



Standard Practice for Insertion of Flexible Polyethylene Pipe Into Existing Sewers¹

This standard is issued under the fixed designation F585; 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.

1. Scope

1.1 This practice describes design and selection considerations and installation procedures for the construction of new sanitary and storm sewers by the insertion of polyethylene pipe through existing pipe and along the previously existing line and grade. The procedures are designed to minimize traffic disruption, surface damage, and restoration, with little or no interruption of service.

NOTE 1—See CGSB 41-GP-25M.

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

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.*

2. Referenced Documents

2.1 ASTM Standards:²

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2657 Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

F412 Terminology Relating to Plastic Piping Systems

F714 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

F894 Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

¹ This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.62 on Sewer. Current edition approved May 1, 2007. Published May 2007. Originally approved in 1978. Last previous edition approved in 2000 as F585 – 94(2000). DOI: 10.1520/F0585-94R07.

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. Terminology

3.1 **Definitions**—Definitions are in accordance with Terminology F412, unless otherwise specified.

4. Significance and Use

4.1 The procedures described can be used in conjunction with the manufacturer's specific recommendations to install polyethylene pipe using the insertion method. The procedures are intended as an aid to and not in replacement of the design and review of the project engineer.

5. Design and Selection Considerations

5.1 General Guidelines:

5.1.1 If the original sewer piping is structurally deteriorated due to offset at the joints or rupture and collapse of the pipe walls, measures should be taken to determine its condition in detail, prior to the selection of pipe size and installation procedure.

5.1.2 Protrusions of lateral or service piping into the old sewer, root growths, sedimentation, or mineral deposits, or any combination of these four, may restrict the access for inserting the polyethylene piping. The presence of obstructions must be determined (see 6.3).

5.1.3 The clearance between the liner pipe and the original pipe should be sufficient to ensure that no interference occurs during insertion. For pipes made in accordance with Specification F714, in general, the liner pipe outside diameter should be no larger than 10 % smaller than the original sewer. For pipes manufactured in accordance with Specification F894, in general, the liner pipe outside diameter should be no larger than 2 in. smaller than the original sewer.

5.1.4 Insertion shafts should be kept to a minimum and should coincide with the areas in which problems have been detected in the existing sewer (see Section 7).

5.1.5 Pipe may be preassigned by the heat fusion technique in accordance with Practice D2657.

5.1.6 Pipe may also be assembled at the time of insertion using mechanical connections or heat fusion.

5.2 **Flow Characteristics**—New polyethylene pipe has a very smooth interior surface of low roughness coefficient. Normal usage does not corrode nor abrade the surface and long-term flow characteristics are not substantially impaired.



5.3 External Loading:

5.3.1 *Hydraulic Loads*—When there is the possibility of ground water level above the pipe, the level and its duration should be estimated by the design engineer and the pipe system designed to withstand the pressure without collapsing.

5.3.1.1 In the event the collapse resistance of the pipe is not sufficient to resist this pressure, the engineer should specify either a stiffer pipe or filling the annular space with a cementitious grout or other material that will provide adequate support for the pipe.

5.3.1.2 The following equation may be used to determine the standard dimension ratio of pipe required:

$$SDR - 1 = F \frac{\sqrt[3]{E_a \left(\frac{2}{1 - \mu^2} \right)}}{P_h} = F \sqrt[3]{\frac{2.508 E_a}{P_h}} \quad (1)$$

where:

- SDR = standard dimension ratio (D_o/t) of the pipe,
 P_h = pressure due to head of water, kPa or psi,
 E_a = apparent (time-corrected) modulus (MPa $\times 10^3$ or psi) for the grade of polyethylene used to manufacture the pipe,
 F = design factor to account for installed out of roundness, variability in the estimation of water head, etc. (F has a value less than 1.0), and
 μ = Poisson's ratio (0.45 average value).

NOTE 2—The choice of value (from manufacturer's literature) of E_a will depend on the estimated duration of the application of the load P_h in relation to the design life of the structure. For example, if the total duration of the load P_h is estimated to be 25 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value for E_a will be that given for 25 years of continuous loading at the maximum ground temperature expected to be reached over the life of the structure.

