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Standard Specification for Rubber Insulating Sheeting¹

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1. Scope

1.1 This specification covers testing of rubber insulating sheeting for use as a covering for the protection of workers from accidental contact with live electrical conductors, apparatus, or circuits.

1.2 Two types of sheeting, differing in chemical and physical characteristics, are provided and are designated as Type I, non-resistant to ozone and Type II, resistant to ozone.

1.3 Six classes of sheeting, differing in electrical protection characteristics are provided and designated as Class 00, Class 0, Class 1, Class 2, Class 3, Class 4.

1.4 Two styles of sheeting, differing in construction characteristics, are provided and are designated as Style A and Style B.

1.5 The follow safety hazards caveat applies only to the test method portion, Sections 17-19, of this specification. *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 requirements prior to use.*

NOTE 1—Rubber Insulating Sheeting should remain flexible for use through normal temperature ranges.

NOTE 2—Rubber as used in this specification is a generic term that includes elastomers and elastomeric compounds, regardless of origin.

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

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D471 Test Method for Rubber Property—Effect of Liquids

D518 Test Method for Rubber Deterioration—Surface Cracking³

D570 Test Method for Water Absorption of Plastics

D751 Test Methods for Coated Fabrics

D1048 Specification for Rubber Insulating Blankets

D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment

D2136 Test Method for Coated Fabrics—Low-Temperature Bend Test

D2240 Test Method for Rubber Property—Durometer Hardness

2.2 Other Standards:

MVSS 302 Motor Vehicle Safety Standard 302 Flammability of Interior Materials⁴

UL 214 Standard for Tests for Flame-Propagation of Fabrics and Films⁵

ANSI C84.1 Voltage Ratings for Electric Power Systems and Equipment (60 Hz)⁶

3. Terminology

3.1 Definitions:

3.1.1 *user*—the entity employing the actual worker(s) utilizing the equipment; if no separate employer, then the individual.

3.1.2 *voltage, maximum use*—the ac voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to phase-to-phase voltage on multiphase circuits.

3.1.2.1 *Discussion*—If there is no multiphase exposure in a system area, and the voltage exposure is limited to phase (polarity on dc systems) to ground potential, the phase (polarity on dc systems) to ground potential shall be considered to be the nominal design voltage.

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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 Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from the U.S. Department of Transportation, 400 7th Street SW, Room 6111, Mail Code: NSA-30, Washington, DC 20590.

⁵ Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

3.1.2.2 *Discussion*—If the electrical equipment and devices are insulated or isolated or both, such that the multiphase exposure on a grounded wye circuit is removed, then the nominal design voltage may be considered as the phase-to-ground voltage on that circuit.

3.1.3 *voltage, nominal design*—a nominal value consistent with the latest revision of **ANSI C84.1**, assigned to the circuit or system for the purpose of conveniently designating its voltage class.

4. Significance and Use

4.1 This specification covers the minimum electrical, chemical and physical properties guaranteed by the manufacturer and the detailed procedures by which such properties are to be determined. The purchaser may as his/her option, perform or have performed any of these tests in order to verify the guarantee. Claims for failure to meet the specification are subject to verification by the manufacturer.

4.2 Rubber Insulating Sheeting is used for personal protection; therefore, when authorizing its use a margin of safety shall be allowed between the maximum voltage at which it is used and the proof-test voltage at which it is tested. The relationship between proof-test and the maximum voltage at which Sheeting shall be used is shown in **Table 1**.

4.3 Work practices vary from user to user, depending upon many factors. These factors may include, but are not limited to operating system voltages, design, work procedures and techniques, weather conditions, etc. Therefore, except for the restrictions set forth in this specification because of design limitations, the use and maintenance of the equipment is beyond the scope of this specification.

4.3.1 It is common practice and the responsibility of the user of this type of protective equipment to prepare complete instructions and regulations to govern the correct and safe use of such equipment.

5. Classification

5.1 Sheeting covered under this specification shall be designated as Type I or Type II: Class 00, Class 0, Class I, Class 2, Class 3, or Class 4; Style A or Style B.

TABLE 1 Proof Test/Use Relationship

NOTE—The ac voltage (rms) classification of the protective equipment designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to: (a) The phase to phase voltage on multiphase circuits, or (b) the phase to ground voltage on single phase grounded circuits.

