~~Designation:F 1668–96 (Reapproved 2002)~~ Designation: F 1668 – 08

An American National Standard

Standard Guide for Construction Procedures for Buried Plastic Pipe[1]

This standard is issued under the fixed designation F 1668; 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.

1. Scope*

1.1 This guide describes installation techniques and considerations for open-cut construction of buried pipe. Although this guide was developed for plastic pipe, the concepts of providing the appropriate soil support, care in handling, correct joining techniques, proper soil compaction methods, and prevention of installation damage may apply to any pipe.

1.1.1 Plastic pipe refers to thermoplastic and fiberglass pipe.

1.1.2 Thermoplastic pipe refers to pipe fabricated from polyvinyl chloride (PVC), polyethylene (PE), acrylonitrile-butadiene styrene (ABS), polybutylene (PB), or polypropylene (PP). A list of ASTM specifications for these products is given in Appendix X2.

1.1.3 Fiberglass pipe refers to a glass-fiber-reinforced thermosetting-resin pipe. A list of ASTM specifications for these products is given in Appendix X2.

NOTE 1—Appendix X2 cannot be considered inclusive because there may be unlisted, recently adopted ASTM specifications for new products that may be installed using this guide.

NOTE 2—Only a few of the ASTM specifications listed in Appendix X2 include the associated fittings. While this guide applies to the installation of pipe, couplings, and fittings, no attempt was made to list all the possible fitting specifications that may be used in conjunction with the pipe specifications. Consult each specification or manufacturer for appropriate fitting standards.

1.1.4 For simplification, the term pipe will be used in this document to mean pipe sections, fittings, and couplings.

1.2 This guide contains general construction information applicable for plastic pipe and supplements the installation standards for the various types of pipe as described in Practices D 2321, D 2774, D 3839, F 690, F 1176, and Guide F 645.

1.3 Flexible pipe, such as thermoplastic and fiberglass, are typically designed to rely on the stiffness of the soil surrounding the pipe for support. The contract documents should describe the requirements of an appropriate soil support system. The construction practices described in this guide can be instrumental in attaining the required soil stiffness.

1.3.1 A discussion of the interaction between a buried pipe and the surrounding soil and the importance of attaining proper soil support is in Appendix X1.

1.3.2 Following these guidelines will be helpful in preventing local deformations in the pipe.

1.4 This guide does not cover underwater installation, pipe that needs to be supported on piling, perforated pipe used for drainage, or gas pipelines.

1.5 Pipelines through areas described as “expansive soils,” “collapsing soils,” landfills or water-logged land (such as swamps) should be constructed using site-specific installation procedures and are not discussed in this guide.

1.6 This guide is not intended to cover all situations. Specific pipe characteristics, fluid transported, local site conditions, environmental concerns, or manufacturer’s recommendations may require different guidelines.

1.7 The construction practices presented in this guide may be affected by the installation requirements of owners, specifying organizations, or regulatory agencies for pipelines crossing roads and highways, other pipelines or cables, or waterways such as streams, drainage channels, or floodways.

1.8 Culverts or pipe that are used as passages through water retaining embankments (for example, earth dams) may be constructed using the principles of this guide, if appropriate provisions are made to prevent water movement along the outside of the pipe (using impervious soils, cutoff collars, head walls, etc.).

1.9 The values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are given for information only.

NOTE 3—There is no similar or equivalent ISO standard covering the primary subject matter of this guide.

1.10 *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*

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

~~Current edition approved Sept. 10, 1996. Published November 1996. Originally published as F1668–95. Last previous edition F1668–95.~~

Current edition approved March 1, 2008. Published April 2008. Originally approved in 1995. Last previous edition approved in 2002 as F 1668 – 96(2002).

***A Summary of Changes section appears at the end of this standard.**

limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 8 Terminology Relating to Materials for Roads and Pavements
D 653 Terminology Relating to Soil, Rock, and Contained Fluids
D 883 Terminology Relating to Plastics
D 1600 Terminology for Abbreviated Terms Relating to Plastics
D 4914 Test Methods for Density and Unit Weight of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
D 5030 Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit
F 412 Terminology Relating to Plastic Piping Systems

2.2 *Pipe Installation:*

~~D2321~~ D 2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
~~D2774~~D 2774 Practice for Underground Installation of Thermoplastic Pressure Piping
~~D3839Practice for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe~~ D 3839 Guide for Underground Installation of Fiberglass (Glass-FiberReinforced Thermosetting-Resin) Pipe
F 645 Guide for Selection, Design, and Installation of Thermoplastic Water- Pressure Piping Systems
~~F690~~ F 690 Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation Systems
F 1176 Practice for Design and Installation of Underground Thermoplastic Irrigation Systems ~~with~~With Maximum Working Pressure of 125 psi

