Designation: D4388 – 13

Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes[1]

This standard is issued under the fixed designation D4388; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers nonmetallic semi-conducting and electrical insulating tapes designed for the splicing and repair of electrical wire and cables operating at voltages up to 325 kV, phase to phase.

1.2 The SI values are the standard. The values stated in inch-pound units given in parentheses are for information purposes only.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1711 Terminology Relating to Electrical Insulation

D4325 Test Methods for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

3. Terminology

3.1 *Definitions*—Use Terminology D1711 for definitions of terms used in these test methods and associated with electrical or electronic insulation materials.

4. Classification

4.1 *Types:*

4.1.1 *Type I*—A low voltage rubber insulating tape designed for use on wires and cables operating up to 2000 V phase to phase in dry locations with conductor temperatures up to 80 °C (176 °F) for continuous operation, up to 95 °C (203 °F) for emergency overload conditions, and up to 150 °C (302 °F) for short-circuit conditions. For outdoor use, protect the tape from ozone attack and ultraviolet radiation by the use of a suitable overwrap. Apply the tape to the wire or cable within an ambient temperature range of – 10 and 40 °C (14 and 104 °F).

4.1.2 *Type II*—A medium voltage, ozone-resistant, rubber insulating tape designed for use with wires and cables operating up to 35 000 V phase to phase in either wet or dry locations with conductor temperatures up to 90 °C (194 °F) for continuous operation, up to 130 °C (266 °F) for emergency overload conditions, and up to 250 °C (482 °F) for short-circuit conditions when installed in accordance with the manufacturer's instruction. For wet or dry outdoor use, protect the tape from ultraviolet radiation by the use of a suitable overwrap. Apply the tape to the wire or cable within an ambient temperature range of – 10 and 40 °C (14 and 104 °F).

4.1.3 *Type III*—A high voltage, ozone-resistant, rubber insulating tape designed for use with wires and cables operating up to 138 000 V phase to phase in either wet or dry locations with conductor temperatures up to 90 °C (194 °F) for continuous operation, up to 130 °C (266 °F) for emergency overload conditions, and up to 250 °C (482 °F) for short-circuit conditions when installed in accordance with the manufacturer's instructions. This tape is suitable for wet or dry outdoor use. Apply the tape to the wire or cable within an ambient temperature range of – 10 and 40 °C (14 and 104 °F).

4.1.4 *Type IV*—A nonmetallic semi-conducting tape designed for shielding various portions of joints and terminations in electrical wires and cables operating at any voltage under wet or dry conditions with conductor temperatures up to 90 °C (194 °F) for continuous operation, or up to 130 °C (266 °F) for emergency overload conditions. This tape is suitable for wet or dry outdoor use. Apply the tape to the wire or cable within an ambient temperature range of – 10 and 40 °C (14 and 104 °F).

4.1.5 *Type V*—A higher voltage, ozone-resistant, rubber insulating tape designed for use with wires and cables operating up to 325 000 V phase to phase in either wet or dry locations with conductor temperatures up to 90 °C (194 °F) for continuous operation, up to 130 °C (266 °F) for emergency overload, and up to 250 °C (482 °F) short-circuit conditions when installed in accordance with the manufacturer's instructions. This tape is suitable for wet or dry outdoor use. Apply the

[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.

Current edition approved Nov. 1, 2013. Published December 2013. Originally approved in 1984. Last previous edition approved in 2008 as D4388 – 08. DOI: 10.1520/D4388-13.

[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**

tape to the wire or cable within an ambient temperature of – 10 and 40 °C (14 and 104 °F).

7.2 Store the tape in the original boxes, preferably in a cool dark location. Do not keep tapes in close proximity to steam pipes, radiators, or other sources of heat.

TABLE 1 Physical Properties for Rubber Insulating Tape

Requirements	Type I	Type II	Type III	Type IV	Type V
Tensile strength, min, MPa (psi)	1.7 (250)	1.7 (250)	1.7 (250)	>0.69 (100)	2.4 (350)
Elongation at break, min, %	300	500	700	300	700
Dielectric strength, min, kV/mm (V/mil):					
0.51 mm (0.020 in.) thickness	...	...	28 (700)	...	32 (800)
0.76 mm (0.030 in.) thickness	14 (350)	20 (500)	24 (600)	...	28 (700)
1.016 mm (0.040 in.) thickness	...	16 (400)	...	...	
Dissipation factor, max:					
after water immersion	...	0.05	0.05	...	0.01
after hot water immersion	...	0.05	0.05	...	0.01
Permittivity, max:					
after water immersion	...	4.5	4.0	...	2.8
after hot water immersion	...	4.5	4.0	...	2.8
Volume resistivity, (ohm-cm):					
96 h at 23 °C and 50 % RH	...	10^{14} min	10^{14} min	10^{3} max	10^{16} min
96 h at 23 °C and 96 % RH	...	10^{13} min	10^{13} min	...	10^{15} min
168 h at 90 °C	...	...	...	5×10^{4} max	
Fusion—Flags 2 mm (5⁄64 in.) max	Pass at 200 % elongation	Pass at 300 % elongation	Pass at 300 % elongation	Pass at 300 % elongation	Pass at 300 % elongation
Ozone resistance	...	Pass if no visible signs of cracks	Pass if no visible signs of cracks	...	Pass if no visible signs of cracks
Heat exposure	Pass at 95 °C	Pass at 110 °C	Pass at 130 °C	...	Pass at 150 °C
UV resistance	...	...	Pass	Pass	Pass

