Designation: D1048 – 14

Standard Specification for Rubber Insulating Blankets[1]

This standard is issued under the fixed designation D1048; 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 acceptance testing of rubber insulating blankets for protection of workers from accidental contact with live electrical conductors, apparatus, or circuits.

1.2 Two types of blankets are provided and are designated as Type I, not resistant to ozone, and Type II, resistant to ozone.

1.3 Five classes of blankets, differing in electrical characteristics, are provided and are designated as Class 0, Class 1, Class 2, Class 3, and Class 4.

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

1.5 The following safety hazards caveat pertains only to the test method portion, Sections 16 – 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 limitations prior to use.*

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

D297 Test Methods for Rubber Products—Chemical Analysis

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D518 Test Method for Rubber Deterioration—Surface Cracking (Withdrawn 2007)[3]

D570 Test Method for Water Absorption of Plastics

D573 Test Method for Rubber—Deterioration in an Air Oven

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D1388 Test Method for Stiffness of Fabrics

D2865 Practice for Calibration of Standards and Equipment for Electrical Insulating Materials Testing

F819 Terminology Relating to Electrical Protective Equipment for Workers

2.2 *American National Standards:*

ANSI/IEEE C 2 National Electrical Safety Code[4]

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

3. Terminology

3.1 *beaded edge*— a narrow border of thicker rubber which extends completely around the outer edges of the blanket.

3.2 *breakdown*—the electrical discharge or arc occurring between the electrodes and through the equipment being tested.

3.3 *designated person*—an individual who is qualified by experience or training to perform an assigned task.

3.4 *electrical testing facility*—a location with qualified personnel, testing equipment, and procedures for the inspection and electrical testing of electrical insulating protective equipment.

3.5 *electrode clearance*—the shortest path from the energized electrode to the ground electrode.

3.6 *flashover*—the electrical discharge or arc occurring between electrodes and over or around, but not through, the equipment being tested.

3.7 *insulated*—separated from other conducting surfaces by a dielectric substance (including air space) offering a high resistance to the passage of current.

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[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. This standard replaces ANSI Standard J 6.4, which is no longer available.

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

[4] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331, http://www.ieee.org.

[5] Available from National Electrical Manufacturers Association, 1300 North 17th Street, Rosslyn, VA 22209.

3.7.1 *Discussion*—When any object is said to be insulated, it is understood to be insulated in a suitable manner for the conditions to which it is subjected. Otherwise, it is, within the purpose of this definition, uninsulated. Insulating covering of conductors is one means of making this conductor insulated.

3.8 *ozone*—a very active form of oxygen that may be produced by corona, arcing, or ultra-violet rays.

3.9 *ozone cutting and checking* —cracks produced by ozone in a material under mechanical stress.

3.10 *rubber*—a generic term that includes elastomers and elastomer compounds regardless of origin.

3.11 *user*—the employer or entity purchasing the equipment to be utilized by workers for their protection; in the absence of such an employer or entity, the individual purchasing or utilizing the protective equipment.

3.12 *voltage, maximum retest*—voltage, either ac rms or dc avg, that is equal to the proof-test voltage for new protective equipment.

3.13 *voltage, retest*—voltage, either ac rms or dc avg, that used protective equipment must be capable of withstanding for a specified test period without breakdown.

3.14 *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.

3.15 *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.

3.15.1 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.

3.15.2 If 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.

NOTE 1—The work practices and methods associated with removing multiphase exposures at any given work site are not addressed in this specification. Users should refer to ANSI C2, National Electrical Safety Code, Section 44, for proper work practices.

3.16 For definitions of other terms, refer to Terminology F819.

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, at his 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 Blankets are used for personal protection; therefore, when authorizing their use, a margin of safety shall be provided between the maximum voltage at which they are used and the proof-test voltage at which they are tested. The relationship between proof-test voltage and the nominal maximum voltage at which blankets 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, construction 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 this 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 Blankets covered under this specification shall be designated as Type I or Type II; Class 0, Class 1, Class 2, Class 3, or Class 4; Style A or Style B.

5.1.1 *Type I,* non-resistant to ozone, made from a high-grade *cis*-1,4-polyisoprene rubber compound of natural or synthetic origin, properly vulcanized.