5.3.2 *Earth Loading*—At all points where the polyethylene pipe has been exposed, such as at the insertion shafts, at service connection fittings, or other points where the old pipe must be removed, the polyethylene pipe and fittings should be encased in a minimum of 6 in. (150 mm) of concrete, cement-stabilized sand, or other high-density material as specified by the engineer to prevent deflection due to earth loading or subsidence. At this point, in preparation for the placing of the encasement material, debris and soil should be removed along each side of the existing pipe down to the spring line. After the encasement material is in place and accepted by the engineer, backfill is placed and compacted to required finished grade in accordance with the engineer's specifications. At service line connections, particular care should be taken to ensure compaction of earth beneath the lateral pipe in order to reduce subsidence and resultant bending at the lateral connection.

5.3.3 Existing pipe deterioration on occasion, deterioration of the original pipe may continue to occur even after the liner has been installed. As a result, uneven or concentrated point loading upon the pipe liner or even subsidence of the soil above the pipe system may occur. This can be avoided by filling the annular space with a cement-sand mixture, a low-density grout material, or fine ash.

5.3.4 *Axial Bending and Radial Deflection*—Polyethylene pipe is relatively flexible and may be curved for convenience in

handling and installation. It will accommodate reasonable irregularities in external loading or in line and grade. Excessive bending, however, should be avoided, particularly in handling and installation. Longitudinal (axial) bends induced during the insertion step in transporting pipe lengths from assembly sites to job sites, or permanent bends to accommodate line or grade changes, should be limited to radii equivalent to a longitudinal strain recommended by the pipe manufacturer. The minimum allowable radius of curvature for any size and weight of pipe can be closely approximated from the following equation:

$$R_c = \frac{D}{2\varepsilon_a} \quad (2)$$

where:

- R_c = radius of curvature, mm or in.,
 D = diameter of the inserted pipe, mm or in., and
 ε_a = allowable axial strain.

Radial deflection at bends is automatically controlled if the radius of curvature is maintained as in the preceding paragraph.

NOTE 3—As an example, some PE pipe manufactures recommend an allowable long-term axial strain of 1.55. The minimum installed bending radius would then be:

$$R_c = D/(2X.015) = 33 D$$

Pipe joints may be more susceptible to failure due to axial bending than pipe. Particular attention should be paid to recommended radii of curvature for joints.

5.4 Anchoring and Encasement:

5.4.1 Anchor blocks of concrete poured around the pipe should be constructed at all points where the old pipe has been broken away, at excavated points, and at lateral connections. This is particularly important when excavations are shallow.

5.4.2 Where the inserted pipe diameter is smaller than two thirds of the inside diameter of the existing pipe, spot anchoring or continuous encasement by grouting the entire length will be desirable to minimize movement of the polyethylene pipe due to changes in temperature or ground water level. When grouting is used, the grouting pressure should not exceed the allowable external hydraulic pressure for the inserted pipe.

5.5 Force and Length:

5.5.1 The length of the pipe to be inserted will seldom be limited by the strength of the pipe itself. The limitations will usually be in the available capacity and the length of the pulling cable.

5.5.2 Utilizing the pulling method, smaller diameter pipe 24 in. (610 mm) or less can usually be handled with winches having about 12-tons-force (110-KN) pulling capacity. Larger pipe may require heavier equipment, particularly if the condition of the existing pipe is poor or if there are bends or offsets which obstruct the passage of the pipe being inserted.

5.5.3 Pipe joints with bell and spigot joints, can be inserted by pushing. Typically, the pushing distance is limited by the axial strength of the pipe resistance of the joints to telescoping. Particular pipe and joint properties should be obtained from the manufacturer.

6. Inspection and Cleaning

6.1 **Warning**—Prior to entering access areas, such as man-holes, to perform inspection or cleaning operations, the following

of the atmosphere to determine the presence of toxic or flammable vapors must be undertaken in accordance with local, state, or federal regulations.

6.2 Preliminary Investigation—Although visual inspection to determine the condition of the original piping may be practical over short distances, closed-circuit TV inspection equipment is generally required to provide detail of problem areas, such as degree of offset of joints, crushed walls, obstruction, and in particular, the location of service entrances and other lateral connections.

6.3 When it is determined that obstructions to the insertion of the polyethylene pipe exist, they must be cleared. In particular, debris or other materials should be removed from the bottom of the original pipe so that the inserted pipe will not be resting on or against, nor be irregularly supported by such materials. Service lines protruding into the original pipe should be cleared.