2.3 *Soil Testing:*

~~D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400 ft-lbf/ft^5(600 kn-m/m^5~~D 698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3(600 kN-m/m^3))
D 1556 Test Method for Density and Unit Weight of Soil in Place by ~~the~~ Sand-Cone Method
~~D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56000 ft-lbf/ft^5(2700 kn-m/m^5~~D 1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
~~D2167~~D 2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D 2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
~~D2487~~D 2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
~~D2488~~D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D 2922 Test Methods for Density of Soil and Soil-Aggregate ~~I~~ in Place by Nuclear Methods (Shallow Depth)
D 3017 Test Method for Water Content of Soil and Rock ~~In~~in Place by Nuclear Methods (Shallow Depth)
~~D4253~~ D 4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
~~D4254~~D 4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
D 4564 Test Method for Density and Unit Weight of Soil in Place by the Sleeve Method
~~D4643Test Method for Determination of Water (Moisture) Content of Soils by the Microwave Oven Method~~ D 4653 Test Method for Total Chlorides in Leather
D 4944 Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester ~~Method~~
D 4959 Test Method for Determination of Water (Moisture) Content of Soil ~~by~~By Direct Heating ~~Method~~
~~D5080~~D 5080 Test Method for Rapid Determination of Percent Compaction

2.4 *Joining Practices:*

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

[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.

D 2855 Practice for Making Solvent-Cemented Joints ~~With~~with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
~~F402~~F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
~~F477~~F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
~~F913Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe~~ F 913 Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F 2620 Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

2.5 *Other ASTM Standards:*

~~C94/C94M~~ C 94/C 94M Specification for Ready-Mixed Concrete
D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
~~F1417~~F 1417 Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

2.6 *American Water Works Association (AWWA) Standards:*

~~C600Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances~~
~~C651Standard for Disinfecting Water Mains~~[3]
C 600 Test Method of Thermal Shock Test on Glass Pipe
C 651 Test Method for Flexural Strength of Manufactured Carbon and Graphite Articles Using Four-Point Loading at Room Temperature
F 2164 Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

2.7 *American Association of State Highway and Transportation Officials (AASHTO) Standard:*

Standard Specification for Highway Bridges[3]

2.8 *Uni-Bell PVC Pipe Association Standard:*

UNI-B-13 Recommended Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride (PVC) Pipe[4]

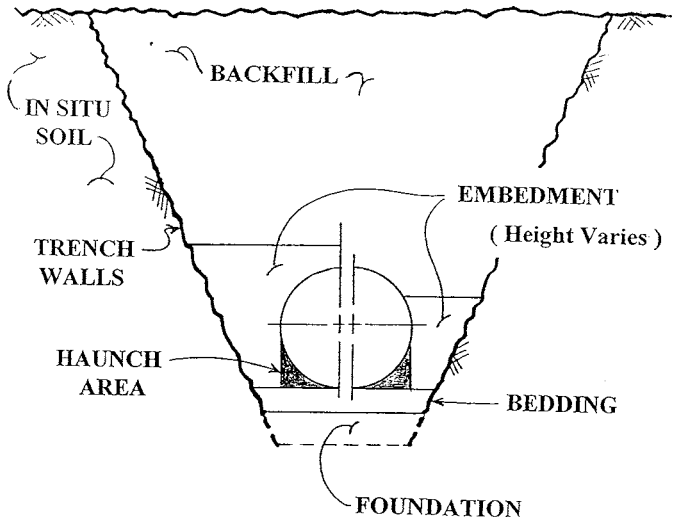
3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies D 8, D 653, D 883, D 1600, and F 412 unless otherwise indicated. Abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

3.1.1 The definitions and descriptions of soil are in accordance with the Unified Soil Classification System as presented in Classification D 2487. Soils may be identified and described in the field using the procedures stated in Practice D 2488.

NOTE 4—The terms describing an installation cross-section are illustrated in Fig. 1. Other terms related to parts of the pipe are illustrated in Fig. 2.

[3] Available from the American Water Works Association, 1401 New York Ave., NW, Suite 640, Washington, DC 20005..
[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.
[4] Available from the American Association of State Highway and Transportation Officials, 444 North Capitol St., NW, Suite 249, Washington DC 20001.
[4] Available from the Uni-Bell PVC Pipe Assoc., 2655 Villa Creek Dr., Suite 155, Dallas, TX 75234.



NOTE 1—This drawing is illustrative only. Trench dimensions and slope vary with depth and soil conditions.