5.1.2 *Type II,* ozone resistant, made of any elastomer or combination of elastomeric compounds.

5.1.3 The class designation shall be based on the electrical properties as shown in Table 1 and Table 2.

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

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

6. Ordering Information

6.1 Orders for blankets under this specification should include the following information:

6.1.1 Type,

6.1.2 Class,

6.1.3 Style,

6.1.4 Size,

6.1.5 Eyelets, and

6.1.6 Color.

TABLE 1 Proof-Test/Use Voltage Relationship

Class of Insulating Blankets	Nominal Maximum Use Voltage [A] Phase-Phase, ac, rms, max	AC Proof-Test Voltage, rms V	DC Proof-Test Voltage, avg, V
0	1 000	5 000	20 000
1	7 500	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 O 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

TABLE 2 Electrical Proof-Tests

Class	AC			DC		
	Proof-Test Voltage, rms, V	Nominal Electrode Clearances [A]		Proof-Test Voltages, [B] avg, V	Nominal Electrode Clearances [A]	
		mm	in.		mm	in.
0	5 000	76	3	20 000	76	3
1	10 000	76	3	40 000	76	3
2	20 000	127	5	50 000	152	6
3	30 000	178	7	60 000	203	8
4	40 000	254	10	70 000	305	12

[A] These nominal clearances are intended to avoid flashover and may be increased by no more than 51 mm (2 in.) when required by a change in atmospheric conditions from the standard of 100 kPa (1 atm) barometric pressure and average humidity conditions. These clearances may be decreased if atmospheric conditions permit.
[B] DC proof-test voltages were determined using negative polarity.

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

7. Manufacture and Marking

7.1 The blankets shall be produced by a seamless vulcanizing process.

7.2 Where eyelets are specified, each blanket shall be equipped with nonmetallic eyelets.

7.3 Each blanket shall be marked clearly and permanently with the name of the manufacturer or supplier, ASTM D1048, type, class, and style.

7.3.1 Blankets may be marked by either molding the information directly into the blanket or by use of a label; either method is equally acceptable. The method shall be at the discretion of the manufacturer. If a label is used the color shall be that specified for each voltage class; Class 0—red, Class 1—white, Class 2—yellow, Class 3—green, and Class 4—orange.

7.4 Blankets shall have a smooth, flat finish and beaded edges.

8. Chemical and Physical Requirements

8.1 The blanket material shall conform to the physical requirements in Table 3 and the accelerated aging in 19.2.7.

8.2 For Type I blankets, the rubber polymer may be determined in accordance with 19.1.1. This shall be the referee test if a dispute exists between the manufacturer and purchaser regarding the elastomer content of Type I blankets.

8.3 The Type II blanket material shall show no visible effects from ozone when tested in accordance with 18.6. Any visible signs of ozone deterioration, such as checking, cracking, breaks, pitting, etc., shall be considered as evidence of failure to meet the requirements of Type II blankets. In case of dispute, Method A of the ozone resistance test shall be the referee test.

9. Electrical Requirements

9.1 Each blanket shall be given a proof test and shall withstand the 60-Hz ac proof-test voltage (rms value) or the dc proof-test voltage (average value) specified in Table 2. The proof test shall be performed in accordance with Section 18 and shall be conducted continuously for at least 3 min.

TABLE 3 Physical Requirements

	Type I		Type II
	Style A Blanket	Style B Blanket	Style A Blanket
Tensile strength, min, Die C, MPa (psi)	17.2 (2500)	17.2 (2500)	10.3 (1500)
Elongation, min, %	500	500	500
Tension set, max, mm (in.)	6.4 (0.25)	6.4 (0.25)	6.4 (0.25)
Tear resistance, min, kN/m (lbf/in.)	21 (120)	26 (150)	16 (90)
Puncture resistance, min, kN/m (lbf/in.)	18 (100)	26 (150)	18 (100)
Drape stiffness, max at 25°C (77°F), mm (in.)	89 (3.5)	89 (3.5)	89 (3.5)
Drape stiffness, max at −10°C (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)
Moisture absorption, max, %	1.5	3.0	2.0

9.2 The blanket material shall show a 60-Hz dielectric strength of not less than 14.8 MV/m (375 V-rms/mil) of specimen thickness for each individual test, when tested in accordance with 18.5.

