



# Standard Specification for Polyethylene of Raised Temperature/Aluminum/Polyethylene of Raised Temperature (PE-RT/AL/PE-RT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems<sup>1</sup>

This standard is issued under the fixed designation F3506; 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 a coextruded polyethylene composite pressure pipe with a butt welded aluminum tube reinforcement between the inner and outer layers. The inner and outer polyethylene layers are bonded to the aluminum tube by a melt adhesive. Included is a system of nomenclature for the polyethylene-aluminum-polyethylene of raised temperature (PE-RT/AL/PE-RT) pipes, the requirements and test methods for materials, the dimensions and strengths of the component tubes and finished pipe, adhesion tests, and the burst and sustained pressure performance. Also given are the requirements and methods of marking. The pipe covered by this specification is intended for use in air conditioning and refrigeration (ACR) line set systems.

1.2 This specification relates only to composite pipes incorporating a butt welded aluminum tube having both internal and external polyethylene layers. The welded aluminum tube is capable of sustaining internal pressures. Pipes consisting of metallic layers not butt welded together and plastic layers other than polyethylene are outside the scope of this specification.

1.3 The dimensions in this specification are ID controlled to match that of ACR Copper Tube so that the flowrate and volume remains the same on a size-for-size basis.

1.4 Specifications for fittings for use with pipe meeting the requirements of this specification are given in [Annex A1](#).

1.5 This specification excludes crosslinked polyethylene-aluminum-crosslinked polyethylene pipes (see Specification [F1281](#)).

1.6 This specification tests the pipe for service at  $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  ( $140\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$ ) or  $82\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  ( $180\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$ ).

1.7 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- [D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension](#)
- [D618 Practice for Conditioning Plastics for Testing](#)
- [D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure](#)
- [D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings](#)
- [D1600 Terminology for Abbreviated Terms Relating to Plastics \(Withdrawn 2024\)<sup>3</sup>](#)
- [D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings](#)
- [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](#)

<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 [F17.11](#) on Composite.

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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 [www.astm.org/contact](http://www.astm.org/contact). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

**E8/E8M** Test Methods for Tension Testing of Metallic Materials

**E84** Test Method for Surface Burning Characteristics of Building Materials

**F412** Terminology Relating to Plastic Piping Systems

**F1281** Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe

**G154** Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials

2.2 *ASHRAE Standard*.<sup>4</sup>

**ASHRAE Standard 15** Safety Standard for Refrigeration Systems

**ASHRAE Guideline 38-2018** for Using Metal Pressure Vessels to Test Materials Used in Refrigeration Systems

2.3 *Uniform Classification Committee*.<sup>5</sup>

**Uniform Freight Classification**

2.4 *National Motor Freight Association Standard*.<sup>5</sup>

**National Motor Freight Classification**

2.5 *Federal Standard*.<sup>6</sup>

**Fed. Std. No. 123** Marking for Shipments (Civil Agencies)

2.6 *Underwriters Laboratory Standards*.<sup>7</sup>

**UL 207** Refrigerant-Containing Components and Accessories

**UL 723** Standard for Test for Surface Burning Characteristics of Building Materials

**UL 1963** Refrigerant Recovery/Recycling Equipment

2.7 *Military Standard*.<sup>6</sup>

**MIL-STD-129** Marking for Shipment and Storage

2.8 *PPI Documents*.<sup>8</sup>

**PPI TR-3** Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Hydrostatic Design Stresses (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), Minimum Required Strength (MRS)

Ratings, and Categorized Required Strength (CRS) for Thermoplastic Piping Materials or Pipe

**PPI TR-4** PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe

### 3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology **F412**, and abbreviations are in accordance with Terminology **D1600**, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *assembly, n*—a system made up of pipe, fittings, flanges, valves, or other piping components.

### 4. Pipe Classification

4.1 *Pipe Diameter*—The PE-RT/AL/PE-RT composite pipes are classified by inside diameter.

NOTE 1—*Pipe Dimension Ratio*—The concept of dimension ratio is not relevant to PE-RT/AL/PE-RT laminated pipes, and cannot be used to relate pressure rating with total wall thickness.

### 5. Materials

5.1 *General*—The PE-RT/AL/PE-RT pipe is composed of one metallic layer, two layers of the same polyethylene melt adhesive and two layers of the same polyethylene. For pipe made to this specification the constituent materials must meet the following requirements:

5.2 *Aluminum*—The aluminum shall have a thickness as specified in **Table 1**. The material shall have minimum elongations and ultimate tensile strengths of 11 % and 124 MPa (18000 psi), respectively when tested in accordance with **9.6**.

5.3 *PE-RT*:

5.3.1 PE-RT resin used to make pipe meeting the requirements of this specification shall be virgin resin, reworked plastic, or both, and shall have a Plastic Pipe Institute (PPI) HDB established at 23 °C (73 °F) and 82 °C (180 °F).

5.3.1.1 Only PE-RT plastics having an HDB at 82 °C (180 °F) shall be used to manufacture pipe rated at 82 °C (180 °F).

5.3.1.2 The inner PE-RT compound shall meet the color and UV stabilizer code of A, B, C, D, or E in accordance with Specification **D3350**. The outer layer PE-RT compound shall meet the color and UV stabilizer code C or E in accordance

**TABLE 1 Inside Diameters, Aluminum Thickness, and Tolerances for PE-RT/AL/PE-RT**

| Nominal Pipe Size | Minimum Inside Diameter, mm (in.) | Tolerance on Minimum, mm (in.) | Maximum Out-of-Roundness, <sup>A</sup> mm (in.) | Minimum Aluminum Thickness, mm (in.) | Tolerance on Aluminum Thickness, mm (in.) |
|-------------------|-----------------------------------|--------------------------------|-------------------------------------------------|--------------------------------------|-------------------------------------------|
| 1/4               | 4.83 (0.190)                      | +0.30 (0.012)                  | 0.40 (0.016)                                    | 0.36 (0.014)                         | +0.09 (+0.004)                            |
| 3/8               | 7.90 (0.311)                      | +0.30 (0.012)                  | 0.40 (0.016)                                    | 0.36 (0.014)                         | +0.09 (+0.004)                            |
| 1/2               | 11.07 (0.436)                     | +0.30 (0.012)                  | 0.50 (0.020)                                    | 0.51 (0.020)                         | +0.09 (+0.004)                            |
| 5/8               | 14.10 (0.555)                     | +0.30 (0.012)                  | 0.50 (0.020)                                    | 0.70 (0.028)                         | +0.09 (+0.004)                            |
| 3/4               | 17.27 (0.680)                     | +0.30 (0.012)                  | 0.50 (0.020)                                    | 0.85 (0.033)                         | +0.09 (+0.004)                            |
| 7/8               | 19.94 (0.785)                     | +0.30 (0.012)                  | 0.50 (0.020)                                    | 0.95 (0.037)                         | +0.09 (+0.004)                            |
| 1 1/8             | 26.04 (1.025)                     | +0.30 (0.012)                  | 0.50 (0.020)                                    | 1.20 (0.047)                         | +0.09 (+0.004)                            |

<sup>A</sup> The out-of-roundness specification applies only to pipe prior to coiling.