Designation: D4565 – 15

Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable[1]

This standard is issued under the fixed designation D4565; 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 These test methods cover procedures for the physical testing of thermoplastic insulations and jackets used on telecommunications wire and cable and the testing of physical characteristics and environmental performance properties of completed products. To determine the procedure to be used on the particular insulation or jacket or on the completed wire or cable, make reference to the specification for that product.

1.2 The test methods appear in the following sections of this standard:

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard, except where only SI units are given.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific caution statement see 19.1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D471 Test Method for Rubber Property—Effect of Liquids

D638 Test Method for Tensile Properties of Plastics

D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics

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

D3032 Test Methods for Hookup Wire Insulation

D4731 Specification for Hot-Application Filling Compounds for Telecommunications Wire and Cable

D4732 Specification for Cool-Application Filling Compounds for Telecommunications Wire and Cable

E29 Practice for Using Significant Digits in Test Data to

[1] These test methods are under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and are 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 1, 2015. Published April 2015. Originally approved in 1986. Last previous edition approved in 2010 as D4565 – 10. DOI: 10.1520/D4565-15.

[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.

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

Determine Conformance with Specifications
E171 Practice for Conditioning and Testing Flexible Barrier Packaging

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *air core*—products in which the air spaces between cable core components (pairs, and so forth) remain in their unfilled or natural state.

3.1.2 *armored wire or cable*—a wire or cable in which the shielded or jacketed or shielded and jacketed wire or cable is completely enclosed by a metallic covering designed to protect the underlying telecommunications elements from mechanical damage.

3.1.2.1 *Discussion*—Select shielding or armoring, or both, from a variety of materials (for example: aluminum, copper, steel). The armoring is applied in a variety of ways (for example, helically wrapped, longitudinally applied, applied corrugated or smooth).

3.1.3 *cable, telecommunications*—products of six or more pair.

3.1.4 *DOD*—an abbreviation for "Diameter over Dielectric." This is a short term to refer to the overall diameter over an insulated conductor.

3.1.5 *filled core*—those products in which air spaces are filled with some materials intended to exclude air or moisture, or both.

3.1.6 *gopher-resistant*—a wire or cable that resists the attack of gophers when installed directly buried.

3.1.6.1 *Discussion*—Telecommunications wire and cable products intended for direct burial in the earth are normally rated as either "gopher-resistant" or "non-gopher-resistant." User selection of products for burial will depend upon the anticipated gopher protection needed for the planned installation site. The gopher-resistant rating is assigned based upon test evaluations (evaluations are commonly performed by the Fish and Wildlife Service, US Department of the Interior, Denver, CO).

3.1.7 *non-gopher-resistant*—a wire or cable that is not designed to resist gopher attack (see 3.1.6).

3.1.8 *pair*—two insulated conductors combined with a twist.

3.1.9 *sheath*—the jacket and any underlying layers of shield, armor, or other intermediate material down to but not including the core wrap.

3.1.10 *shielded wire or cable*—a wire or cable in which the core (or inner jacket) is completely enclosed by a metallic covering designed to shield the core from electrostatic or electromagnetic interference.

3.1.11 *wire, telecommunications*—products containing less than six pair.

DIMENSIONAL MEASUREMENTS OF INSULATIONS, JACKETS, MISCELLANEOUS CABLE COMPONENTS, AND COMPLETED CABLES

4. Scope

4.1 Dimensional measurements include, but are not limited to, measurements of insulation and jacket thicknesses, tape and armor thicknesses, conductor diameters, DODs, core diameters, overall diameters, and so forth.

5. Significance and Use

5.1 Dimensional measurements, properly interpreted, provide information with regard to the conductors, insulation, or jacket. The dimensional measurements provide data for research and development, engineering design, quality control, and acceptance or rejection under specifications.

6. Diameters

6.1 Measure diameters of essentially round items (such as insulated or uninsulated conductors) using any type of micrometer reading to at least 0.001 in. (0.025 mm) with each division of a width that facilitates estimation of each measurement to 0.0001 in. (0.0025 mm). Take a minimum of two readings, essentially at right angles to each other, and average the results.

6.2 In case of dispute, optical methods as described in Test Methods D3032 shall be used as the referee method.

NOTE 1—For insulated conductors with dual insulation (for example, foam-skin), the DOD of the inner layer must be measured using the optical methods of Test Methods D3032.

6.3 Measure the approximate or effective diameters of non-circular cross sections (such as irregular or oval cables or cable cores) by the use of strap gauges.

6.4 *Precision and Bias*—The precision and bias of this method for measuring diameters are in accordance with Test Methods D2633.

7. Thicknesses

7.1 Measure insulation thickness using appropriate methods specified in Test Methods D2633, except that the micrometer accuracy described in 6.1 is required. A pin gauge having the accuracy of the micrometers as specified in 6.1 is acceptable for thickness measurements made on tubular sections of insulation removed from conductors. Optical methods (as specified in 6.2) are also permitted.

