



# Standard Specification for Corrugated Polyethylene Pipe and Fittings for Mine Heap Leach Aeration Applications<sup>1</sup>

This standard is issued under the fixed designation F2987; 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, workmanship, dimensions, perforations, pipe stiffness, elongation, joint separation resistance, quality of extruded polyethylene, brittleness, testing, and marking of corrugated polyethylene (PE) pipe and fittings for mine heap leach pile aeration. It covers with nominal sizes 100 mm (4 inch), 150 mm (6 inch), 200 mm (8 inch), 250 mm (10 inch), 300 mm (12 inch), 375 mm (15 inch), and 450 mm (18 inch) diameter.

1.2 This specification covers double wall, annular extruded corrugated polyethylene pipe as depicted in Fig. 1.

1.3 The values given in parentheses are provided for information purposes only.

1.4 *The following precautionary caveat pertains only to the test method portion, Section 9, of this specification: 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:<sup>2</sup>

- D618 Practice for Conditioning Plastics for Testing
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

<sup>1</sup> This test method 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.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

F412 Terminology Relating to Plastic Piping Systems

F2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

### 2.2 Federal Standards:<sup>3</sup>

Fed. Std. No. 123 Marking for Shipment (Civil Agencies) Federal Emergency Management Agency (FEMA) Technical Manual: Plastic Pipe Used in Embankment Dams: Best Practices for Design, Construction, Problem Identification and Evaluation, Inspection, Maintenance, Renovation, and Repair

### 2.3 Military Standard:<sup>3</sup>

MIL-STD-129 Marking for Shipment and Storage

## 3. Terminology

3.1 *Definitions*—Definitions used in this specification are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600, unless otherwise specified. The abbreviation for polyethylene is PE.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *split*—any break or crack that extends through the wall.

3.2.2 *crease*—a deformation that cannot be removed like a dent: generally associated with wall buckling.

3.2.3 *leaching*—minerals are removed (leached) from ores that have been mined, crushed, and placed on impervious pads for removal (by chemical leaching) by percolation of the solution through the ore, and collection of that solution at the bottom of the heap leach pile.

## 4. Ordering Information

4.1 Orders for product made to this specification shall include the following information to adequately describe the desired product:

<sup>3</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

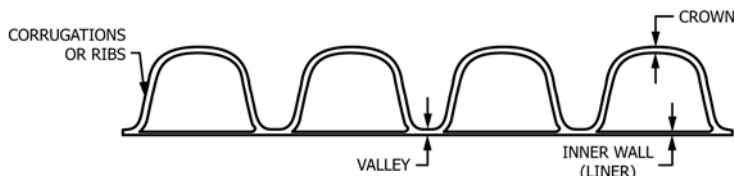


FIG. 1 Typical Double Wall Profile Cross-Section

- 4.1.1 This ASTM designation and year of issue,
- 4.1.2 Perforations:
  - 4.1.2.1 With perforations,
  - 4.1.2.2 Without perforations,
- 4.1.3 Diameters,
- 4.1.4 Total meters of each pipe diameter involved,
- 4.1.5 Pipe laying length,
- 4.1.6 Fitting type(s):
  - 4.1.6.1 Size and type of fittings, including mainline and branch diameters, and
  - 4.1.6.2 Number of fittings per diameter.

5. Significance and Use

5.1 Corrugated PE pipe and fittings in this standard are intended for deep underground applications under harsh chemical exposure from a corrosive effluent where they serve as heap leach pile aeration pipe under a mine heap or dump leaching process. Their major use is to aerate the pile to improve the chemical extraction of the desired metal by the leachate.. Heap leaching is used to extract copper, gold, lead, nickel, silver, uranium, or zinc.

6. Materials

6.1 *Pipe and Fittings*—The pipe and fittings shall be made of virgin PE plastic compound meeting the requirements of Specification D3350 cell classification 435400C or 435400E, except that carbon black content shall be equal to or greater than 2.0% but not exceed 3.0%. Compounds that have a higher cell classification in one or more performance properties shall be permitted all other product requirements are met. For slow crack-growth resistance, resins shall be evaluated using the notched constant ligament stress (NCLS) test according to the procedure described in 9.9.1. Samples shall be taken from the extruded pipe supplied to the project. The average failure time of the five test specimens shall exceed 24 h with no single test specimen’s failure time less than 17 h. Samples taken from the extruded pipe supplied to the project shall have a minimum

Oxidative-Induction-Time of 20 minutes when tested in accordance with in accordance with ASTM D3895.

