
Standard Practice for Solid Wall High-Density Polyethylene (HDPE) Conduit for Non-Pressure Applications Used for the Protection of Power and Telecommunications Cables

AASHTO Designation: R 63-13 (2017)¹

Technical Subcommittee: 4b, Flexible and Metallic Pipe

Release: Group 2 (June)



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Solid Wall High-Density Polyethylene (HDPE) Conduit for Non-Pressure Applications Used for the Protection of Power and Telecommunications Cables

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1. SCOPE

- 1.1. This standard practice provides guidance to engineers in the specification of HDPE conduit used in buried applications for the protection of power cables for use in highways, airport lighting, traffic control, and fiber optic data and command and control applications in State Transportation Projects.
- This standard practice covers conduit used in the following manner:
- HDPE pipe used as a casing for the protection of smaller individual conduits, innerducts, in road crossings;
 - HDPE conduit in coils, on steel reels, or in straight sticks; and
 - CIC (cable in conduit), when power cable (conductors), CATV (coaxial), or fiber optic cable is installed in the conduit at the conduit manufacturing facility.
 - HDPE pipe is commonly installed in standalone duct installations for the protection of power cable (conductors), CATV (coaxial cable), or fiber optic cable.
 - HDPE pipe is commonly installed in standalone duct applications for road crossings when the bury depth is sufficient to avoid degradation effects to the road.
 - HDPE pipe is commonly installed in standalone duct applications parallel to the roadway.
- 1.2. This standard practice covers material, dimensional, workmanship, and performance requirements for use of conduit in non-pressure applications.
- 1.3. HDPE conduit meeting the guidelines of this standard practice shall be outside diameter (OD)-controlled solid wall, with or without external or internal ribs. The sizing shall be Iron Pipe Size or Schedule as noted in Tables 6 and 7. The internal or external surface may contain a coextruded layer provided the finished conduit meets the product requirement in this standard.
- 1.4. This standard practice does not include guidelines for installation of HDPE conduit. Typical installation methods include trenching, plowing, and Horizontal Directional Drilling (HDD). Consult the PPI (Plastic Pipe Institute) *Handbook of Polyethylene Pipe* and TN (Technical Notes) on the PPI website, <http://plasticpipe.org>, for further information and guidance on installation methods.

2. REFERENCED DOCUMENTS

2.1. *ASTM Standards:*

- D570, Standard Test Method for Water Absorption of Plastics
- D618, Standard Practice for Conditioning Plastics for Testing
- D638, Standard Test Method for Tensile Properties of Plastics
- D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1238, Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique
- D1600, Standard Terminology for Abbreviated Terms Relating to Plastics
- D1603, Standard Test Method for Carbon Black Content in Olefin Plastics
- D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D2122, Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter
- D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D2444, Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D2839, Standard Practice for Use of a Melt Index Strand for Determining Density of Polyethylene
- D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- D3485, Standard Specification for Coilable High Density Polyethylene (HDPE) Cable in Conduit
- D4703, Standard Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
- D4883, Standard Test Method for Density of Polyethylene by the Ultrasound Technique
- D6070, Standard Test Methods for Physical Properties of Smooth-Wall, Coilable, Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable (withdrawn 2016)
- F412, Standard Terminology Relating to Plastic Piping Systems
- F1804, Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation
- F1962, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
- F2160, Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

2.2. *National Electrical Manufacturers Association (NEMA) Standard:*

- NEMA TC 7, Smooth-Wall Coilable Electrical Polyethylene Conduit

2.3. *Underwriters Laboratories (UL) Standards:*

- UL 651A, High Density Polyethylene HDPE Conduit

Note 1—In November of 2011, UL changed the specification numbers (no changes in the body of the specifications). Prior to November 2011, UL 651A was PVC and HDPE in stick form and UL 651B was HDPE in coiled form. As of November 2011, UL 651 now addresses PVC in stick-form conduit and UL 651A addresses HDPE in stick-form and coiled-form conduit.

- UL 1990, Nonmetallic Underground Conduit with Conductors

2.4. *National Fire Protection Association (NFPA 70); National Electric Code:*

- NFPA 70; National Electric Code (NEC), 2011:
 - i. Article 353: High Density Polyethylene Conduit; Type HDPE Conduit
 - ii. Article 354: Nonmetallic Underground Conduit with Conductors: Type NUCC