5. Physical Properties

5.1 The tape shall consist of a non-crosslinked or partially crosslinked rubber nonmetallic semi-conducting or insulating compound. The compound shall be well, evenly, and smoothly processed, cut to the specified widths, and tightly wound in rolls with a separator between layers. Where a non-removable separator is used, the separator will be considered an integral part of the tape.

5.2 The separator shall be parchment paper, glazed or plastic sheeting, or any suitable material interposed between adjacent layers. The removable or non-removable separator shall not interfere with the use of the roll during application. Where a removable separator is used, the separator shall be readily removable from the rubber insulation without tearing or damaging the tape insulation. The outside end of the roll shall be securely fastened.

5.3 Rubber tapes shall conform to the requirements of Table 1.

6. Permissible Variations in Dimensions

6.1 The tape shall conform to the nominal dimensions found in Table 2 when tested in accordance with Test Methods D4325.

6.2 The average thickness shall not vary from the nominal thickness by more than ±0.076 mm (±0.003 in.) and the average width by more than ±0.76 mm (±0.03 in.).

6.3 The average length of the rolls in any sampling shall be no less than the nominal length.

7. Aging and Storage

7.1 Tapes shall not become unduly attached to the separators within the period of time specified in Table 3.

8. Test Methods

8.1 Select rolls, conditioning, and testing in accordance with Test Methods D4325.

8.2 Unless otherwise stated, measurements are made on tapes from which the removable separator has been removed.

9. Rejection and Retest

9.1 If only one sample roll fails to meet the specification, take a second set of samples in accordance with Test Methods D4325. Failure of two sample rolls constitutes grounds for rejection.

10. Inspection

10.1 Inspection of the material shall be made as agreed upon by the purchaser and seller as part of the purchase contract.

10.2 If inspection is required, the tape shall be tested and inspected either at the place of manufacture prior to shipment or at the place of delivery within four weeks from date of delivery.

11. Packaging and Package Marking

11.1 *Packaging*—Unless otherwise specified, the tape or carton shall be securely wrapped and sealed in a moisture-proof material to protect the contents.

11.2 *Package Marking*—Each box shall be marked with the name of the manufacturer or trademark, nominal width, thickness, and length of tape.

TABLE 2 Typical Nominal Dimensions

Type	Width, mm (in.)	Thickness, mm (in.)	Length, m (yd)
III, V	19 (0.75)	0.508 (0.020)	9.1 (10.0)
I, II, III, IV	19 (0.75)	0.762 (0.030)	9.1 (10.0)
IV	19 (0.75)	0.762 (0.030)	4.6 (5.0)
IV	19 (0.75)	0.762 (0.030)	2.7 (3.0)
II, V	19 (0.75)	1.016 (0.040)	3.4 (3.7)
III	25 (1.00)	0.508 (0.020)	9.1 (10.0)
I, II, III	25 (1.00)	0.762 (0.030)	9.1 (10.0)
II	25 (1.00)	1.016 (0.040)	3.4 (3.7)
III, V	38 (1.50)	0.508 (0.020)	9.1 (10.0)
I, II, III	38 (1.50)	0.762 (0.030)	9.1 (10.0)
II	38 (1.50)	1.016 (0.040)	3.4 (3.7)
III, V	51 (2.00)	0.508 (0.020)	9.1 (10.0)
I, II, III	51 (2.00)	0.762 (0.030)	9.1 (10.0)
II	51 (2.00)	1.016 (0.040)	3.4 (3.7)
V	38 (1.50)	0.508 (0.020)	50 (55.0)

TABLE 3 Aging and Storage

Product	Aging Time
Type I	8 months
Type II	8 months
Type III	2 years
Type IV	2 years
Type V	2 years

12. Keywords

12.1 dielectric strength; dissipation factor; elongation; fusion; heat exposure; high voltage; low voltage; medium voltage; ozone resistance; permittivity; rubber electrical insulating tape; rubber semi-conducting nonmetallic tape; sheath repair; splicing; tensile strength; ultraviolet and weather exposure; volume resistivity

SUMMARY OF CHANGES

Committee D09 has identified the location of selected changes to this specification since the last issue, D4388 – 08, that may impact the use of this specification. (Approved Nov. 1, 2013)

(*1*) Added Terminology D1711 to 2.1.

(*2*) Added section 3.