10. Dimensions and Permissible Variations

10.1 *Length and Width*— The length and width of the blankets shall be specified on the purchase order. Some standard sizes are as shown in Table 4. Permissible variations from the specified length and width shall be ±13 mm (±0.5 in.) except for the 1160 by 1160-mm (45.5 by 45.5-in.) slotted size for which the permissible variation shall be ±25 mm (±1.0 in.).

TABLE 4 Standard Blanket Sizes—Length and Width

Without Slot mm (in.)	
457 by 910	(18 by 36)
560 by 560	(22 by 22)
690 by 910	(27 by 36)
910 by 910	(36 by 36)
910 by 2128	(36 by 84)
1160 by 1160	(45.5 by 45.5)
With Slot mm (in.)	
560 by 560	(22 by 22)
910 by 910	(36 by 36)
1160 by 1160	(45.5 by 45.5)

10.2 *Thickness*—See Table 5.

10.2.1 Manufacturers must meet the minimum thickness requirements for each Class of blanket as specified in Table 5. The manufacturer may label a blanket lower than actual Class value if so specified by the purchaser.

10.3 *Bead on Edge*— The bead shall be not less than 8 mm (0.31 in.) wide nor less than 1.5 mm (0.06 in.) high.

10.4 *Eyelets*—If other than manufacturer's standard is desired; the number, size, and type of eyelet shall be given on the purchase order. The eyelets shall not be less than 8 mm (0.31 in.) in diameter.

10.5 No eyelets, holes, or slots are permitted in a blanket which will reduce the test electrode clearance to less than the values listed in Table 2.

11. Workmanship and Finish

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

11.1.1 Harmful physical irregularities may be defined as any feature that disrupts the uniform, smooth 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), prominent ripples, and prominent mold marks.

11.2 *Non-harmful Irregularities* —Surface irregularities may be present on all rubber goods due to imperfections on forms or molds and inherent difficulties in the manufacturing process. These irregularities 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.

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

11.2.3 Foreign material remains in place when the blanket is rolled and stretches with the material surrounding it.

12. Guarantee

12.1 The manufacturer or supplier shall replace, without charge to the purchaser, unused blankets which, at any time within a period of nine (9) months from the date of initial delivery of shipment to the purchaser or his designee, fail to pass the tests in this specification. This guarantee will be binding on the manufacturer or supplier only if the blankets have been properly stored and have not been subjected to more than an original acceptance test and one retest.

TABLE 5 Thickness Measurements

Class	Thickness	
	mm	in.
0	1.6 to 2.2	0.06 to 0.09
1	2.6 to 3.6	0.10 to 0.14
2	2.8 to 3.8	0.11 to 0.15
3	3.0 to 4.0	0.12 to 0.16
4	3.2 to 4.3	0.13 to 0.17

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 2—Proper storage means that the blankets are stored flat, not folded nor stored directly above or in proximity to steam pipes, radiators, or other sources of artificial heat, or exposed to direct sunlight or other sources of ozone. It is desirable that the ambient storage temperature shall not exceed 35°C (95°F).

13. Sampling

13.1 Each blanket in a lot or shipment shall be subject to inspection and test to meet the requirements of Sections 7, 11, 15, and 9.1.

13.2 An original sample of 1 % of the lot or shipment or not less than one blanket, whichever is greater, shall be selected at random from the lot or shipment for the test requirements of 9.2 and Section 10. If a failure occurs in the first sample, a second sample of the same quantity shall be selected and tested.

13.3 An original sample of 0.1 % of the lot or shipment or not less than one blanket, whichever is greater, shall be selected at random from the lot or shipment for the test requirements of 8.1 and 8.3.

14. Rejection

14.1 Individual blankets shall be rejected if they fail to meet manufacturing and marking requirements of Section 7, the electrical requirements of 9.1, the minimum thickness requirements of 10.2, or the workmanship requirements of Section 11.

14.2 Individual blankets may be rejected at the option of the purchaser if they fail to meet the requirements stipulated in 10.1, 10.2, 10.3, 10.4, and Section 15.