Class of Insulating Sheeting	Maximum Use Voltage ^A Phase-Phase ac rms, max	AC Proof-Test Voltage, rms V	DC Proof-Test Voltage, avg V
00	500	2500	10 000
0	1000	5000	20 000
1	7500	10 000	40 000
2	17 000	20 000	50 000
3	26 500	30 000	60 000
4	36 000	40 000	70 000

^A Except for Class 00 and 0 equipment, the maximum use voltage is based on the following formula: maximum use voltage (maximum nominal design voltage) = 0.95 ac proof-test voltage–2000.

5.1.1 *Type I*, non-resistant to ozone, made from any elastomer or combination of elastomeric compounds of natural or synthetic origin.

5.1.2 *Type II*, ozone resistant, made from any elastomer or combination of elastomeric compounds of natural or synthetic origin, which may include one or more of the following special properties:

- A—Flame Resistance
- B—Oil Resistance

5.1.3 The class designation is based on the electrical properties as shown in **Tables 1-3**.

5.1.4 *Style A*, constructed of the elastomers indicated under Type I or Type II, shall be free of any reinforcements.

5.1.5 *Style B*, constructed of the elastomers indicated under Type I or Type II, shall incorporate a reinforcement or reinforcements; this shall not adversely affect the dielectric characteristics of the sheeting.

6. Ordering Information

6.1 Orders for Rubber Insulating Sheeting under this specification should include the following information:

- 6.1.1 Type,
- 6.1.2 Class,
- 6.1.3 Width,
- 6.1.4 Length, and
- 6.1.5 Style.

7. Manufacture and Marking

7.1 The sheeting shall consist of a rubber compound with a surface free of harmful physical irregularities, as defined in **11.1**, and may have one or more fabric inserts. Any such fabric insert shall not affect adversely the dielectric characteristics of the sheeting.

7.2 The sheeting shall be marked clearly and permanently at a maximum interval of 0.33 m (1ft) with the name of the manufacturer or supplier, ASTM (this specification#), Type, and Class.

8. Chemical and Physical Requirements

8.1 Insulating Sheeting shall conform to the applicable chemical and physical requirements in **Table 4**.

9. Electrical Requirements

9.1 The entire length when new (unused) shall withstand the 60-Hz ac proof-test voltage (rms value), **Table 2** or the dc

TABLE 2 AC Electrical Test Requirements

Class	AC Electrode mm	Clearances min ^A in.	Proof Test Voltage rms V	Dielectric Breakdown Test Voltage rms V
00	76	3	2500	4000
0	76	3	5000	6000
1	76	3	10 000	20 000
2	127	5	20 000	30 000
3	178	7	30 000	40 000
4	254	10	40 000	50 000

^A These nominal clearances are intended to avoid flashover and may be increased from the standard of 100 kPa (1 atm) barometric pressure and average humidity by no more than 51 m (2 in.) when required by change in atmospheric conditions. These clearances may be decreased if atmospheric conditions permit.

TABLE 3 DC Electrical Test Requirements

Class	DC Electrode mm	Clearances min ^A in.	Proof Test Voltage ^B rms V	Dielectric Breakdown Test Voltage rms V
00	76	3	10 000	13 000
0	76	3	20 000	35 000
1	76	3	40 000	60 000
2	152	6	50 000	70 000
3	203	8	60 000	80 000
4	305	12	70 000	90 000

^A These nominal clearances are intended to avoid flashover and may be increased from the standard of 100 kPa (1 atm) barometric pressure and average humidity by no more than 51 mm (2 in.) when required by change in atmospheric conditions. These clearances may be decreased if atmospheric conditions permit.

^B DC Proof Test voltages were determined using negative polarity.

