



# Standard Specification for Crosslinked Polyethylene Insulation for Wire and Cable Rated 0 to 2000 V<sup>1</sup>

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## 1. Scope

1.1 This specification covers a crosslinked polyethylene insulation for electrical wires and cables in conductor sizes 14 AWG [2.08 mm<sup>2</sup>] and larger. The base polymer of this insulation consists substantially of polyethylene or a polyethylene copolymer.

1.2 This type of insulation is suitable for continuous use on power cables in wet and dry locations, for voltage ratings not exceeding 2000 V and at conductor temperatures not exceeding 90°C for normal operation. For copper conductors, the insulation can be applied over the uncoated metal.

1.3 Materials covered by this specification are not sunlight and weather resistant unless they are carbon black pigmented or contain an additive system designed for this protection.

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

1.5 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:<sup>2</sup>

[D470 Test Methods for Crosslinked Insulations and Jackets for Wire and Cable](#)

[D1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable](#)

[D1711 Terminology Relating to Electrical Insulation](#)

<sup>1</sup> 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 Telecommunication Wires and Cables.

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

[D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics](#)

### 2.2 ICEA Standard:

[ICEA T-28-562 Test Method for Measurement of Hot Creep of Polymeric Insulations<sup>3</sup>](#)

## 3. Terminology

### 3.1 Definitions:

3.1.1 For definitions of terms used in this specification refer to Terminology [D1711](#).

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aging (act of), n*—exposure of materials to air at 121°C for 168 h.

## 4. Physical Properties

4.1 The requirements for the insulation are listed in [Table 1](#).

## 5. Electrical Requirements

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

5.2 *AC Voltage Test*—Subject wires and cables to an ac test voltage for a period of 5 min. Unless otherwise specified, omit this test if the dc voltage test described in [5.4](#) is to be performed. Test at a voltage of 100 V/mil [4 kV/mm] based on the specified nominal thickness of insulation for the rated circuit voltage, phase to phase. Conduct the tests in accordance with Test Methods [D470](#).

5.3 *Insulation Resistance*—The insulated conductor shall have an insulation resistance equal to or greater than that corresponding to a constant of 10 000 at 60°F [15.6°C]. When the temperature of the water in which the insulation is tested differs from 60°F, apply a correction factor. [Table 2](#) of Test Methods [D470](#) contains the correction factors. Each insulation manufacturer can furnish the 1°F coefficient for the insulation material by using the procedure given in Test Methods [D470](#).

<sup>3</sup> Available from Insulated Cable Engineers Association, P. O. Box 440, South Yarmouth, MA 02664 or Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112.

**TABLE 1 Physical Properties for Crosslinked Polyethylene Insulation**

Unaged Requirements:	
Tensile strength, min, psi [MPa]	1800 [12.4]
Elongation at rupture, min, %	250
Aged Requirements:	
After Air Oven Test at 121 ± 1°C for 168 h:	
Tensile strength, min, % of unaged value	75
Elongation at rupture, min, % of unaged value	75
Heat Distortion:	
At 121 ± 1°C, max, % of unaged value:	
4/0 Awg [107 mm <sup>2</sup> ] and smaller (insulation on cable)	30
Larger than 4/0 AWG [107 mm <sup>2</sup> ] (buffed sample of insulation)	15
Percent Hot Creep	
Filled	100
Unfilled	175
Percent Hot Set	
Filled	5
Unfilled	10

**TABLE 2 Accelerated Water Absorption Test Requirements**

Electrical Method:	
Permittivity after one day, max	6.0
Increase in capacitance, max, %	
From 1 to 14 days	3.0
From 7 to 14 days	1.5
Stability factor after 14 days, max	1.0

Multiply the measured value by the correction factor to obtain the insulation-resistance value corrected to 60°F.

5.3.1 Where a nonconducting separator is applied between the conductor and insulation or where an insulated conductor is covered with a nonmetallic jacket so that the insulation resistance can be measured only on the completed assembly, the required insulation resistance shall be at least 60 % of that required for the primary insulation based on the nominal thickness of that insulation.

5.4 *DC Voltage Test*—Upon completion of the insulation resistance test, each unshielded insulated conductor shall withstand for 5 min a dc test voltage which is three times the ac test voltage specified in 5.2. Unless otherwise specified, omit this test if the ac voltage test described in 5.2 has been performed.

5.5 *Accelerated Water Absorption Requirements*—The insulation shall meet the requirements of Table 2 when tested in

accordance with the Accelerated Water Absorption Tests in Test Methods D470. Conduct the Electrical Method Test at 60 Hz with the water temperature at 75 ± 1°C.

## 6. Heat Distortion

6.1 The requirements for heat distortion are given in Table 1 of this specification. The test is conducted in accordance with Test Methods D470.

## 7. Percent Hot Creep and Percent Hot Set

7.1 Determine the percent hot creep for 15 min at 150°C [302°F] as follows: Meet the filled or unfilled values specified in Table 1. Conduct this test in accordance with Practice ICEA T-28-562.

7.2 Determine the percent hot set for 5 min at 150°C [302°F] as follows: Meet the filled or unfilled values specified in Table 1. Conduct this test in accordance with Practice ICEA T-28-562.

7.3 In case of dispute, the solvent extraction test in Test Method D2765 is to be the referee method. The extractables, after a drying time of 20 h, shall be no more than 30 %.

## 8. Test Applicable for Sunlight and Weather Resistant Materials

8.1 For insulations requiring sunlight- and weather-resistance testing, test in accordance with “Weatherability for Colored Materials (including white and black)” in Specification D1248. Prepare the specimens in accordance with Test Methods D470 for physical tests of insulations and jackets.

## 9. Sampling

9.1 Unless otherwise instructed, sample the insulation in accordance with Test Methods D470.

## 10. Test Methods

10.1 Unless otherwise instructed, test the insulation in accordance with Test Methods D470.

## 11. Keywords

11.1 ac voltage; crosslinked polyethylene; dc voltage; heat distortion; hot creep; hot set; insulation resistance; water absorption; weather resistant

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