6.4 Immediately before the insertion operation, it may be desirable to pass a test-head of the same diameter as the polyethylene pipe to be inserted through the original pipe to ensure free passageway. Test heads should be inspected for damage. Test-heads may be made from a short section of the polyethylene pipe, and should be attached to pulling cables at both ends.

7. Excavation

7.1 Warning—In making excavations, the contractor must comply with local, state, or federal regulations for safety of excavations together with other applicable laws and ordinances covering public and private access, protection, and safety of the public and of property.

7.2 Insertion Shaft—For prefused pipelines, the excavation down to the springline of the existing pipe should have an entry slope grade of $2\frac{1}{2}:1$. The length of the level excavation should be at least 12 times the diameter of the polyethylene pipe being inserted. The width of the shaft should be as small as possible, consistent with the diameter of the pipe, kind of soil, height of water table, and length of the original sewer (see Fig. 1). For single joints being pushed or jacked into position, the length of

the excavation should be sufficient to handle the pipe joint length and if necessary, for the jacking equipment, typically 10 ft (see Fig. 2).

7.3 Lateral Connection Shafts—These shafts should be located at points from which the connection of the lateral piping to the original sewer can be exposed. These points are readily located from TV inspection records, though other techniques may be employed. Remote tapping methods utilizing entrances to service or other lateral piping remote from the actual point of connection may be used on the basis of the engineer's evaluation. Provision for sealing and anchoring the connection should be included in proposals to use such systems.

8. Storage, Handling, and Joining of Polyethylene Pipe

8.1 Unloading and Storage:

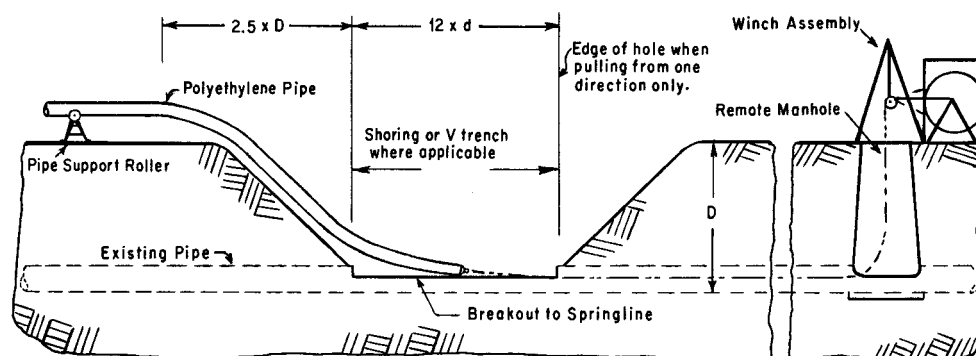
8.1.1 Polyethylene pipe should not be dumped from trucks or railcars. Straight lengths of 12 in. (300 mm) and smaller pipe can usually be safely unloaded by hand using ropes and skids. Mobile handling equipment is generally required for larger pipes or for pipe bundles.

8.1.2 Wide "belly-band" slings are recommended for hoisting pipe using boom-type trucks or other hoisting equipment. Natural or synthetic fiber ropes may be used for slings but must support the pipe lengths at two points, using inverted "y" or spreader beams to distribute the weight. Chain or wire ropes are not recommended.

8.2 Piling for Storage:

8.2.1 Pipe should be stored on level ground, free of stones, debris, or litter of any type which could create points of loading on pipe in contact with it. The use of dunnage should be avoided, but if necessary, should be closely spaced, not more than 5 ft (1.5 m) apart and consist of pieces at least 3.5 in. (90 mm) in width.

8.2.2 Pipe may be placed in a pyramidal pile of no more courses than recommended in the manufacturer's literature and chocked to prevent roll-out of the bottom layer. The bottom courses should have the ends of the pipe covered to prevent dirt or debris from entering the pipes and damaging the inside surface.



D = Depth to invert
d = Diameter of insert pipe

NOTE—Width of excavation will depend on shoring method or depth of existing pipe, or both. To permit proper flow, break out existing pipe to springline only.

FIG. 1 Insertion Hole Detail