



Designation: D3150 – 11

Standard Specification for Crosslinked and Noncrosslinked Poly(Vinyl Chloride) Heat- Shrinkable Tubing for Electrical Insulation¹

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1. Scope*

1.1 This specification applies to flexible, crosslinked and noncrosslinked poly(vinyl chloride) heat-shrinkable tubing for electrical insulating purposes. It is supplied in an expanded form and will shrink to its extruded diameter when heated.

NOTE 1—This standard is similar but not identical to IEC 60684–3–201.

1.2 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.

1.2.1 In some cases (including the title), temperatures are described in degrees Celsius only.

2. Referenced Documents

2.1 *ASTM Standards:*²

D1711 Terminology Relating to Electrical Insulation

D2671 Test Methods for Heat-Shrinkable Tubing for Electrical Use

D3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials

E176 Terminology of Fire Standards

2.2 *Military Standards:*³

MIL-STD-104 Limits for Electrical Insulation Color

MIL-H-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance

MIL-T-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-L-7808 Lubricating Oil, Aircraft, Turbine Engine, Synthetic Base

MIL-L-23699 Lubricating Oil, Aircraft, Turbine Engines, Synthetic Base

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 Flexible and Rigid 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 Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

MIL-A-8243 Anti-Icing and De-Icing Defrosting Fluid

2.3 *Federal Standards:*

SS-S-550 Sodium Chloride, Technical, for Water-Softening Units⁴

2.4 *IEC Standards:*

60684–3–201 Flexible insulating sleeving, Part 3, Sheet 201: Heat shrinkable sleeving, general purpose, flexible, cross-linked PVC, shrink ratio 2:1⁵

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions pertaining to electrical insulation, refer to Terminology D1711.

3.1.2 For definitions pertaining to fire standards, refer to Terminology E176.

4. Classification

4.1 *Type I*—Flexible, noncrosslinked poly(vinyl chloride) tubing capable of being shrunk at 135°C (275°F) in 15 min.

4.2 *Type II*—Flexible, crosslinked poly(vinyl chloride) tubing capable of being shrunk at 175°C (347°F) in 15 min.

5. Ordering Information

5.1 When tubing is ordered to this specification, the purchaser shall define the size, color, and type of the required tubing.

6. Materials and Manufacture

6.1 The polymers used in the manufacture of heat-shrinkable tubing shall be modified poly(vinyl chloride) and the finished compound shall be free of all foreign matter other than intended formulation additives as appropriate.

6.2 The tubing shall be extruded, crosslinked (Type II only), and then expanded to the required dimensions.

7. Chemical and Physical Property Requirements

7.1 The material shall conform to the chemical and physical property requirements specified in Table 1.

⁴ Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

TABLE 1 Chemical and Physical Property Requirements

Property	Requirements	
	Type I	Type II
Restricted shrinkage, Procedure A:		
Type I—30 min, 135 ± 2°C (275 ± 4°F)	no cracks	no cracks
Type II—30 min, 175 ± 2°C (374 ± 4°F)		no cracks
2000-V proof voltage	no failures	no failures
Longitudinal change, max, %	0, – 25	+ 1, – 10
Dielectric strength, V/mil (kV/mm)	400 (15.75)	400 (15.75)
Color	MIL-STD-104	MIL-STD-104
Color stability, 24 h at 130 ± 2°C (266 ± 4°F)	MIL-STD-104	MIL-STD-104
Water absorption, 24 h at 25 ± 2°C (77 ± 4°F), max, %	1.0	1.0
Specific gravity, max	1.40	1.40
Volume resistivity, min, ohm-cm	10 ¹¹	10 ¹¹
Flammability, max, s, Procedure A	15	15
Heat shock:		
Type I—4 h at 180 ± 2°C (236 ± 4°F)	no dripping, flowing, or cracking	
Type II—4 h at 200 ± 2°C (392 ± 4°F)		no dripping, flowing, or cracking
Low-temperature flexibility, Procedure B, all sizes 1 h at – 10°C (14°F) on as-received specimens	no cracking	no cracking
Tensile strength, min, psi (MPa)	2000 (13.8)	2000 (13.8)
Elongation, min, %	200	200
Heat resistance, 168 h at 136 ± 2°C (277 ± 4°F), followed by tests for:		
Elongation, min, %	150	130
Elongation, % of original, min	65	65
Fluid resistance, 24 h at 25 ± 2°C (77 ± 4°F):		
Hydraulic Fluid, MIL-H-5606		
JP-4 Fuel, MIL-T-5624		
Lubricating Oil, MIL-L-7808		
Lubricating Oil, MIL-L-23699		
De-icing Fluid, MIL-A-8243		
5 % NaCl, SS-S-550		
Followed by tests for:		
Dielectric strength, V/mil (kV/mm)	280 (11.0)	280 (11.0)
Tensile strength, min, psi (MPa)	1800 (12.4)	2000 (13.8)
Copper corrosion, Procedure B:		
168 h at 136°C (277°F)	no blackening or pitting of copper	no blackening or pitting of copper
Copper dust humidity test, Procedure C	no corrosion or discoloration of copper dust	no corrosion or discoloration of copper dust
Shelf life		
The required shelf life is 2 weeks at 40 ± 2°C (104 ± 4°F). The supplier must advise and caution the customer if special storage and handling precautions must be observed to maintain required product dimensions and characteristics.		