14.3 The entire lot or shipment of blankets shall be rejected under any of the following conditions:

14.3.1 If 5 % or more, but not less than two blankets, in a lot or shipment fail to meet the requirements of 9.1.

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

14.3.3 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 in 9.2.

14.3.4 If the sample specimens of Type II blankets, using the sampling methods and criteria specified in 14.3.2 and 14.3.3, fail to meet the corona or ozone resistance requirements of 8.3.

14.4 The testing shall be terminated and the manufacturer or supplier notified if, during the course of testing, the blankets in a lot or shipment fail to meet the requirements of 8.3, 9.1, or 9.2, as determined by the rejection criteria of 14.3.1, 14.3.2, 14.3.3, or 14.3.4. The manufacturer or supplier may in such a case require the purchaser to submit proof that the test procedure and equipment conform to the appropriate paragraphs of Section 18. When such proof has been furnished, the manufacturer or supplier may request that his representative witness the testing of additional blankets from the shipment.

14.5 If two of the five specimens tested fail any of the separate requirements outlined in Section 8, a second blanket shall be selected and, if one specimen from this blanket fails, the entire lot or shipment of blankets may be rejected at the option of the purchaser.

14.6 The entire lot or shipment of blankets may be rejected at the option of the purchaser if 25 % of the blankets in the lot or shipment fail to meet the requirements of Section 10 or 11.

14.7 All rejected material shall be returned as directed by the manufacturer, at his or the suppliers request, without being defaced by rubber stamp or other permanent marking. However, those blankets punctured when tested in accordance with the requirements of 9.1 and 9.2 shall be stamped, punched, or cut prior to being returned to the supplier to indicate that they are unfit for electrical use.

15. Packaging

15.1 Blankets shall be packaged for shipment in an extended, flat position or in rolls having an inner diameter of not less than 50 mm (2 in.), and shall not be otherwise distorted mechanically while in transit.

TEST METHODS

16. Sequence of Testing

16.1 The following order of procedure is suggested for testing rubber insulating blankets:

16.1.1 Inspection of the surfaces in accordance with Section 11.

16.1.2 The thickness in accordance with Section 17.

16.1.3 Electrical proof test in accordance with the appropriate paragraph of Section 18.

16.1.4 Breakdown voltage test in accordance with the appropriate paragraphs of Section 18.

16.1.5 Ozone resistance tests in accordance with the appropriate paragraphs of Section 18.

16.1.6 Chemical and physical property tests in accordance with Section 19.

17. Thickness Measurements

17.1 Thickness measurements should be made on complete blankets with a micrometer graduated to within 0.025 mm (0.001 in.), having an anvil approximately 6 mm (0.25 in.) in diameter and a presser foot 3.17± 0.25 mm (0.125 ± 0.01 in.) in diameter. The presser foot shall exert a total force of 0.83 ± 0.03 N (3.0 ± 0.1 ozf) on the specimen during this test. Sufficient support should be given the blanket sample so that it will present an unstressed, flat surface between the anvil faces of the micrometer. The presser foot applied force will ensure uniform loading of the blanket material. Make not less than five thickness measurements at selected points uniformly distributed over the test area of the blanket.

18. Electrical Tests

18.1 *Conditioning*— Prior to testing, leave all blankets in a flat position for at least 24 h.

NOTE 3—All blankets should be in an unstressed physical condition prior to testing. Failure to achieve this may result in excessive breakdown or damage.

NOTE 4—Both ac and dc proof-test methods are included in this section. It is intended that one test method be selected for the electrical acceptance tests. The test method selected shall be at the option of the purchaser, and the supplier should be so notified of the selection.

18.2 **Warning**—It is recommended that the test apparatus be designed to afford the operator full protection in performance of his duties. Reliable means of de-energizing and grounding the high-voltage circuit should be provided. It is particularly important to incorporate positive means of grounding the high-voltage section of dc test apparatus due to the likely presence of high-voltage capacitance charges at the conclusion of the test.

18.2.1 To eliminate damaging ozone and possible flashover along the blanket, there should be a sufficient flow of air into and around the blanket and an exhaust system to adequately remove ozone from the test machine. Consistent ozone cutting and checking during the test procedure should be cause to ascertain the adequacy of the exhaust system.