6.2 *Rework Material*—Clean rework material, generated from the manufacturer’s own production of this product, may be used by the manufacturer provided that the tubing and fittings produced meet all requirements of this specification.

7. General Requirements

7.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and be as uniform as commercially practical in color, opacity, and density. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. The ends shall be cut cleanly and squarely. Holes intentionally placed in perforated pipe are acceptable.

7.1.1 Visible defects, cracks, creases, splits, obstruction to flow in perforations, or in pipe are not permissible.

7.2 Dimensions and Tolerance:

7.2.1 *Nominal Size*—The nominal size for the pipe and fittings for single profile wall and double profile wall shall be the minimum inside diameter as shown in Table 1, rounded to the closest whole number.

7.2.2 *Inside Diameter*—The actual inside diameter for single profile wall and double profile wall shall be the minimum inside diameter with a +4.5% or - 0 % tolerance when measured in accordance with 9.3 and as shown in Table 1.

NOTE 1—The outside diameters and the corrugation pitch of products manufactured to this specification are not specified; therefore, compatibility between pipe and fittings from different manufacturers or the same manufacturer shall be verified.

7.2.3 *Minimum Crown, Liner Wall Thickness*—The minimum wall thickness of the pipe crown shall meet the requirements given in Table 1 when measured in accordance with 9.4.

TABLE 1 Double Wall Pipe Stiffness and Pipe Dimensions

Minimum Inside Diameter		Minimum Pipe Stiffness at 5 % Deflection		Minimum Crown Thickness		Minimum Liner Thickness	
mm	[in.]	kPa	[lbs/in/in]	mm	[in.]	mm	[in.]
75	[3]	345	[50]	0.64	[0.025]	0.5	[0.020]
100	[4]	345	[50]	0.64	[0.025]	0.5	[0.020]
125	[5]	345	[50]	0.69	[0.027]	0.5	[0.020]
150	[6]	345	[50]	0.71	[0.028]	0.5	[0.020]
200	[8]	345	[50]	0.91	[0.036]	0.6	[0.024]
250	[10]	345	[50]	1.22	[0.048]	0.6	[0.024]
300	[12]	345	[50]	1.80	[0.071]	0.9	[0.035]
375	[15]	290	[42]	2.21	[0.087]	1.0	[0.040]
450	[18]	275	[40]	3.05	[0.120]	1.3	[0.051]
600	[24]	235	[34]	3.05	[0.120]	1.5	[0.060]

7.2.4 *Length*—The pipe shall be supplied in any length agreeable to both the owner and the manufacturer. Length shall not be less than 99 % of stated quantity when measured in accordance with 9.5.

7.2.5 *Perforations*—Perforations shall be cleanly cut, placed in the valley of the corrugation rib, and uniformly spaced along the length and circumference of the pipe. Pipe connected by bell and spigot joints shall not be perforated in the area of the bells and spigots. Perforations shall be placed in the top 120° of the pipe.

NOTE 2—For heap leach aeration pipe systems, the perforation open area will vary throughout the pipe run to achieve even distribution of the air through the heap leach pile. Some non-perforated pipe is required as part of the air distribution manifold system.

7.2.6 *Perforation covers*—Perforations must be protected from plugging with ore by a cover or hat as shown in Fig. 2. This cover must permit air to be discharged through the openings between the corrugation valleys and the cover (or “hat”). The covers are equal in thickness to the pipe couplings, are produced with resins compatible to the pipe, and welded at both longitudinal ends to the corrugation crests by extrusion

welding. Perforation covers shall be clearly marked (color, large lettering, numbers) identifying the perforation pattern under it. Spacing of the perforations and covers are determined by the design engineer (typical 2 meters apart).

