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Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable¹

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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 use on wire or cable that will be used for continuous operation at conductor temperatures up to 75°C with a maximum conductor size of 1000 kcmil (507 mm²). 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 material cannot be tested unless it has been formed around a conductor. Therefore, tests done on insulated wire or cable in this specification are solely to determine the relevant property of the insulation material and not to test the insulated conductor or completed cable.

1.4 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*:²

D1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

D1711 Terminology Relating to Electrical Insulation

D2308 Specification for Thermoplastic Polyethylene Jacket for Electrical Wire and Cable

D2633 Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable

D3349 Test Method for Absorption Coefficient of Ethylene Polymer Material Pigmented with Carbon Black

¹ This specification is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.07 on Electrical Insulating Materials.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 *ICEA Standard*:

T-24-380 Guide for Partial-Discharge Procedure³

3. Terminology

3.1 *Definitions*:

3.1.1 Refer to Terminology D1711 for definitions of terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *aging (act of), n*—exposure of materials to air at a temperature of 100°C for 48 h.

4. Conductor Shields

4.1 Conductor shields shall be used 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. The options include 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 D1248 for Type I; Class A, B or C; Category 4 or 5; Grade E4 or E5. The requirements of Specification D1248 do not apply to insulation removed from the conductor.

5.2 Insulation exposed to sunlight or weather requires Specification D1248, 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 86°F) shall conform to the requirements for physical properties specified in Table 1. Alternatively, the insulation shall 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

³ Available from The Insulated Cable Engineers Association, Inc. (ICEA), P.O. Box 1568, Carrollton, GA 30112, <http://www.icea.net>.

*A Summary of Changes section appears at the end of this standard

TABLE 1 Physical Properties of Compound

Unaged Requirements:	
Tensile strength, min, psi (MPa)	1500 (10.4)
Elongation at rupture, min, %	350
Aged Requirements:	
After air oven aging at 100 ± 1°C for 48 h:	
Tensile strength, % retention, min	75
Elongation at rupture, % retention, min	75
Absorption Coefficient, min, absorbance/nm	320

specification. The minimum thickness shall be at least 90 % of the specified minimum average thickness.

5.5 *Absorption Coefficient*—Test according to Test Method **D3349**. Alternatively, 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.

6.2 *Partial Discharge*—When tested in accordance with ICEA T-24-380, as modified in Test Methods **D2633**, 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 **D2633**.

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 shall be omitted for nonshielded conductors rated up to 5000 V if the dc voltage test described in **6.6** is 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 MΩ-1000 ft 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 **D2633** contains the correction factors. Each insulation or cable manufacturer can furnish the 1°F coefficient for their insulation material by using the procedure given in Test Methods **D2633**. 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, it is acceptable to omit this test 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

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