



Standard Specification for Smooth-Wall Coilable Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable¹

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1. Scope

1.1 This specification covers materials, dimensions, and workmanship, and performance tests for medium-density and high-density smooth-wall coilable polyethylene (PE) conduit (duct) containing electrical wires or cables, or both, preassembled by the manufacturer.

NOTE 1—The end user may elect to assemble the conduit and the wire or cable system in the field.

1.2 Whenever two sets of values are presented, in different units, the values in the first set are the standard, while those in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

- D 638 Test Method for Tensile Properties of Plastics²
- D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact²
- D 1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer²
- D 1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable²
- D 1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics²
- D 2951 Test Method for Resistance of Types III and IV Polyethylene Plastics to Thermal Stress-Cracking³
- D 6070 Test Methods for Physical Properties of Smooth-Wall, Coilable, Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable⁴

2.2 Other Document:

National Electrical Code⁵

3. Significance and Use

3.1 PE duct must have smooth surfaces to facilitate the installation and removal of electrical wire and cable. It must be capable of being manufactured and coiled (reeled) in continuous lengths, transported, and subsequently uncoiled for installation or further processing, or both, without affecting its properties or performance.

4. Application and Installation

4.1 PE duct is suitable for underground electrical distribution systems utilizing insulations suitable for use at conductor temperatures not exceeding 90°C (190°F) for normal operation. The minimum recommended installation temperature for the PE duct is –25°C (–13°F), however, depending on the type of wire or cable installed in the duct, a higher installation temperature may be required.

5. Extrusion Compounds

5.1 The PE-extrusion compounds shall be either medium-density Type II, Class C, or high-density Type III, Class C, as described in Specification D 1248, and in addition meet the requirements shown in Table 1. Remove the electrical wires or cables, or both, from the duct before testing.

6. Finished PE Duct

6.1 *Workmanship*—Coilable PE duct shall be free of visible cracks, holes, foreign inclusions, or other physical defects that would detract from its performance. It shall be as uniform as practicable in dimensions, smoothness, density, and other physical properties.

6.2 *Dimensions*—Smooth-wall coilable PE duct shall have the dimensions prescribed in Table 2.

¹ This specification is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.18 on Solid Insulations, Non-Metallic Shieldings, and Coverings for Electrical and Telecommunications Wires and Cables.

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 08.02.

⁴ *Annual Book of ASTM Standards*, Vol 10.02.

⁵ Available from the National Fire Protection Assn., 470 Atlantic Ave., Boston, MA 02210.

TABLE 1 Requirements for PE Extruded Compounds

| Property | Test Method | Type II | Type III |
|--|-----------------------------------|-------------|-------------|
| Tensile strength, min, psi (MPa) | D 638 ^A | 2500 (17.2) | 2800 (19.3) |
| Elongation, min, % | D 638 ^A | 350 | 350 |
| Brittleness temperature, max, °C | D 746 | -75 | -75 |
| Melt index, max | D 1238 Table number 1 Condition E | 0.5 | 0.5 |
| Environmental stress – crack resistance, min, F ₂₀ , h ^B | D 1693 Condition B ^C | 48 | 48 |
| Thermal stress – crack resistance without cracking, min, h | D 2951 ^C | | 168 |
| Compression and recovery, min %, within 10 min | D 6070 | 85 | 85 |
| Impact test, max, number of failures | D 6070 | 3/10 | 3/10 |

^A Cut smooth parallel strip test specimens directly from the finished duct. Where the wall thickness prohibits this procedure cut a standard Type 4 specimen from shaved parallel strips approximately 0.050 in. (1.25 mm) in thickness.

^B F₂₀, h = the minimum number of hours necessary for a maximum 20 % of the samples to fail.

^C Mold material from finished duct to the correct thickness as required in the individual test procedure.

