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Standard Specification for Rubber Insulating Sheeting[1]

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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 ElastomersTension

D471 Test Method for Rubber PropertyEffect of Liquids

D518 Test Method for Rubber DeteriorationSurface Cracking

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 DeteriorationCracking in an Ozone Controlled Environment

D1388 Test Method for Stiffness of Fabrics

D2136 Test Method for Coated FabricsLow-Temperature Bend Test

D2240 Test Method for Rubber PropertyDurometer Hardness

2.2 *Other Standards:*

MVSS 302 Motor Vehicle Safety Standard 302 Flammability of Interior Materials[3]

UL 214 Standard for Tests for Flame-Propagation of Fabrics and Films[4]

ANSI C84.1 Voltage Ratings for Electric Power Systems and Equipment (60 Hz)[5]

3. Terminology

3.1 *Definitions:*

[1] This specification is under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.25 ~~on Insulating Cover-up Equipment.~~

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

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

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

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.

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.

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

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 AC Use Voltage ms,V[A] Phase-Phase ac rms, max	AC Proof-Test Voltage, rms V	Maximum DC Use Voltage, avg, V	DC Proof-Test Voltage, avg V
~~00~~	~~500~~	~~2500~~		~~10 000~~
00	500	2500	750	10 000
~~0~~	~~1000~~	~~5000~~		~~20 000~~
0	1000	5000	1500	20 000
~~1~~	~~7500~~	~~10 000~~		~~40 000~~
1	7500	10 000	11 250	40 000
~~2~~	~~17 000~~	~~20 000~~		~~50 000~~
2	17 000	20 000	25 500	50 000
~~3~~	~~26 500~~	~~30 000~~		~~60 000~~
3	26 500	30 000	39 750	60 000
4	36 000	40 000	54 000	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.

5.1.3 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.

6.2 The listing of types, classes, widths, length and styles is not intended to mean that all shall necessarily be available from manufacturer; it signifies only that, if made, they shall conform to the detail of this specification.

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 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.

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.

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 purchasers 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

~~13.1Each 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~~

13.1 Each roll of sheeting in a lot or shipment shall be subject to inspection and test to meet the requirement of Sections 7, 9.1~~,~~ ~~10~~, 11 ~~, and~~ and 15.

~~13.2An original sample of sufficient material shall be cut from the end of a roll or rolls selected from the lot for the test requirements of Sections 8 and 9. A lot is defined as that quantity of material produced by a common manufacturing process during a consecutive time period. If failure occurs in the first sample, a second sample of the same quantity shall be selected and tested.~~

13.2 An original sample of one roll or 1 % of the lot or shipment, whichever is greater, shall be selected at random from the lot or shipment for the test requirements of 9.2 and Sections 8 and 15. If a failure occurs in the first sample, a second sample of the same quantity shall be selected and tested. A sufficient amount of material shall be cut from the end of a roll or rolls selected from the lot for the test.

14. Rejection

14.1 Individual rolls shall be rejected if they fail to meet the manufacturing and marking requirements of Section 7, the electrical requirements of Section 9, the width requirements of 10.1, the thickness requirements of 10.2, or the workmanship requirements of Section 11.

14.2 The entire lot or shipment of sheeting shall be rejected under any of the following conditions:

14.2.1 If 5 % or more of the sheeting in a shipment fails to meet the requirements of 9.1.

14.2.2 If two dielectric breakdowns that do not meet the dielectric strength value specified in 9.2 occur in five tests on the specimen.

14.2.3 If one dielectric breakdown of five tests on the original and one or more dielectric breakdowns of five tests on an additional specimen fail to meet the dielectric strength value specified in 9.2.

14.2.4 If the coating sample specimens of Type II sheeting, using the sampling methods and criteria specified in 19.1.1.1-19.1.1.3 fail to meet the ozone resistance requirements of 9.2.

14.2.5 *(If Applicable)*—If the coating sample specimens of Type II sheeting using the sampling methods and criteria specified in 19.1.3 fail to meet the oil resistance requirements of Table 4.

14.2.6 *(If Applicable)*—If the Sheeting sample specimens of Type II sheeting using the sampling methods and criteria specified in 19.2.8 fail to meet the flame-resistant requirements of Table 4.

14.3 The testing shall be terminated and the manufacturer or supplier notified if, during the course of testing, 5 % or more, of the sheeting in a lot or shipment fail to meet the requirements of 9.1, 9.2 or as determined by the rejection criteria of 14.1 and 14.2.