



Designation: D2655 – 23

# Standard Specification for Crosslinked Polyethylene Insulation for Wire and Cable Rated 0 to 2000 V, 90 °C Operation<sup>1</sup>

This standard is issued under the fixed designation D2655; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 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.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

<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 D09.07 on Electrical Insulating Materials.

Current edition approved Aug. 1, 2023. Published August 2023. Originally approved in 1967. Last previous edition approved in 2019 as D2655 – 19. DOI: 10.1520/D2655-23.

<sup>2</sup> 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.

[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](#)

[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 Requirements

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

4.2 *Tensile Strength and Percent Elongation at Rupture:*

4.2.1 The test is conducted in accordance with Test Methods [D470](#). The requirements for tensile strength and elongation are given in [Table 1](#) of this Specification.

4.3 *Heat Distortion:*

4.3.1 The test is conducted in accordance with Test Methods [D470](#). The requirements for heat distortion are given in [Table 1](#) of this specification.

4.4 *Percent Hot Creep and Percent Hot Set:*

4.4.1 Conduct these test in accordance with Test Method [ICEA T-28-562](#).

4.4.2 Determine the percent hot creep for 15 min at 150 °C (302 °F). Meet the filled or unfilled values specified in [Table 1](#).

4.4.3 Determine the percent hot set for 5 min at 150 °C (302 °F). Meet the filled or unfilled values specified in [Table 1](#).

<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.

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

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

Unaged Tensile Properties Requirements:	
Tensile strength, min, psi [MPa]	1800 [12.4]
Elongation at rupture, min, %	250
Aged Tensile Properties Requirements:	
After Air Oven Test at 121 °C ± 1 °C for 168 h:	
Tensile strength, min, % of unaged value	75
Elongation at rupture, min, % of unaged value	75
Heat Distortion Requirements:	
At 121 °C ± 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 Requirements:	
Filled (max %)	100
Unfilled (max %)	175
Percent Hot Set Requirements:	
Filled (max %)	5
Unfilled (max %)	10
Percent Extractable Requirement:	
After drying for 20 h (** referee test only **) (max)	30

4.4.4 Determination of gel content is the referee Test Method in case of a dispute, and the test is conducted in accordance with Standard Test Methods D2765. Meet the percent extractable requirements specified in Table 1.

4.5 Test Applicable for Sunlight and Weather Resistant Materials:

4.5.1 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 (physical test procedures section). THE SPECIMENS SHALL MEET THE REQUIREMENTS FOR CLASS C OR CLASS D IN SPECIFICATION D1248.

## 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—Conduct the tests in accordance with Test Methods D470. 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.

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. 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—Test 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 °C ± 1 °C. The insulation shall meet the requirements of Table 2.

## 6. Sampling

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

## 7. Test Methods

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

## 8. Keywords

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

**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