



Standard Specification for Deformed Polyethylene (PE) Liner¹

This standard is issued under the fixed designation F1533; 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 specification covers requirements and test methods for materials of deformed PE liner intended for the rehabilitation of gravity flow and nonpressure pipelines. This application is for municipal sewage, storm water, industrial process liquids and effluents, conduit, and ducts. This renewal process involves installing a deformed liner into an existing pipeline, conduit, or duct, then reforming the liner with heat and pressure to fit tightly to the bore of the original pipeline, conduit, or duct.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard. In referee decisions, inch-pound units shall be used.

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

- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

Current edition approved Dec. 1, 2009. Published March 2010. Originally approved in 1994. Last previous edition approved in 2001 as F1533 – 01. DOI: 10.1520/F1533-01R09.

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.

- D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- F412 Terminology Relating to Plastic Piping Systems
- F1248 Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe (Withdrawn 2007)³
- 2.2 *Federal Standard:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴
- 2.3 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage⁴

3. Terminology

3.1 Definitions:

3.1.1 Unless otherwise indicated, definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600.

3.1.2 *deformed liner*—polyethylene pipe manufactured in a deformed shape that reduces the cross-sectional area for insertion and rehabilitation of nonpressure pipelines, conduits, and ducts. (See Fig. 1.)

3.1.3 *reformed liner*—a reformed pipe is a sample for test purposes formed when the deformed pipe has been inserted into a given casing pipe and rerounded with heat and pressure to fit snugly to the casing pipe taking a given cross-section, in accordance with Sections 5 and 6. (See Fig. 1.)

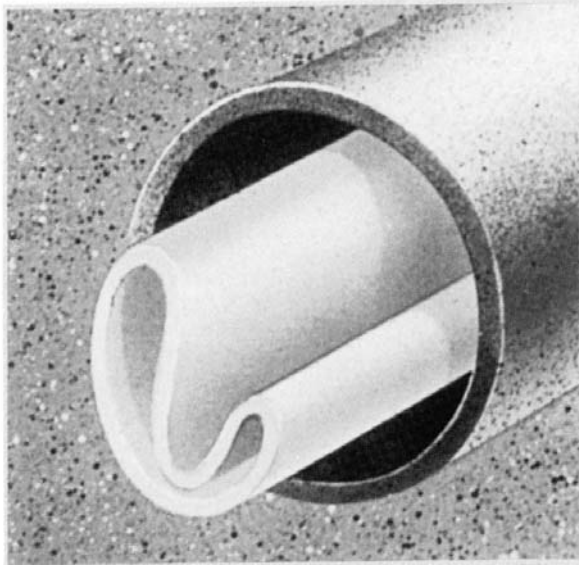
4. Materials

4.1 Material requirements are applicable only to materials prior to extrusion into the liner. Post-extrusion product requirements are presented in Section 6.

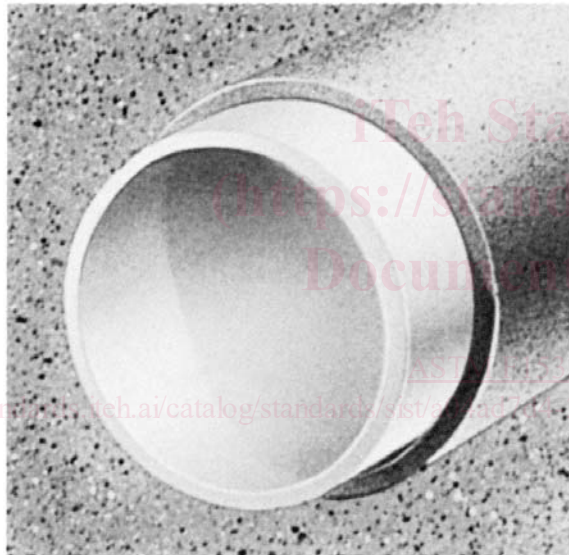
4.2 *Material Classifications*—Polyethylene materials allowable for use in the manufacture of polyethylene liner under this

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.



(a) Deformed Pipe



(b) Reformed Pipe

NOTE 1—This figure is intended only for clarification of terms specific to this specification and shows representative deformed and reformed pipe shapes. Other deformed pipe shapes may meet the general requirements of this specification.

FIG. 1 Deformed Pipe and Reformed Pipe—Clarification of Terms

specification shall have a Plastic Pipe Institute (PPI)⁵ recommended Hydrostatic Design Basis in accordance with Table 1 and shall have a minimum classification in accordance with Specification D3350, as shown in Table 2.

4.3 Rework Material—Clean, rework material, meeting requirements in 4.2, and generated from the manufacturer’s own pipe production, may be used by the same manufacturer, with

⁵ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

TABLE 1 Hydrostatic Design Basis of Pipe Materials

Thermoplastic Pipe Material Designation Code	Required Hydrostatic Design Basis
Pipe Designation	HDB, psi (MPa)
PE 3408	1600 psi at 73°F (11.03 MPa at 23°C)
PE 2406	1250 psi at 73°F (8.62 MPa at 23°C)

TABLE 2 Minimum D3350 Cell Classification Limits for Liner Materials^A

Property Material	PE 2406	PE 3408
Density	2	3
Melt	3	4
Flexural modulus	4	5
Tensile strength	3	4
ESCR	3	3
HDB	3	4
Color and UV stabilizer	C or E	C or E

^A Cell classification should be certified by the resin manufacturer per lot, as shipped to the pipe manufacturer.

material meeting requirements in 4.2 in any combination, as long as the liner produced meets all of the requirements of this specification for the pipe designated.

5. Sampling

5.1 Reformed pipe sample preparation shall involve the rounding of a deformed pipe sample within a split pipe mold with an inside diameter equal to the nominal outside diameter shown in Table 3. A deformed pipe sample of sufficient length (10 ft maximum) to complete the testing requirements shall be inserted into the split pipe mold and secured at the ends. The ends shall have threaded nipples for applying steam with a pressure gage having steam discharge piping. The assembly shall be placed in an enclosed chamber for heating. Ambient pressure steam shall be applied to the chamber for at least a 15-min period at a minimum temperature of 200°F. The temperature shall be elevated to 250°F and the pipe shall be reformed by applying 14.5 psig for a period of 2 min. The pressure shall be increased to a maximum of 26 psig for an additional period of 2 min. While maintaining the 26-psig internal pressure, transition to air pressure and cool to 100°F or less. Remove the reformed sample from the mold for testing.

TABLE 3 Dimensions and Tolerances

Nominal Outside Diameter, in. ^A	Outside Diameter Tolerances ^B	Minimum Wall Thickness, in.			
		DR17	DR24	DR26	DR32.5
3.00	+0.00, -0.015	0.176	0.124	0.115	...
4.00	+0.00, -0.015	0.234	0.166	0.153	...
6.00	+0.00, -0.015	0.352	0.249	0.230	0.184
8.00	+0.00, -0.020	0.469	0.332	0.306	0.245
10.00	+0.00, -0.020	0.587	0.416	0.384	0.307
12.00	+0.00, -0.025	0.704	0.499	0.461	0.368
15.00	+0.00, -0.050	0.879	0.623	0.575	0.460
18.00	+0.00, -0.060	1.055	0.748	0.690	0.552

^A The reformed pipe permits variance of nominal outside diameter during installation of -0.4 to +3.4 % to match existing pipe inside diameter. The larger variance may increase the DR value. Existing inside pipe diameters outside this range will necessitate special sizes.

^B The listed outside diameter tolerances are provided for manufactured liner pipe.