3. TERMINOLOGY

- 3.1. *Definitions*—General terms used in this standard are as defined in ASTM F412, ASTM F2160, UL 651A, and NEMA TC 7. Abbreviations are in accordance with ASTM D1600, unless otherwise specified.
- 3.2. *Definitions of Terms Specific to This Standard:*
- 3.2.1. *CATV and CCTV, n*—cable television and closed circuit television
- 3.2.2. *cell classification (cell class), n*—method of identifying thermoplastic materials such as HDPE, as specified in ASTM D3350, where the cell classification is based on six properties for PE.
- 3.2.3. *CIC (cable in conduit), n*—when the power or fiber cable is installed during the extrusion process of the HDPE conduit.
- 3.2.4. *conduit (duct), n*—a tubular raceway for carrying power, communications, or other wires and cable.
- 3.2.5. *EPEC A, n*—Electrical Polyethylene Conduit A. This type represents the nominal dimensions as specified in standard dimension ratio (SDR) 17.
- 3.2.6. *EPEC B, n*—Electrical Polyethylene Conduit B. This type represents the nominal dimensions as specified in SDR 13.5.
- 3.2.7. *ESCR, n*—environmental stress crack resistance. Also termed as “Slow Crack Growth Resistance.”
- 3.2.8. *FTTH, n*—fiber to the home.
- 3.2.9. *HDD, n*—horizontal directional drilling.
- 3.2.10. *innerduct, n*—a conduit installed inside a conduit.
- 3.2.11. *IPS (Iron Pipe Size), n*—Iron Pipe Size convention for PE pipe. Based on OD-controlled pipe-SDR nomenclature.
- 3.2.12. *ITS, n*—Intelligent Transportation Systems.
- 3.2.13. *ovality, n*—a conduit’s deviation from roundness as a consequence of coiling, handling, or installation.

- 3.2.14. *NEC, n*—National Electric Code.
- 3.2.15. *Schedule 40/80, n*—This type represents the nominal dimensions as specified in ASTM F2160, UL 651A, and NEMA TC 7 (EPEC-40, EPEC-80).
- 3.2.16. *ribs, n*—a series of ridges, longitudinal or spiral, along the inside or outside surface of a conduit.
- 3.2.17. *SCADA, n*—Supervisory Control and Data Acquisition systems.
- 3.2.18. *SDR (standard dimension ratio), n*—the ratio of the average OD divided by the minimum wall thickness.
- 3.2.19. *SIDR, n*—a sizing system that denotes an inside diameter (ID)-controlled conduit. SIDR sizing is noted in ASTM D2239.
- Note 2**—This is a pressure pipe specification, and in this standard, ONLY the dimensions of the conduit are to be used. Tables 1 and 2 in ASTM D2239 list conduit dimensions.
- 3.2.20. *trade size, n*—the nominal diameter of the conduit (pipe). Refer to the particular specification for dimensions and tolerances.
- 3.2.21. *true size, n*—denotes the use of a sizing system that requires a nominal inside diameter to be equal to or greater than the stated nominal size of the conduit (that is, a 1¹/₄-in. conduit has a minimum ID of 1.25).

4. SIGNIFICANCE AND USE

- 4.1. *Significance*—High-Density Polyethylene (HDPE) conduit is a protective pathway for telecommunications and power cables used throughout the infrastructure. The inherent properties of HDPE such as chemical resistance and stress crack resistance are well suited for infrastructure systems, as these require long service life.
- Because of HDPE coilable conduit's long lengths, flexibility, and tensile strength, it is ideally suited for HDD (horizontal directional drilling) installation methodologies and construction by plowing along highway rights-of-way. HDPE "sticks" (20- to 40-ft lengths) are used for larger sizes ranging from 6 to 12 in. and sometimes larger when the installation requires multiple pathways (innerducts) to run through one service pathway.
- 4.2. *Use*—The following lists the different areas for each segment, but use is not limited to the list:
1. *Telecommunications*—fiber optics, CATV, CCTV, or FTTH along highway rights-of-way; and Intelligent Transportation Systems (ITS).
 2. *Data Acquisition*—SCADA (Supervisory Control and Data Acquisition) Systems for Positive Train Control Technology; pipeline control; weigh stations and SMART bridges (structural monitoring); Intelligent Highway Systems (ITS); traffic control and highway monitoring systems; road condition sensors; and security.
 3. *Power Systems*—electrical cables rated for 600V to 69kV (distribution and transmission lines), highway lighting systems, Intelligent Transportation Systems (ITS), traffic control and highway monitoring systems, and airport lighting systems.
- Note 3**—Power conductors rated at 90°C and medium voltage cable rated at 105°C are permitted for use with HDPE conduit. Per NEC Code 2011, Article 353, conductors or cable rated at higher temperatures are permitted, provided they do not operate at a higher temperature than the rating for HDPE conduit.
4. *Installation*—HDD, plowing and open cut; underground installations, either direct buried or concrete encased; and new installations, existing installations, or any additions/alterations.