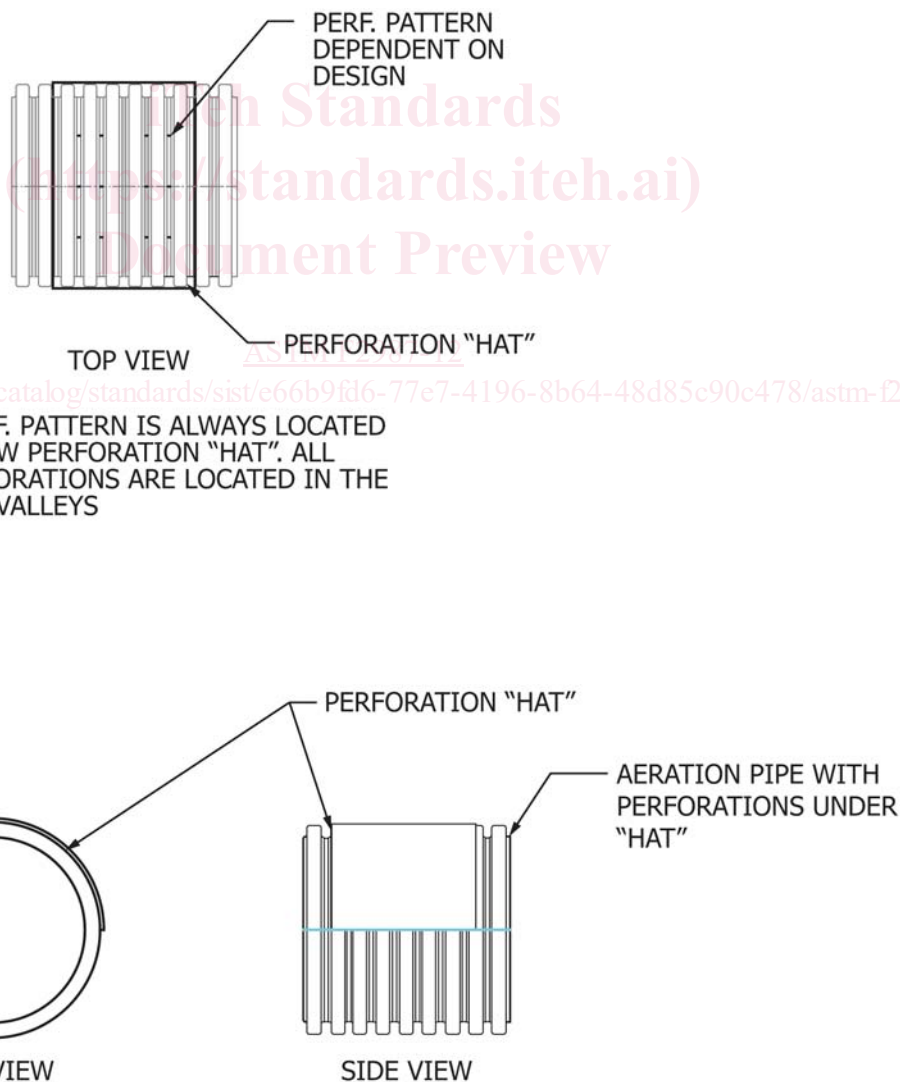
7.2.7 *Crown Marking*—The perforated pipe shall have clear marking, such as a stripe, colored spots, etc., identifying the pipe crown centered over the perforations.

7.3 *Pipe Stiffness*—The pipe shall have a minimum pipe stiffness at 5 % deflection for single wall and double wall as shown in Table 1, when tested in accordance with 9.7.

7.4 *Brittleness*—Pipe and fitting specimens shall be tested in accordance with 9.8.

7.5 *Bond*—The bond between layers of laminated pipe shall be strong and uniform. There shall be no separation of layers when the pipe is deflected 20 %, in accordance with Test Method D2412, nor shall it be possible to separate the layers with the point of a knife when the pipe is in the deflected condition.

NOTE 3—This test may be conducted as a continuation of pipe stiffness testing as specified in 9.7.



\*PERF. PATTERN IS ALWAYS LOCATED BELOW PERFORATION "HAT". ALL PERFORATIONS ARE LOCATED IN THE PIPE VALLEYS

FIG. 2 Perforation Location and Covers