and lean clays (the maximum compaction will be obtained by tamping). Note that because of their nature these materials may, under certain conditions, present problems in proper placement and compaction. Their use, therefore, requires greater care.

8.1.1 Haunching and initial backfill materials should consist of stable soil free of rocks, stones, or hard clods greater than ¾ in. (19 mm) in diameter.

8.1.2 Initially, sufficient material should be carefully worked under the haunches of the pipe to provide adequate and continuous support throughout the entire pipe length. Pipe movement should be avoided during this placement.

8.1.3 Initial backfill should be placed in two stages: the first up to the spring line of the pipe (see Fig. 2) and the second to a point at least 6-in. (150 mm) over the top of the pipe to protect it from final backfilling. The first stage should be placed in approximately 6-in. (150-mm) layers, and each layer compacted as required. The material above the spring line need only be compacted to the same requirements as for the final backfill.

8.2 *Compaction Methods*:

8.2.1 When using mechanical tamping to achieve desired backfill soil densities, care must be taken to ensure that the tamping or vibratory equipment does not come in contact with the pipe. Care should be taken to avoid deformation or displacement of the pipe during compaction. If using a hydrohammer the setting should not be greater than 1000 lb/ft^2 (47.8 kPa).

8.2.2 Water packing is accomplished by adding sufficient water to saturate the initial backfill. Excess inundation should be avoided. To keep the pipeline from floating or shifting it should be filled with water prior to water packing and until initial backfilling procedures are completed.

8.3 *Final Backfill*:

8.3.1 Final backfill material should be free of debris and rocks or boulders larger than 3 in. (75 mm) and should be added and compacted in a manner that will leave the fill at ground level after settlement has occurred.

8.3.2 Final backfill should be placed and spread in approximately uniform-compacted layers until the trench is filled, with care taken to ensure that no unfilled voids remain in the backfill.

8.3.3 Rolling equipment should not be run over the pipeline unless compacted and stable backfill covers the pipe to the minimum cover requirements given in 4.6.1. In addition, because very wet soils may lose their stability, rolling equipment should also not be run over pipe lines in freshly irrigated fields.

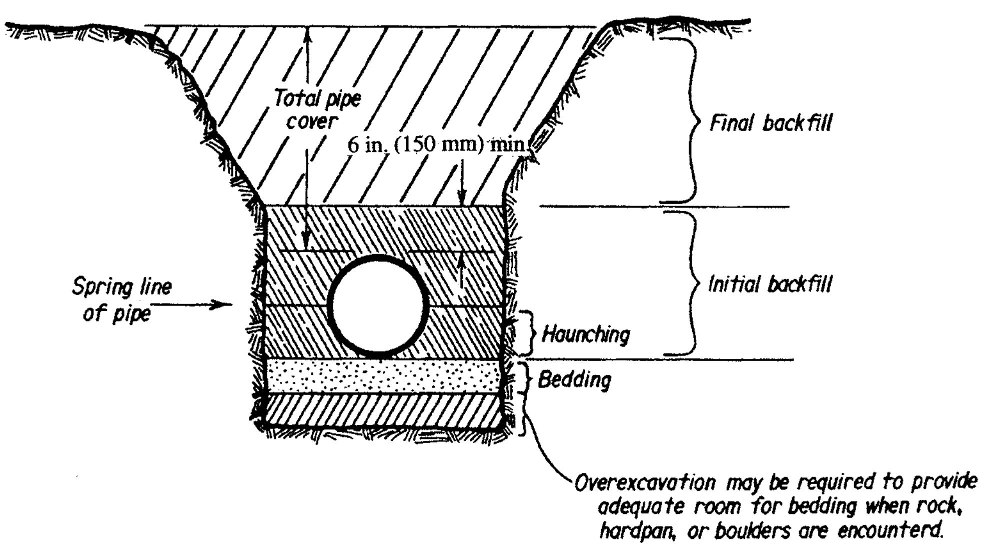

FIG. 2 Trench Cross Section

8.4 *Handling and Storage*—Handling and storage of plastics piping should be in accordance with manufacturer's recommendations. Depending on the material, prolonged outdoor storage, or storage under adverse weather conditions may require protection from the elements.

9. Keywords

9.1 irrigation system; pressure piping; thermoplastic; underground installation

APPENDIX

(Nonmandatory Information)

X1. RELATED DOCUMENTS

X1.1 The following ASTM documents contain information related to this practice:[2]

X1.1.1 *Terminology*:

F 412 Terminology Relating to Plastic Piping Systems

X1.1.2 *Pipe and Tubing:*

D 1527 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D 1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D 2104 Specification for Polyethylene (PE) Plastic Pipe, Schedule 40

D 2239 Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D 2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

D 2447 Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80 Based on Outside Diameter

D 2666 Specification for Polybutylene (PB) Plastic Tubing

D 3000 Specification for Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter[3]

D 3035 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

X1.1.3 *Joining Systems and Materials:*

D 2235 Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D 2282 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)

D 2464 Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2465 Specification for Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80[3]

D 2466 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D 2467 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2468 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40[3]

D 2469 Specification for Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80[3]

D 2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D 2657 Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

D 2672 Specification for Joints for IPS PVC Pipe Using Solvent Cement

D 2683 Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

D 2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

D 3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

D 3261 Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

F 545 Specification for PVC and ABS Injected Solvent-Cemented Plastic Pipe Joints[3]

F 771 Specification for Polyethylene (PE) Thermoplastic High-Pressure Irrigation Pipeline Systems

X1.1.4 *Other Installation Practices:*

D 2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravitiy-Flow Applications

D 2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

[3] Withdrawn.