7.2 Measure jacket thickness using appropriate methods specified in Test Methods D2633, except that the micrometer accuracy specified in 6.1 is required. In determining the thickness of jackets applied over corrugated shields or armors, measurements must be made in the corrugation impressions (thinnest jacket spots). Optical methods (as specified in 6.2) are also permitted.

7.3 *Precision and Bias*—The precision and bias of this method for measuring thickness are in accordance with Test Methods D2633.

NOTE 2—For designated purposes (such as process control, and so forth), continuous uniformity thickness gauges or measuring devices are employed during processing to provide running records of jacket thicknesses. Record charts are normally maintained for a minimum of six months.

8. Eccentricity

8.1 Calculate eccentricity using measured thickness values for insulation or jacket, or both.

8.2 Calculate absolute eccentricity, E_{ab}, of insulation or jacket, or both as follows:

$$E_{ab} = (\text{Maximum Thickness}) - (\text{Minimum Thickness}) \quad (1)$$

8.3 Calculate percent eccentricity, $E_{\%}$, of insulation or jacket, or both as follows:

$$E_{\%} = \frac{(\text{Max Thickness}) - (\text{Min Thickness})}{(\text{Average Thickness})} \times 100\,(\%) \quad (2)$$

8.4 *Precision and Bias*—The precision and bias of this method of measuring eccentricity are in accordance with Test Methods D2633.

9. Cross-Sectional Areas

9.1 When needed, determine cross-sectional areas (usually insulations or jackets only) using the methods outlined in Test Methods D2633, except that the dimensions used in the calculations must be maintained to the accuracy specified in 6.1.

9.2 *Precision and Bias*—The precision and bias of this method for measuring cross-section areas are as specified in Test Methods D2633.

PHYSICAL AND ENVIRONMENTAL TESTS OF INSULATIONS AND JACKETS

10. Scope

10.1 Physical and environmental tests for insulations and jackets include, but are not limited to, determination of some or all of the properties covered in Sections 12 – 25.

11. Significance and Use

11.1 Physical tests, properly interpreted, provide information with regard to the physical properties of the insulation or jacket. The physical test values give an approximation of how the insulation will physically perform in its service life. Physical tests provide data for research and development, engineering design, quality control, and acceptance or rejection under specifications.

12. Melt Flow Rate Change—Polyolefin Materials

12.1 *Raw Material Baseline*—Melt flow rate for insulation and jacket materials obtained from finished cable must be compared with the flow rates for corresponding raw materials. Determine the flow rates for the basic insulating and jacketing raw materials in accordance with the requirements of Test Method D1238. Standard conditions of test shall be as prescribed by the product specification. If possible, obtain samples of raw materials before or during the extrusion process (but *not* after heating). Since insulating and jacketing raw materials are normally obtained and used in bulk, it is usually difficult if not impossible to relate a particular lot of raw material with a particular reel of finished wire or cable; accordingly, average raw materials values shall be established as necessary for an appropriate manufacturing time frame, unless otherwise agreed upon between the producer and the purchaser.

12.2 *Insulation Material*—Perform tests on insulation removed from finished conductors. Note that thin wall and fine gauge insulations shall be handled carefully because of entrapped air. In the case of insulation in filled cable, the preferred method is to obtain insulating material from conductors before they are exposed to the filling operation. If necessary, conductors obtained from completed filled cable shall be wiped dry and free of grease or foreign material using a dry cloth (without solvent). Chop the insulation, stripped from a conductor, as necessary to obtain specimens suitable for testing (approximately 3 g of material is required for each test). Test the chopped material as required by Test Method D1238 to determine a melt flow rate. Run three tests and average the results. Standard conditions of test shall be as indicated in 12.1.

12.3 *Jacket Material*—Jacket material used for this test must be free of filling or flooding compound. Soft filling or flooding compounds shall be removed by thoroughly wiping the jacket specimen using a clean dry cloth (without solvent); harder filling or flooding compounds shall be removed by cutting. Buffing is permitted to be used as a finishing operation to ensure clean and dry specimens. Use jacketing material removed from completed cable for performing tests. Chop the jacket material removed from the cable as is necessary to obtain specimens suitable for testing (approximately 3 g of material is required for each test). Test the chopped material as required by Test Method D1238 to determine a melt flow rate. Run three tests and average the results. Standard conditions of test shall be as indicated in 12.1.

12.4 *Calculation*—Calculate the percent increase in flow rate as follows:

$$I = \frac{M_2 - M_1}{M_1} \times 100 \quad (3)$$

where:

I = increase, %,
M_1 = melt index of raw material, and
M_2 = melt index of material from the finished cable.

12.5 *Precision and Bias*—The precision and bias of this method for measuring melt-flow rate changes are basically in accordance with Test Method D1238.

13. Tensile and Elongation Tests

13.1 *Insulation Material*—Provide test specimens by removing insulation from finished conductors. (See Test Specimen section of Test Methods D2633 for methods of removing the conductor.) Perform tests in accordance with Test Method D638 to determine such properties as tensile strength