Designation: D 1351 – 97

Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable[1]

This standard is issued under the fixed designation D 1351; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers a thermoplastic insulation which consists substantially of polyethylene.

1.2 This type of insulation is considered suitable for continuous operation for conductor temperatures up to 75°C with a maximum conductor size of 1000 kcmil (507 mm^2). The maximum voltage rating shall not exceed 35 000 V for power application or 9 000 V for series lighting.

1.3 In many instances the insulation cannot be tested unless it has been formed around a conductor or cable. Therefore, tests done on insulated wire or cable in this document are solely to determine the relevant property of the insulation and not to test the insulated conductor or completed cable.

1.4 The values stated in inch-pound units are the standard, except in cases where SI units are more appropriate. The values in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics for Testing[2]

D 1248 Specification for Polyethylene Plastics Molding and Extrusion Materials[2]

D 1711 Terminology Relating to Electrical Insulation[3]

D 2308 Specification for Polyethylene Jacket for Electrical Insulated Wire and Cable[3]

D 2633 Methods of Testing Thermoplastic Insulations and Jackets for Wire and Cable[4]

D 3349 Test Method for Absorption Coefficient of Ethylene Polymer Material Pigmented with Carbon Black[4]

2.2 *ICEA Standard:*

T-24-380 Guide for Partial-Discharge Procedure[5]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology D 1711 for definitions pertinent to this specification.

3.2 *Definition of Term Specific to This Standard:*

3.2.1 *aging, n*—exposure of materials to air at 100°C for 48 h.

4. Conductor Shields

4.1 Use conductor shields on solid and stranded conductors of power cables having rated circuit voltages above 2000 V. This requirement does not apply to series lighting cables. Conductor shielding is conducting material at least 0.0025 in. (0.06 mm) thick applied over the surface of the conductor. It may be conducting nonmetallic tape, conducting compound, or conducting cement.

5. Physical Properties

5.1 The polyethylene, before application to the conductor, shall comply with the requirements of Specification D 1248 for Type I; Class A, B or C; Category 4 or 5; Grade E4 or E5. The requirements of Specification D 1248 do not apply to the insulation removed from the conductor.

5.2 Insulation exposed to sunlight or weather requires Specification D 1248, Class C compound or suitable protective coverings. Class C compound shall meet the minimum absorption coefficient requirement in Table 1.

5.3 Specimens removed from the wire or cable and tested at 20 to 30°C (68 to 80°F) shall conform to the requirements for physical properties specified in Table 1. The insulation may be air-oven aged without removal from the conductor.

5.4 *Thickness of Insulation*—The minimum average insulation thickness shall be as specified in Table 2 or Table 3 of this specification. The minimum thickness shall be at least 90 % of the specified minimum average thickness.

5.5 *Absorption Coefficient*—See Test Method D 3349. Instead of testing insulation removed from the conductor, a certification by the manufacturer of the polyethylene compound that the requirement has been complied with shall suffice.

6. Electrical Requirements

6.1 *Order of Testing*—Perform the partial discharge, ac voltage, insulation resistance, and dc voltage tests in that order when any of these tests are specified. The sequence of other testing is not specified.

[1] This specification is under the jurisdiction of ASTM Committee D-9 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 Telecommunication Wires and Cables.

Current edition approved April 10, 1997. Published January 1998. Originally published as D 1351 – 54T. Last previous edition D 1351-90.

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

[3] *Annual Book of ASTM Standards*, Vol 10.01.

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

[5] Available from the Insulated Cable Engineers Association, P.O. Box 440, South Yarmouth, MA 02664.

TABLE 1 Physical Properties of Compound

Unaged Requirements:	
Tensile strength, min, psi (MPa)	1400 (9.7)
Elongation at rupture, min, %	350
Aged Requirements:	
After air oven aging at 100 ± 1°C for 48 h:	
Tensile strength, min, psi (MPa)	1050 (7.3)
Elongation at rupture, min, %	265
Absorption Coefficient, min, absorbance/mm	320

6.2 *Partial Discharge*—When tested in accordance with ICEA T-24-380, as modified in Test Methods D 2633, each length of completed shielded power cable rated for service at 2001 V and above shall comply with the minimum partial discharge extinction level. See Test Methods D 2633.

6.3 *AC Voltage Test*—The insulated conductor shall withstand the ac voltage specified in Table 2 or Table 3 for 5 min. Unless otherwise specified, this test may be omitted for nonshielded conductors rated up to 5000 V if the dc voltage test described in 6.6 is to be performed.

6.4 *Insulation Resistance*—The insulated conductor shall have an insulation-resistance value equal to or greater than that corresponding to a constant of 50 000 at 60°F (15.6°C). When the temperature of the water in which the insulation is tested differs from 60°F, a correction factor must be applied. Table 1 of Test Methods D 2633 contains the correction factors. Each insulation manufacturer can furnish the 1°F coefficient for their insulation material by using the procedure given in Test Methods D 2633. Multiply the measured value by the correction factor to obtain the insulation resistance value corrected to 60°F.

6.5 *DC Voltage Test (Cables Rated at 5001 V and Above)*—Upon completion of the insulation resistance test, each length of insulated power cable rated for service at 5001 V and over shall withstand for 15 min the dc test voltage given in Table 2 or Table 3.

6.6 *DC Voltage Test (Cables Rated at 5000 V or Less)*—Upon completion of the insulation resistance test, each nonshielded conductor rated up to 5000 V shall withstand for 5 min the dc test voltage given in Table 2 or Table 3. Unless otherwise specified, this test may be omitted for nonshielded conductors rated up to 5000 V if the ac voltage test described in 6.3 has been performed.

7. Keywords

7.1 cable; conductor; electrical; insulation; polyethylene; thermoplastic; wire