



## Standard Specification for Deformed Polyethylene (PE) Liner<sup>1</sup>

This standard is issued under the fixed designation F 1533; 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 ( $\epsilon$ ) 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 In referee decisions, inch-pound units shall be used. In all cases, the values given in parentheses are provided for information purposes 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:

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>2</sup>
- D 638 Test Method for Tensile Properties of Plastics<sup>3</sup>
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials<sup>3</sup>
- D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>3</sup>
- D 1693 Test Method for Environmental Stress Cracking of Ethylene Plastics<sup>3</sup>
- D 2122 Method for Determining Dimensions of Thermoplastic Pipe and Fittings<sup>4</sup>
- D 2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials<sup>4</sup>
- D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials<sup>4</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin-Based Pipe.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.04.

F 412 Terminology Relating to Plastic Piping Systems<sup>4</sup>

F 1248 Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe<sup>4</sup>

#### 2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)<sup>5</sup>

#### 2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage<sup>6</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 Unless otherwise indicated, definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600.

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 specification shall have a Plastic Pipe Institute (PPI)<sup>7</sup> recommended Hydrostatic Design Basis in accordance with Table 1 and shall have a minimum classification in accordance with Specification D 3350, 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 material meeting requirements in 4.2 in any combination, as long as the liner produced meets all of the requirements of this

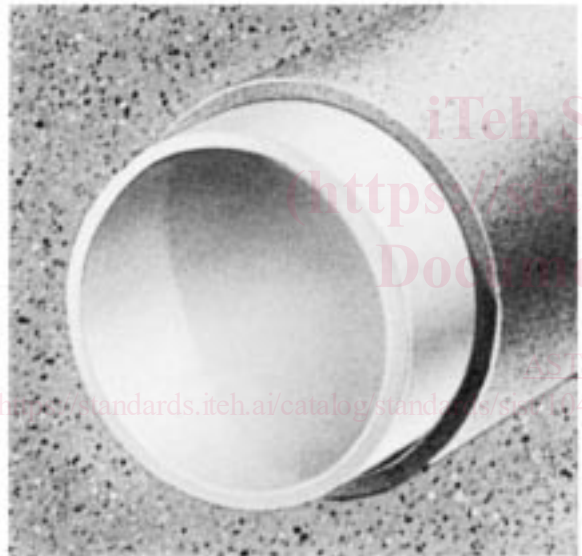
<sup>5</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>6</sup> Available from the Superintendent of Documents, Washington, DC.

<sup>7</sup> Plastics Pipe Institute, Division of the Society of the Plastics Industry, Inc., Wayne Interchange Plaza II, 155 Route 46 West, Wayne, NJ 07470.



(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

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)  |

specification for the pipe designated.

TABLE 2 Minimum D 3350 Cell Classification Limits for Liner Materials<sup>A</sup>

| 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  |

<sup>A</sup> Cell classification should be certified by the resin manufacturer per lot, as shipped to the pipe manufacturer.

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. Safety precautions shall be provided during the test procedure, that is, during application of steam and pressure.

5.2 The frequency of sampling shall be agreed upon between the purchaser and the seller.

6. Requirements and Test Methods

6.1 *Workmanship*—The deformed liner shall be essentially uniform in color, opacity, and other properties. There shall be no evidence of splits, cracks, crazing, kinks, or breaks.

6.2 *Dimensions:*

6.2.1 *Outside Diameter*—The outside diameter shall be as shown in Table 3 when measured in accordance with Test

TABLE 3 Dimensions and Tolerances

| Nominal Outside Diameter, in. <sup>A</sup> | Outside Diameter Tolerances <sup>B</sup> | 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  |

<sup>A</sup> 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.

<sup>B</sup> The listed outside diameter tolerances are provided for manufactured liner pipe.