TABLE 4 Physical Requirements for Sheeting

	Type I		Type II
	Style A	Style B	Style B
Tensile strength, min Mpa(psi)	4.83 (700)	4.83 (700)	4.83 (700)
Resistance to Accelerated heat-aging, max. loss warp and fill % ^A	20	20	20
Bursting Strength, min, Mpa (psi)	1.72 (250)	1.72 (250)	1.72 (250)
Tear Resistance, Min., N (lb)			
Warp	1.3 (6)	1.3 (6)	1.3 (6)
Fill	1.3 (6)	1.3 (6)	1.3 (6)
Low temperature Resistance ^B	No Cracking	No Cracking	No Cracking
Puncture resistance, min KN/m (lbf/in.)	18 (100)	29 (150)	18 (100)
Moisture absorption, max Increase ^C %	3	3	3
Flame resistance, Type II A			
Horizontal	N/A	N/A	Self-Extinguishing
Vertical	N/A	N/A	Pass
Ozone resistance, Type II ^D	N/A	N/A	No Cracking
Bent Loop			
Oil resistance, max, volume Increase, ^E % Type II B	N/A	N/A	4
Elongation, min %	500	500	500
Tension set, max, mm (in.)	6.4 (0.25)	6.4 (0.25)	6.4 (0.25)
Drape Stiffness, max at 25°C (77°F), min (in.)	89 (3.5)	89 (3.5)	89 (3.5)
Drape Stiffness, max at -10° (14°F), mm (in.)	110 (4.5)	110 (4.5)	110 (4.5)
Flex Stiffness, max at 25°C (77°F), N-m (in.·lbf)	0.028 (0.25)	0.028 (0.25)	0.028 (0.25)
Flex Stiffness, max at -10°C (14°F), N-m (in.·lbf)	0.034 (0.30)	0.034 (0.30)	0.034 (0.30)

^A 70°C (158°F) for 7 days.

^B -40°C (-40°F) for 4 h.

^C Distilled water 23°C (75°F).

^D 50 pph for 3 h 40°C.

^E ASTM Oil No. 2 room temperature for 24 h.

proof-test (average value) specified in **Table 3**. The test voltage shall be applied continuously for at least 3 min.

9.2 The sheeting material, when tested between 50-mm (2 in.) disk electrodes with edges rounded to a radius of 6 mm (0.25 in.), shall show a 60-Hz dielectric strength of not less than the value shown in **Table 2**, when tested in accordance with **18.4**.

10. Dimensions and Permissible Variations

10.1 *Width*—Standard width shall be 914 ± 25 mm (36 ± 1 in.)

10.2 *Thickness*—The thickness of the sheeting shall be as specified in **Table 5**.

11. Workmanship and Finish

11.1 The sheeting shall be free of harmful physical irregularities, which can be detected by a thorough test or inspection.

11.1.1 Harmful physical irregularities may be defined as any feature that disrupts the uniform surface and represents a potential hazard to the user, such as pinholes, cracks, blisters, cuts, conductive imbedded foreign matter creases, pinch marks, voids (entrapped air), and prominent ripples.

11.2 *Nonharmful Irregularities*—Surface irregularities or imperfections may be present on all rubber sheeting due to inherent difficulties in the manufacturing process. These irregularities or imperfections may appear as indentations, protuberances, or imbedded foreign material that are acceptable provided that:

11.2.1 The indentation or protuberance tends to blend into a smooth slope upon stretching of the material. The rubber thickness at any irregularity conforms to the thickness requirements.

11.2.2 The rubber thickness at any irregularity conforms to the thickness requirements.

11.2.3 Foreign material remains in place when the sheeting is bent and stretches equally with the material surrounding it.

12. Guarantee

12.1 The manufacturer or supplier shall replace without charge to the purchaser, unused sheeting which, at any time within a period of (12) months from date of initial delivery of shipment to the purchaser or his/her designee, fails to pass the tests in this specification. The guarantee will be binding on the manufacturer or supplier only if the sheeting has been properly stored and has not been subjected to more than an original acceptance test and one retest.

12.2 Any acceptance test made by the purchaser, or the purchaser's designee, shall be performed within the first two (2) months of the guarantee period unless otherwise specified.

NOTE 3—Proper storage means that the sheeting is stored without distortion, and not stored directly above or in proximity to steam pipes, radiators, or other sources of artificial heat, or exposed to direct sunlight or sources of ozone. It is desirable that the ambient storage temperature not exceed 36°C (95°F).

13. Sampling

13.1 Each roll of sheeting in a lot or shipment shall be subject to inspection and test by the manufacturer including electrical proof test to levels required in **Table 2** or **Table 3** and Sections **7**, **9.1**, **10**, **11**, and **15**.

TABLE 5 Thickness Measurement

Class	Thickness	
	mm	in.
00	0.45 to 0.56	0.018 to 0.022
0	0.75 to 1.02	0.030 to 0.040
1	0.90 to 1.50	0.035 to 0.059
2	2.40 to 3.20	0.094 to 0.126
3	2.80 to 3.60	0.100 to 0.142
4	3.05 to 4.05	0.100 to 0.159