FIG. 1 Trench Cross Section Terminology

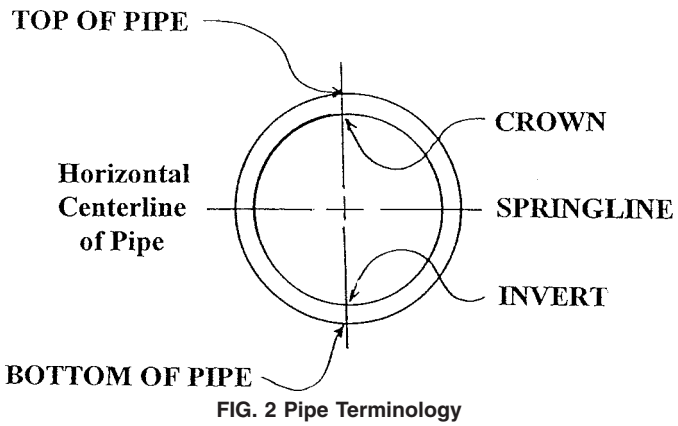


FIG. 2 Pipe Terminology

NOTE 5—These terms may be different from the ones used in Practices D 2321, D 2774, D 3839, F 690, or F 1176. The terms in this guide are used to describe the construction sequence and are not meant to replace or conflict with other standards.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backfill*—material placed over the embedment up to the ground surface.

3.2.2 *bedding*—material placed in the bottom of the trench on top of the foundation soil to provide uniform support for the pipe.

3.2.3 *embedment*—material placed around the pipe that provides side support.

3.2.4 *foundation soil*—material in the bottom of the trench that is (*1*) undisturbed and remains in place; (*2*) removed and replaced by another material, (*3*) displaced by another material; or (*4*) removed and then recompacted into place.

3.2.5 *haunch area*—the area of the embedment under the pipe from the bottom of the pipe up to the springline, as illustrated in Fig. 1.

3.2.6 *in situ material*—the in-place soil or rock that a trench is excavated through that is either (*1*) naturally formed or deposited; or (*2*) manmade.

3.2.7 *manufactured aggregates*—aggregates that are products or byproducts of a manufacturing process (such as slag), or natural aggregates that are reduced to their final form by a manufacturing process such as crushing.

3.2.8 *springline*—a line along the length of the pipe at its maximum width along a horizontal plane. **(F 412)**

4. Significance and Use

4.1 This guide may be used as a reference of acceptable open-cut construction practices for the proper installation of buried fiberglass and thermoplastic pipe. This guide may be used as follows:

4.1.1 Installation contractors have an awareness of the level of workmanship required and use this information for bidding purposes and during construction.

4.1.2 Construction inspectors have a reference of acceptable installation practices.

4.1.3 Specification writers may use this guide as a reference in contract documents.

4.1.4 Designers may review this information during planning and design for factors to consider in the preparation of plans and specifications.

4.1.5 The owner of the pipeline may use this guide as a reference for restoration of proper pipe support and embedment when original construction is disturbed due to repairs, modifications, or construction of adjacent or crossing pipelines or cables.

4.2 This guide should not be used to replace project specification requirements, manufacturer's recommendations, plumbing codes, building codes, or ASTM installation standards, but may be used to supplement that information.

5. Inspection, Handling, and Storage

5.1 *Load Inspection*—The pipe should be packaged or loaded as recommended by the supplier. The receiver of the pipe should be aware of (*1*) the loading and packaging requirements for each mode of transportation used; (*2*) the continuance of proper handling in any multiple loading and unloading before arrival; and (*3*) any transportation incident (wreck). Before unloading, the receiver should examine the load for transportation damage, particularly if the load has shifted, packaging is broken, or if there are signs of rough treatment. Damage may also have been caused from overtightening tie-down straps or from the tie-down straps not being located at the same point along the pipe barrel where the pipe supports are located. The pipe should be examined for abrasion due to (*1*) bells, couplings, or other joint surfaces being in contact with each other or any hard object or surface; and (*2*) unpadded metal tie-down straps.

5.2 *Pipe Inspection*—Each load of pipe should be inspected and inventoried for conformance to product specifications and contract documents. Pipe markings vary according to ASTM specification, the type of pipe, and the manufacturer. In general, these markings include: ASTM specification, pipe class or pressure designation, cell classification, pipe diameter, date of manufacture, name or trademark of the manufacturer, and plant identification. In some circumstances, the plant inspector's approval mark may also be required. Pipe intended for the conveyance of potable water is evaluated, tested, and certified for use by an acceptable

certifying organization when required by the regulatory authority having jurisdiction. The seal or mark of the laboratory making the evaluation should be on the pipe. Observe the unloading, uncrating, storage and distribution of the pipe, as applicable, and inspect each pipe section for damage, such as cuts, cracks, or gouges. Depths of cuts and gouges should be compared to allowable limits in the pipe specifications, contract documents, or manufacturer's recommendations.