18.2.2 The equipment shall be inspected at least annually to ensure that the general condition of the equipment is acceptable and to verify the characteristics and accuracy of the test voltages. To ensure the continued accuracy of the test voltage, as indicated by the test equipment voltmeter, the test equipment shall be calibrated at least annually in accordance with the latest revision of Practice D2865.

18.3 *AC Proof Test:*

18.3.1 *Electrodes*—Where electrodes are to be employed as part of the test apparatus, they shall be of such design so as to apply the electrical stress uniformly over the test area to minimize corona and mechanical strain in the material. The electrodes used in the proof test shall be designed to comply with the flashover clearances specified in Table 2. A satisfactory procedure for ac proof test utilizes water electrodes or electrodes that will provide intimate contact without undue pressure.

NOTE 5—*For Classes 0, 1, and 2:* rectangular metal sheets approximately 5 mm (3/16 in.) thick, having smoothly rounded edges and corners, and wet pads, approximately 6 mm (1/4 in.) thick, placed between the metal sheets and the blanket have been found satisfactory.

For Classes 3 and 4: Maximum area can be tested when both electrodes are the same size. When an insulated table is not convenient the following mask method may be used. A 3 to 5-mm (0.12 to .018-in. thick sheet of insulating material which is a minimum of 1270 mm square (50 in. square) and has a 762 by 762-mm (30 by 30-in.) opening in the center, is placed on a grounded metal plate. This mask which has a "picture frame" appearance shall have the opening filled with a conductive material of such thickness as to bring the ground electrode to approximately the same level as the mask in order to maintain direct contact with the blanket to be tested. The blanket is placed over the ground electrode and a wet pad approximately the same size as the ground electrode is placed on top of the blanket. The wet pad is energized with the test voltage. This method will test a 762 by 762-mm (30 by 30-in.) area of a 914 by 914-mm (36 by 36-in.) blanket at 40 kV ac as the mask prevents flashover.

Other electrode design may be used to achieve the same results.

NOTE 6—The clearances in footnote *A* of Table 2 are intended to avoid flashover and may be increased by no more than 51 mm (2 in.) when required by a change in atmospheric conditions from the standard of 100 kPa (1 atm) barometric pressure and average humidity conditions. These clearances may be decreased if atmospheric conditions permit.

18.3.2 *Voltage Supply and Regulation:*

18.3.2.1 The test equipment used in both the proof test and dielectric breakdown tests shall be capable of supplying an essentially stepless and continuously variable voltage to the test specimen. Motor-driven regulating equipment is convenient and tends to provide uniform rate-of-rise to the test voltage. Protect the test apparatus by an automatic circuit-breaking device designed to open promptly on the current produced by breakdown of a specimen under test. This circuit-breaking device should be designed to protect the test equipment under any conditions of short circuit.

18.3.2.2 The desired voltage may be obtained most readily from a step-up transformer energized from a variable low-voltage source. The transformer and its control equipment shall be of such size and design that, with the test specimen in the circuit, the crest factor (ratio of maximum to mean effective) of the test voltage shall differ by not more than 5 % from that of a sinusoidal wave over the upper half of the range of test voltage.

18.3.2.3 The accuracy of the voltage measuring circuit shall be within ±1 kV of the test voltage. The ac voltage applied to the test specimen shall be measured with either an ac voltmeter (RMS or average responding) or a peak responding voltmeter calibrated to pk/SQRT2 using one of the following methods: (*1*) a voltmeter used in conjunction with a calibrated instrument transformer connected directly across the high-voltage circuit, (*2*) a calibrated electrostatic voltmeter connected directly across the high-voltage circuit, or (*3*) a meter connected in series with appropriate high-voltage type resistors directly across the high-voltage circuit.

18.3.2.4 The crest factor may be checked by the reading of a peak-reading voltmeter connected directly across the high-voltage circuit; or, if an electrostatic voltmeter or a voltmeter in conjunction with an instrument potential transformer is connected across the high-voltage circuit, a standard sphere gap may be sparked over and the corresponding voltage compared with the reading of the rms voltmeter.