TABLE 2 Smooth-Wall Coilable PE Duct

| Nominal Size in. ^A | Wall Thickness, min ^B | | Outside Diameter ^C | | Bending Radius, min | |
|-------------------------------|----------------------------------|------|-------------------------------|-------------|---------------------|------|
| | in. | mm | in. | mm | in. | mm |
| 1/2 | 0.060 | 1.52 | 0.840 ± 0.008 | 21.0 ± 0.20 | 13 | 330 |
| 3/4 | 0.060 | 1.52 | 1.050 ± 0.012 | 26.7 ± 0.30 | 13 | 330 |
| 1 | 0.075 | 1.91 | 1.315 ± 0.012 | 33.4 ± 0.30 | 13 | 330 |
| 1 1/4 | 0.100 | 2.54 | 1.660 ± 0.012 | 42.2 ± 0.30 | 18 | 460 |
| 1 1/2 | 0.115 | 2.92 | 1.900 ± 0.012 | 48.0 ± 0.30 | 21 | 530 |
| 2 | 0.145 | 3.68 | 2.375 ± 0.012 | 60.3 ± 0.30 | 26 | 660 |
| 2 1/2 | 0.203 | 5.16 | 2.875 ± 0.012 | 73.0 ± 0.30 | 30 | 760 |
| 3 | 0.216 | 5.49 | 3.500 ± 0.012 | 89.0 ± 0.30 | 40 | 1020 |

^A These are "trade sizes" and are not to be used for acceptance. The outside diameter is the controlling dimension.

^B Maximum wall: + 0.020 in. (0.50 mm).

^C Tolerances apply to duct as extruded.

7. Duct Size Selection

7.1 Use this section only as a guide. Actual duct sizes must be agreed to between the seller and the purchaser.

7.1.1 *Percent Fill*—Article 347 (Paragraph 11) of the National Electrical Code limits the maximum percentage fill of electrical duct to the figures shown in Table 3.

7.1.2 *Cross-Sectional Area*—Table 4 gives cross-sectional area for the various duct sizes.

7.1.3 *Calculations of Duct Size*:

$$\text{Minimum duct area} = 100 \times (A/B) \quad (1)$$

where:

A = cross-sectional area of cable to be installed, in.² (mm²), and

B = percent fill from Table 3.

8. Sampling

8.1 The number of samples or the selection of the sample or samples of duct shall be agreed upon by the purchaser and the seller. In case of no prior agreement, one or more samples per lot of material is adequate.

8.2 *Size of Samples*—Make the samples at least 3 ft (1 m) long.

TABLE 3 Percentage Fill, max

| Conductor Type | No. of Conductors | | | | |
|---------------------------|-------------------|----|----|----|--------|
| | 1 | 2 | 3 | 4 | Over 4 |
| All (except lead-covered) | 53 | 31 | 40 | 40 | 40 |
| Lead-covered | 55 | 30 | 40 | 38 | 35 |

TABLE 4 Cross-Sectional Area

| Nominal Size, in. | Minimum Internal Area | |
|-------------------|-----------------------|-----------------|
| | in. ² | mm ² |
| 1/2 | 0.390 | 240 |
| 3/4 | 0.650 | 420 |
| 1 | 1.03 | 660 |
| 1 1/4 | 1.63 | 1050 |
| 1 1/2 | 2.14 | 1370 |
| 2 | 3.35 | 2160 |
| 2 1/2 | 4.71 | 3040 |
| 3 | 7.30 | 4710 |

9. Test Methods

9.1 Unless otherwise instructed, test the material in accordance with Table 1.

10. Marking

10.1 Marking on the duct shall include the following spaced at intervals of not more than 5 ft (1.5 m):

10.1.1 Manufacturer's name or trademark,

10.1.2 Duct size, and

10.1.3 Type of polyethylene plastic, in accordance with Specification D 1248 nomenclature (for example, Type III) or the terminology (for example, HDPE), or both.

11. Keywords

11.1 brittleness temperature; compression and recovery; duct; elongation; environmental stress cracking; extrusion; impact testing; polyethylene; tensile strength; thermal stress cracking

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