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TABLE 2 Type I Dimensions

7.2 Every lot of material shall be tested for dimensional requirements, restricted shrinkage, tensile strength, elongation, longitudinal change, and dielectric breakdown. Other requirements shall be tested at a frequency agreed upon between the supplier and the purchaser.

8. Dimensional Requirements

8.1 Type I material shall conform to the applicable requirements listed in **Table 2** or **Table 3**.

8.2 Type II material shall conform to the requirements listed in **Table 3**.

8.3 Tubing with non-standard dimensions shall be supplied only when agreed upon between purchaser and seller. Tubing with non-standard dimensions shall be considered to comply with this specification if the requirements of **Table 1** and **Table 2** are satisfied and the minimum recovered wall thickness equals or exceeds that of the identical or next largest as supplied size. The wall for sizes greater than the largest specified size shall be at least as thick as that of the largest specified size.

Nominal Size, in.	As Supplied		After Unrestricted Shrinkage	
	Inside Diameter, min, in. (mm)	Inside Diameter, max, in. (mm)	Inside Diameter, max, in. (mm)	Wall Thickness, in. (mm)
1/16	0.063 (1.60)	0.037 (0.94)	0.014 ± 0.003 (0.35 ± 0.08)	0.014 ± 0.003 (0.35 ± 0.08)
3/32	0.093 (2.34)	0.055 (1.41)	0.014 ± 0.003 (0.35 ± 0.08)	0.014 ± 0.003 (0.35 ± 0.08)
1/8	0.125 (3.18)	0.075 (1.91)	0.014 ± 0.003 (0.35 ± 0.08)	0.014 ± 0.003 (0.35 ± 0.08)
3/16	0.187 (4.75)	0.110 (2.80)	0.018 ± 0.003 (0.45 ± 0.08)	0.018 ± 0.003 (0.45 ± 0.08)
1/4	0.250 (6.35)	0.150 (3.81)	0.022 ± 0.004 (0.56 ± 0.12)	0.022 ± 0.004 (0.56 ± 0.12)
3/8	0.375 (9.5)	0.225 (5.71)	0.022 ± 0.004 (0.56 ± 0.12)	0.022 ± 0.004 (0.56 ± 0.12)
1/2	0.500 (12.7)	0.300 (7.61)	0.022 ± 0.004 (0.56 ± 0.12)	0.022 ± 0.004 (0.56 ± 0.12)
3/4	0.750 (19.7)	0.450 (11.4)	0.022 ± 0.004 (0.56 ± 0.12)	0.022 ± 0.004 (0.56 ± 0.12)
1	1.000 (25.4)	0.600 (15.25)	0.022 ± 0.004 (0.56 ± 0.12)	0.022 ± 0.004 (0.56 ± 0.12)
1 1/2	1.500 (38.1)	0.900 (22.9)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)
2	2.000 (50.1)	1.200 (30.5)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)
3	3.000 (76.4)	1.800 (45.8)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)
4	4.000 (101.6)	2.400 (61.0)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)
5	5.000 (127.0)	3.000 (76.3)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)
6	6.000 (152.5)	3.600 (91.5)	0.034 ± 0.005 (0.86 ± 0.13)	0.034 ± 0.005 (0.86 ± 0.13)