18.3.3 *Procedure*—Initially apply the proof-test voltage at a low value and then gradually increase it at a constant rate-of-rise of approximately 1000 V/s ac until the prescribed test voltage level is reached, or failure occurs. The test period starts at the instant that the prescribed testing voltage is reached. The applied voltage should be reduced to at least half value, unless an electrical puncture has already occurred, at the end of the test period before opening the test circuit.

18.4 *DC Proof Test:*

18.4.1 *Electrodes*—The dc proof test may be made with dry electrodes that consist of two flat metallic plates, at least one of which is sized so that the electrode clearances recommended in Table 2 are not exceeded, or with the wet electrode described in Section 18.2.1. The edges of these plates should be rounded so as to eliminate sharp nicks and protuberances.

NOTE 7—The clearances in footnote *A* of Table 2 are intended to avoid flashover and may be increased by no more than 51 mm (2 in.) when required by a change in atmospheric conditions from the standard of 100 kPa (1 atm) barometric pressure and average humidity conditions. These clearances may be decreased if atmospheric conditions permit.

18.4.2 *Voltage Supply and Regulation:*

18.4.2.1 Obtain the dc proof-test voltage from a dc source capable of supplying the required voltage. The peak-to-peak ac ripple component of the dc proof-test voltage shall not exceed 2 % of the average voltage value under no-load conditions.

18.4.2.2 Measure the dc proof-test voltage by a method that provides the average value of the voltage applied to the blanket. It is recommended that this voltage be measured by the use of a dc meter connected in series with appropriate high-voltage type resistors across the high-voltage circuit. An electrostatic voltmeter of proper range may be used in place of the dc meter-resistor combination. The accuracy of the voltage-measuring circuit shall be within ±1 kV of the test voltage.

18.4.3 *Procedure*—The procedure shall be the same as the ac proof test, except that the rate-of-rise shall be approximately 3000 V/s dc.

18.5 Perform the dielectric breakdown test in accordance with Test Methods D149. Apply the voltage at the rate of 3000 V/s under the short-time procedure. The specimen shall be representative of the blanket material to be tested. Sufficient material shall be available to permit making five tests.

18.6 *Ozone Resistance Test*—Make the ozone resistance test in accordance with one of the following test methods to ensure conformance of Type II blankets with the requirements of 8.3.

18.6.1 *Method A*—Make the ozone resistance test in accordance with Procedure A of Test Method D518. The specimen should be cut to a 10 by 100 mm (0.5 by 4 in.) rectangular size. Follow procedure A using a 20 % extension. Maintain the ozone concentration at 50 ± 5 MPa partial pressure (50 ± 5 pphm by volume at standard atmospheric pressure) for a 3-h test period at a test temperature of 40°C (104°F). Type II blankets shall show no effect from ozone exposure during this test period.

18.6.2 *Method B:*

18.6.2.1 Make the ozone resistance test on a 100 by 150-mm (4 by 6-in.) specimen of the blanket material prepared from a sample suitably conditioned by lying flat for 24 h. Drape the specimen over a 25-mm (1-in.) diameter metal tube of sufficient length to completely underlie the specimen, while possessing additional length for the required mounting supports. Electrically ground the metal tubing. Clamp the free ends of the specimen beneath the tubing electrode so that an intimate contact is established between the specimen and the tubing along the upper half of the cylindrically shaped electrode surface.

18.6.2.2 Place a piece of flat aluminum sheet foil approximately 50 by 100 mm (2 by 4 in.) over the draped specimen so as to provide adequate separation distance to prevent flashover between the foil and the metal tubing. Connect an electrode wire to the aluminum foil.

18.6.2.3 Energize the outer electrode (metal foil) to approximately 15 kV ac (rms) from a stable 60-Hz source. The 15-kV potential may be derived from a suitably rated potential transformer energized from its low-voltage winding through a continuously variable autotransformer. An overcurrent protective device should be incorporated into the low voltage control circuit in case of an electrical breakdown.

18.6.2.4 Determine the ozone resistance of the specimen qualitatively, by inspection, after a 1-h exposure period in the test apparatus at the 15-kV potential. Test at least two specimens from each sample blanket selected in accordance with 13.2. Two specimens should not be taken from the same section of the sample blanket.

NOTE 8—The rate of ozone degradation by use of Method B is inversely proportional to the relative humidity of the surrounding air. Empirical data indicate, however, that visible ozone effects will be evident over a broad range of ambient humidities under these test conditions.

18.6.3 Method A is the preferred method for determining ozone resistance.

19. Chemical and Physical Tests

19.1 *Chemical Tests:*

19.1.1 Determine the composition of the rubber hydrocarbon portion of Type I blankets using the test methods in Test Methods D297.

19.2 *Physical Tests:*

19.2.1 Perform physical tests to determine the physical properties specified in Section 8. Condition the blanket samples by storing in a flat position for at least 24 h at room temperature.

19.2.2 Perform the tensile strength, elongation, and tension set tests in accordance with Test Methods D412. The test specimen shall conform in dimensions to Die C. The elongation in the tension set shall be 400 %.

19.2.3 Perform the tear resistance test in accordance with Test Method D624. The test specimen shall conform in dimensions to Die C of Test Method D624.

19.2.4 Perform the puncture resistance test to determine the ability of the blanket to withstand puncture.

19.2.4.1 Cut a blanket specimen to fit between the opposing faces of two flat metal plates having concentric openings. Measure the thickness of each test specimen in accordance with Section 17. One of the plates shall have a circular opening 6 mm (0.25 in.) in diameter to allow the passage of a stainless steel needle. The other plate shall have an opening 25 mm (1.0 in.) in diameter to provide a fixed free area through which the specimen can elongate while being subjected to the pressure of the needle point. The edges of the openings should be rounded to a radius of approximately 0.8 mm (0.03 in.). The needle shall be made from 5-mm (0.19-in.) diameter Type 304 stainless steel rod. The rod shall be machined at one end to produce a taper with an included angle of 12° with the tip of the tapered end rounded to a radius of 0.8 mm (0.03 in.). Initially position the needle perpendicularly to the specimen so that the point contacts the specimen through the small hole in the plate. Thereafter apply motion to the needle at a continuous rate of approximately 8.3 mm/s (20 in./min) until the needle point has been driven completely through the specimen. Note the maximum force required to perform the puncturing operation and calculate the puncture resistance by dividing the maximum puncturing force by the specimen thickness. Measure the maximum applied force required to perform the puncturing operation to the nearest 2 N (0.5 lbf). The puncture resistance is calculated by dividing the puncturing force by the specimen thickness and is recorded in units of newtons per metre (pounds-force per inch).

19.2.5 Perform the drape stiffness and flex stiffness tests in a manner similar to the method specified in Test Methods D1388. Use Option A, Cantilever Test, of Test Methods D1388 as the test method. Drape stiffness is a measure of how a material will bend under its own weight, and is referred to as "Bending Length" in Test Methods D1388. Flex stiffness measures how stiff a material will feel when flexed, and is called "Flexure Rigidity" in Test Methods D1388.

19.2.5.1 Perform the test with one of two sizes of specimen. A25 by 300-mm (1 by 12-in.) rectangular die cut specimen may be used for the majority of stiffness tests on electrical insulating blankets. A25 by 150-mm (1 by 6-in.) rectangular specimen may be used for testing those blanket materials that flex relatively easily. Use of the longer specimen may be required to maintain the more flexible materials in a flat position on the horizontal platform of the test device.

19.2.5.2 Test five specimens from each sample lot. Perform the stiffness test at a temperature of 23 ± 2°C (73 ± 4°F) and also at a temperature of – 10 ± 2°C (14± 4°F). Condition the specimen and the test device for at least 4 h at each of these temperatures prior to the performance of the test.

19.2.5.3 **Caution:**Take care to ensure that the temperature of the specimen is maintained within the prescribed tolerances during the performance of the test.

19.2.6 Perform the moisture absorption test in accordance with Test Method D570, using the 24-h immersion procedure at a temperature of 24°C (73.4°F).

19.2.7 Perform the accelerated aging tests in accordance with Test Method D573. After being subjected to a temperature of 70 ± 1°C (158 ± 2°F) in circulating air for 7 days, the tensile strength and elongation of the specimen shall not be less than 80 % of the original.

20. Keywords

20.1 electrical insulating blanket; lineman; lineman protective equipment