5.2.1 Damaged pipe may or may not be repairable depending on the type of pipe.

5.2.1.1 Repairable pipe should be repaired in accordance with the manufacturer's recommendations.

5.2.1.2 Pipe that cannot be repaired should be clearly marked to prevent usage, in a manner acceptable to the supplier, and then removed from the job.

5.2.2 Gaskets should be checked for conformance to contract documents and inspected for transportation damage. If two or more types of gaskets are being used, the different gaskets should be clearly identified by appropriate markings. Specifications F 477 and F 913 cover the requirements for two types of gaskets.

5.2.3 All solvent cements, primers, cleaners, adhesives, and lubricants should be marked, or otherwise certified, for conformance to applicable standards and regulations.

5.3 *Nested Pipe*—The pipe interiors and exteriors should be inspected for transportation damage. Follow manufacturer's recommendations for unloading, or proceed as follows: The pipe should be removed starting with the inside pipe (smallest diameter). The pipe should be removed with a padded forklift boom and without touching other pipe.

5.4 *Handling*—Handling of the pipe to prevent damage should be in agreement with manufacturer's requirements. Typically, handling procedures will include the following precautions:

5.4.1 Avoid rough handling or dropping of the pipe and resting the pipe on hard objects that would create a point loading on the pipe. Pipe sections should not be rolled over rough or rocky ground. Prevent objects from being dropped on or impacting the pipe.

5.4.2 Move individual sections of pipe too heavy to be lifted manually with a fabric sling, a pair of slings, or with appropriate lifting equipment. Do not use chains, wire ropes, backhoe buckets, or hooks.

5.4.3 Move packaging units only with forks or slings that go under the packaging units. Packaging is not normally designed to be lifted by a chain or cable attached only to the top of the unit.

5.4.4 The flexibility and impact resistance of PVC, PE, ABS, and PB pipe are reduced as the temperature approaches freezing. Use extra care when handling these pipes during cold weather. (**Warning** —Unloading pipe may be hazardous and the unloading steps must always follow the supplier's instructions.)

5.5 *Storage*—Store the pipe in accordance with the manufacturer's recommendations. Depending on the material, typical precautions may be as follows:

5.5.1 Store pipe under appropriate protective cover for adverse weather conditions or if the unprotected storage time might exceed the manufacturer's recommendation.

5.5.2 Store pipe under conditions that will minimize dirt and foreign matter accumulating on the sealing surface and in the interior of the pipe to reduce future cleaning.

5.5.3 Store pipe in a manner that prevents bulges, flat areas, ovalization, or any other abrupt change in pipe curvature. If the pipe or packaging units are stacked, never exceed the stack height allowed by the manufacturer. If the pipes are not stored in their packaging units, use the original shipping supports. If this is not possible, store the pipe with supports that prevent the bells, spigots, couplings, or any other joint surface from contact. Space the supports at intervals along the pipe to prevent longitudinal sag. Use chocks, with or without fabric (or rope) tiedowns, to prevent the pipe from rolling.

5.5.4 Protect the pipe from excessive heat or harmful chemicals. Use cleaning solutions, detergents, solvents, etc., only in accordance with the manufacturer's recommendations.

5.5.5 Protect gaskets from harmful substances such as dust and grit, solvents, and petroleum-based greases and oils. Do not store gaskets close to electrical equipment that produces ozone. Some gaskets may need to be protected from sunlight.

5.6 *Stringing*—When distributing the pipe along the pipeline alignment, the same precautions mentioned in 5.4 should be followed. In addition, the pipe should be blocked to prevent any possibility of rolling, due to a slight slope, wind, wash-out, or accidental bumping. Pipe with bells and spigots should be supported along the barrel of the pipe to prevent deformation of the jointing ends. Supporting the pipe on two or more wooden blocks, sandbags, or earth mounds, will help prevent dirt accumulating on the sealing surfaces and inside the pipe and, where appropriate, provide a space to slip any pipe-lifting slings under the pipe.

6. Trench Excavation

6.1 *Excavation*—Excavate trenches so that sidewalls will be stable under all working conditions. Slope trench walls or provide supports in conformance with all local and national standards for safety. Open only as much trench as can be safely maintained.

6.1.1 The amount of open trench and the length of time trenches remain open may be restricted for other reasons such as pedestrian safety, traffic disruptions, etc.

6.2 *Minimum Trench Width*—The trench width, normally specified in the contract documents, is based on design and construction factors such as pipe outside diameter, installation methods, and inspection requirements. Specific activities in the trench that might influence the width would be joining procedures, checking gaskets, compacting soil into the haunch area and beside the pipe, and soil density testing.

6.3 *Supported Trench Walls*—Sheeting, bracing, shoring, or trench shields should be used in the following conditions: