Designation: D8318 – 20

Standard Specification for Low-Density Poly (Vinylidene Fluoride) Based Material Intended for Use in Wire and Cable Jacketing[1]

This standard is issued under the fixed designation D8318; 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 low-density material based on poly (vinylidene fluoride) (PVDF), intended for use as jacketing material for wire and cable.

1.1.1 The material has a closed cell foam structure.

1.2 The jacketing material covered in this specification is intended for use in wires and cables in power-limited applications, such as optical fiber cables, communications cables, coaxial cables, or power limited fire alarm cables. The material is not intended for use in power cables.

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

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:*[2]

D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D638 Test Method for Tensile Properties of Plastics

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1711 Terminology Relating to Electrical Insulation

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

D3222 Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials

D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry

D3801 Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position

D5575 Classification System for Copolymers of Vinylidene Fluoride (VDF) with Other Fluorinated Monomers

E162 Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

E176 Terminology of Fire Standards

E662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials

2.2 *UL Standards:*[3]

UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 1581 Reference Standard for Electrical Wires, Cables and Flexible Cords

UL 1666 Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts

UL 1685 Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

2.3 *NFPA Standards:*[4]

NFPA 70 National Electrical Code

[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.

[3] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

TABLE 1 Material Property Requirements for Low-density PVDF Based Jacketing Material[A]

Unaged Requirements		Standard
Specific gravity, min, g/cm^3 (lb/in.^{3})	0.50 (0.018)	Test Methods D792
Specific gravity, max, g/cm^3 (lb/in.^{3})	1.60 (0.058)	Test Methods D792
Melting point, min, ºC (ºF)	95 (203)	Test Method D3418
Tensile strength, min, MPa (psi)	4.1 (600)	Test Methods D638
Elongation at rupture, min, %	50	Test Methods D638
Flexural modulus, min, MPa (psi)	30 (4350 psi)	Test Methods D790
Dielectric strength, kV/mm (V/mil)	>7.9 × 10 6 (>200)	Test Method D149
Dielectric constant at 100 Hz	<13.5	Test Methods D150
Dielectric constant at 1 MHz	<13.5	Test Methods D150
Dissipation factor at 100 Hz	<0.05	Test Methods D150
Dissipation factor at 1 MHz	<0.5	Test Methods D150
Aging		
Tensile strength retention	See 4.10	Test Methods D638
Elongation retention	See 4.10	Test Methods D638

[A] The numbers in parentheses are the values in inch-pound units, with the units shown in the first column.

NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

2.4 *Canadian Standards Association Standard:*[5]

CSA C22.2 No. 0.3 Test Methods for Electrical Wires and Cables – CSA FT4 test

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this specification associated with electrical and electronic insulating materials, refer to Terminology D1711. For definitions of terms used in this specification associated with fire issues, refer to Terminology E176.

3.2 *Acronyms:*

3.2.1 *HFP*—hexafluoropropylene.

3.2.2 *PVDF*—poly (vinylidene fluoride).

3.2.3 *VDF*—vinylidene fluoride.

4. Material Properties

4.1 The material shall either be poly (vinylidene fluoride) (PVDF) homopolymer or a copolymer of vinylidene fluoride (VDF) and hexafluoropropylene (HFP). In case the material is a copolymer, the fraction of VDF shall represent at least two thirds, by weight, of the total monomer content. See Classification D5575 for information on vinylidene fluoride copolymers.

4.2 The low-density PVDF based jacketing material shall comply with the material property (physical, mechanical, and electrical) requirements in Table 1.

4.3 Test for specific gravity in accordance with Test Methods D792.

4.4 Test for melting point in accordance with Test Method D3418.

4.5 Test for tensile properties in accordance with Test Methods D638, except as indicated in 4.5.1 and 4.5.2.

4.5.1 Test the specimens at a temperature of 20 to 28 ºC (68 to 82 °F).

4.5.2 Mark the specimens for all tests with gauge marks 25 mm (1 in.) apart. Place a specimen in the jaws of the testing machine. The maximum distance between the jaws shall be 50 mm (2 in.).

4.6 Test for flexural modulus in accordance with Test Methods D790.

4.7 Test for dielectric strength in accordance with Test Method D149.

4.8 Test for dielectric constant in accordance with Test Methods D150, at both 100 Hz and 1 MHz.

NOTE 1—Specification D3222, which deals with unmodified PVDF requires measurements at 100 Hz and 1 MHz, and the same is required in this document. While Specification D3222 includes both a minimum and a maximum, there is no need for a minimum in this document since the maximum is the limiting value in design of a cable.

4.9 Test for the dissipation factor in accordance with Test Methods D150, at both 100 Hz and 1 MHz.

NOTE 2—In the range of 100 Hz to 1 MHz, measurements with Test Methods D150, should yield values of between 0.01 and 0.30, regardless of specific gravity. Specification D3222 requires a maximum value for unmodified PVDF, indicating that at 100 Hz the dissipation factor should be below 0.05 and at 1 MHz the dissipation factor should be below 0.5 MHz.

4.10 The material shall retain most of the original tensile properties (tensile strength and elongation) after aging. Retention of tensile properties shall be assessed either after long-term aging (in accordance with 4.10.1) or short-term aging (in accordance with 4.10.2), but both shall not be required.

4.10.1 The material shall retain more than 50 % of the original tensile properties after aging. Aging shall be conducted for 60 days at a conditioning temperature (T_c), based on the rating temperature of the wire or cable (T_r), in accordance with Eq 1, rounded to the nearest degree centigrade.

$$T_c = 1.02(T_r + 273) - 273 \quad (1)$$

where:

T_c = the conditioning temperature, in °C, and
T_r = the rating temperature for the wire or cable, in °C.

4.10.2 The material shall retain more than 75 % of the original tensile properties after short-term aging. Aging shall

[5] Available from Canadian General Standards Board (CGSB), 11 Laurier St., Phase III, Place du Portage, Gatineau, Quebec K1A 0S5, Canada, http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb.