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Standard Specification for In-Service Care of Insulating Blankets[1]

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1. Scope

1.1 This specification covers the in-service care, inspection, testing, and use voltage of insulating blankets for protection of workers from accidental contact with live electrical conductors, apparatus, or circuits. The product requirements and acceptance testing are as shown in Specification D1048.

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.

1.3 *This standard does not purport to address all of the safety problems, 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.* See Section 6 and 8.2 for specific precautionary statements.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1048 Specification for Rubber Insulating Blankets

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

F819 Terminology Relating to Electrical Protective Equipment for Workers

2.2 *ANSI Standard:*[3]

C39.5 Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation

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

3. Terminology

3.1 *Definitions:*

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

3.1.2 *compatible*—not injurious to or changing the physical or electrical characteristics of the blankets or affecting their application, use, or acceptability.

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

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

3.1.5 *electrode*—the energized or grounded conductor portion of electrical test equipment which is placed near or in contact with the material or equipment being tested.

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

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

3.1.7.1 *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 purposes of this definitions, uninsulated. Insulating covering of conductors is one means of making the conductor insulated.

3.1.8 *ozone*—a very active form of oxygen that may be produced by corona, arcing, or ultraviolet rays.

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

3.1.10 *retest*—the tests given after the initial acceptance test usually performed at regular periodic intervals or as required because of physical inspection.

3.1.11 *unassigned blankets*—blankets that are in storage prior to being issued for use.

3.1.12 *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 the phase-to-phase voltage on multiphase circuits.

3.1.12.1 *Discussion*—If there is no multiphase exposure in a system area, and the voltage exposure is limited to the phase

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

(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.

3.1.12.2 *Discussion*—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.

3.1.12.3 *Discussion*—The work practices and methods associated with removing multiphase exposures at any given work site are not addressed in the ASTM standards. The users of ASTM standards should reference appropriate industry consensus standards for proper work practices.

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

3.1.14 *voltage, nominal design*—a nominal value consistent with ANSI C84.1-2001, assigned to the circuit or system for the purpose of conveniently designating its voltage class.

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

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

4. Significance and Use

4.1 Compliance with this specification should continue to provide personnel with insulating blankets of known and acceptable quality after initial acceptance in accordance with Specification D1048. The standards herein are to be considered as minimum requirements.

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.

5.2 *Type I,* not resistant to ozone, made from a high-grade *cis*-1,4-polyisoprene rubber compound of natural or synthetic origin, properly vulcanized.

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

5.4 The class designation shall be based on the electrical properties as shown in Specification D1048.

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

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

6. Safety Precautions

6.1 A margin of safety shall be provided between the maximum use voltage on which the blankets are used and the voltage at which they are retested. The relationship between retest voltage and maximum use voltage at which the blankets shall be used is shown in Table 1.

TABLE 1 Voltage Requirements for Blankets

Class Designation of Blankets	AC Use Voltage, rms, max[A]	AC Retest Voltage, max	DC Retest Voltage, max
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] The maximum use voltage is based on the following equations:
Maximum ac use voltage = 0.95 ac maximum retest voltage – $2\ 000_v$
Classes 1, 2, 3, and 4.
Maximum ac use voltage = 0.95 dc maximum retest voltage – $30\ 500_v$
Classes 1, 2, 3, and 4.
Maximum ac use voltage = 0.95 dc maximum retest voltage – $18\ 000_v$
Class 0.

6.2 The user of this type of protective equipment shall be knowledgeable of and instructed in the correct and safe visual inspection and use of this equipment.

7. Inspection and Testing at an Electrical Testing Facility

7.1 The recommended sequence for inspection and testing of insulating blankets at the electrical testing facility is as follows:

7.1.1 Check in, washing, and preliminary inspection,
7.1.2 Electrical test,
7.1.3 Final inspection,
7.1.4 Recordkeeping and marking, and
7.1.5 Packing for storage and shipping.

7.2 Dirty blankets should be cleaned. They may be washed with a mild soap or mild detergent and water. Mild household-type chlorine bleach may be used for disinfectant purposes. Soaps, detergents, and bleaches shall not be used at strengths that would attack or harm the rubber surface. They shall be rinsed thoroughly with water to remove all of the soap or detergent. Severe dirt and grime may be wiped off using a compatible solvent.

7.2.1 The cleaning agent shall not degrade the insulating or physical qualities of the blankets.

7.2.2 A commercial tumble type washing machine may be used. Caution must be observed to eliminate any interior surfaces or edges that may damage the blankets.

7.3 If washed, blankets should be air-dried. The air temperature should not be over 150°F (65.5°C).

7.4 Prior to the electrical test, the blankets shall be given a preliminary inspection for punctures, cuts, corona cutting, or any obvious condition which would adversely affect the performance. If any of these conditions are found, blankets shall be rejected or repaired.

7.5 The blankets shall be tested in accordance with Section 8.

7.6 After the test, the blankets shall be given an inspection for corona and ozone damage.

8. Electrical Tests

8.1 All blankets issued for service shall be retested and shall withstand the 60-Hz ac test voltage (rms value) or the dc voltage (average value) specified in Table 1. The retest shall be

performed in accordance with Section 8 and shall be conducted continuously for not less than 1 min, and not more than 3 min.

8.1.1 The interval between date of issue and retests shall be based on work practices and test experience, but shall not exceed 1 year. Blankets that have been tested electrically, but not issued for service, shall not be placed into service unless they have been tested electrically within the previous 12 months.

8.1.2 Where a visual inspection indicates that there may be reason to suspect the electrical integrity of a blanket, an electrical test shall be performed before reissuing the blanket for service.

8.2 The test apparatus shall be designed to afford the operator full protection in the performance of his duties. Reliable means of de-energizing and grounding the high voltage circuit shall 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. See ANSI C39.5.

8.2.1 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.

8.2.2 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.

8.3 Both ac and dc voltage retest methods are included and either method may be selected for electrical testing.

8.4 All electrical tests shall be performed on clean blankets at normal room temperatures.

NOTE 1—All blankets should be in an unstressed physical condition prior to testing. Failure to achieve this may result in excessive breakdown or damage.

8.5 *AC Test:*

8.5.1 *Voltage Supply and Regulation*—The voltage supply and its control equipment shall be of such size and design that, with the test specimens in the circuit, the crest factor (ratio of peak 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 the test voltage. The accuracy of the voltage measuring circuit shall be within ±2 % of full scale. The correct rms value of the sinusoidal voltage wave form applied to the blanket may be measured by one of the following methods:

8.5.1.1 A voltmeter used in conjunction with a calibrated instrument transformer connected directly across the high voltage circuit,

8.5.1.2 A calibrated electrostatic voltmeter connected directly across the high voltage circuit, or

8.5.1.3 An ac meter connected in series with appropriate high-voltage type resistors directly across the high voltage circuit.

8.5.1.4 The crest factor may be checked by the use of a peak reading voltmeter connected directly across the high-voltage circuit.

8.5.2 *AC Retest:*

8.5.2.1 Each blanket shall be given an electrical retest in accordance with 8.1. The test period shall start at the instant that the prescribed testing voltage is reached.

NOTE 2—It is recommended that the retest voltage be applied initially at a low value and increased at a constant rate-of-rise of approximately 1000 V/s until the prescribed test voltage level is reached. Unless an electrical puncture has already occurred, the applied voltage should be reduced to at least half value at the end of the test period before opening the test circuit.

8.5.2.2 Electrodes 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.

NOTE 3—*Recommended Electrodes for Classes 0, 1, and 2*—Rectangular metal sheets approximately 1⁄16 in. (2 mm) thick having edges and corners rounded smoothly and wet pads approximately 1⁄4 in. (6 mm) thick, placed between the metal sheets and the blanket.

Recommended Electrodes 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 0.12 to 0.18 in. (3 to 5 mm) thick sheet of insulating material which is a minimum of 50 $in.^2$ (1270 mm^2) and has a 30 by 30 in. (762 by 762 mm) 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 30 by 30 in. (762 by 762 mm) area of a 36 by 36 in. (914 by 914 mm) blanket at 40 kV ac as the mask prevents flashover.

Other electrode designs may be used to achieve the same result.

8.6 *DC Test:*

8.6.1 *Voltage Supply and Regulation*—The dc test voltage may be obtained from a source capable of supplying a dc voltage whose peak to peak ac ripple component does not exceed 2 % of the average voltage value under no load conditions. The dc test voltage shall be measured by a method that provides the average value of the voltage applied to the blanket. It is recommended that the voltage be measured by the

TABLE 2 Electrode Clearances [A]

Class Designation Blanket	AC Retest, in. (mm)	DC Retest, in. (mm)
0	3 (76)	3 (76)
1	3 (76)	3 (76)
2	5 (127)	6 (152)
3	7 (178)	8 (203)
4	10 (254)	12 (305)

[A] These nominal clearances are intended to avoid flashover and may be increased by no more than 2 in. (51 mm) when required by 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.

use of a dc meter connected in series with appropriate high voltage type resistors across the high voltage circuit, or by an electrostatic voltmeter of proper range. The accuracy of the voltage measuring circuit shall be within ±2 % of full scale.

8.6.2 *DC Retest:*

8.6.2.1 Each blanket shall be given an electrical retest in accordance with 8.1.

NOTE 4—It is recommended that the dc retest voltage be applied in the same manner as the ac retest voltage, with the exception of a rate-of-rise of approximately 3000 V/s dc.

8.6.2.2 *Electrodes*—The dc retest may be made with dry electrodes that consist of two flat metallic plates. The electrodes used in the proof test shall be designed to comply with the flashover clearances specified in Table 2. The edges and corners of these plates should be rounded smoothly so as to eliminate sharp nicks, protuberances, and point sources that are conducive to corona inception and lowered flashover voltage.

9. Rejection Criteria

9.1 Each blanket shall withstand the 60 Hz ac retest voltage (rms value) or the dc retest voltage (average value) specified in Table 1.

9.2 Any blanket that fails to comply with the electrical retest requirements in 8.1 shall be rejected or repaired in accordance with Section 10.

9.3 Minor surface corona cutting or ozone checking need not be cause for rejection.

9.4 Blankets found upon inspection to have punctures, cuts, snags, cracks, burns, corona cutting, or any obvious condition that would adversely affect performance shall be rejected or repaired in accordance with Section 10.

10. Repairs

10.1 Physical defects in blankets such as cuts, tears, or punctures may be repaired by the application of a compatible patch that results in physical and electrical properties equal to those required in Specification D1048. Repairs shall not be made on top of previous repairs or on ozone or corona damage. With Type II blanket repair using a heat-curing device, the repair shall be made such that no previously repaired area is recured for a second time.

10.2 Blankets with defects too extensive to repair may be salvaged by severing the defective area from the undamaged portion of the blanket provided that in Class 1, 2, 3, and 4, the remaining portion of the blanket is not reduced to size such that the test electrode clearance is less than the values listed in Table 2.

10.3 Subsequent to any repair, blankets shall be reinspected and retested in accordance with Sections 7 and 8 of this specification.

11. Field Care, Inspection, and Storage

11.1 The field care and inspection of electrical insulating blankets, performed by the individual, is an important requirement in providing protection from electrical shock. Defective or suspected defective blankets shall not be used. They shall not be reissued for use until they have been inspected and retested at an electrical testing facility, and meet the requirements of Section 8.

11.2 Blankets shall be inspected visually by the user for defects before being installed, and at other times if there is cause to suspect any damage. They shall be inspected on both sides over the entire surface for defects and imbedded materials.

11.3 Blankets shall be cleaned as necessary to remove foreign substances and shall be wiped clean of any oil, grease, or other damaging substances as soon as practicable.

11.4 A visual inspection of blankets shall be made in the field by a designated person to determine that such equipment is being maintained in a satisfactory condition by the users. The frequency of this inspection shall be at intervals of not more than 6 months.

11.5 Blankets shall be stored in a location as cool, dark, and dry as practicable. The location shall be as free as possible from ozone, chemicals, oils, solvents, damaging vapors and fumes, and away from electrical discharges and sunlight. Field storage of blankets shall be in a bag, box, container, or compartment that is designed for and used exclusively for them. Blankets shall not be kept folded, creased, or compressed in any manner that will cause stretching or compression.

11.6 Blankets shall not have any identifying adhesive tapes or labels applied to them by other than authorized personnel. Tape shall not be used to secure blankets for shipment or storage.

NOTE 5—Use of tape may cause blanket surface contamination or damage that may lead to reduced blanket life.

11.7 Blankets with any of the following defects shall not be used, and shall be returned to an electrical testing facility for inspection and electrical retest:

11.7.1 Holes, tears, punctures, or cuts.

11.7.2 Severe corona cutting, severe ozone checking.

11.7.3 Imbedded foreign objects.

11.7.4 Texture changes: swelling, softening, hardening, becoming sticky or inelastic.

11.7.5 Other defects that damage the insulating properties.

12. Recordkeeping and Product Marking

12.1 The test procedures of the electrical test facility shall specify the test voltage for each class of blanket to be tested, or a record shall be kept of the voltage used in the test. A date specified as test or retest shall be either recorded or provided by marking or affixing a label to the blanket. The product marking or labeling method and material shall not adversely affect the electrical or physical characteristics of the blanket or conflict with the manufacturer's original product marking or labeling.

12.2 Blankets that have been rejected and are not suitable for electrical service shall be defaced, cut, or otherwise marked and identified to indicate that they are not to be used for electrical service.

13. Precision and Bias

13.1 No statement is made about either the precision or the bias of the test methods in this standard for measuring the

dielectric strength since the results merely state whether there is conformance to the criteria for success specified in the procedure.

14. Keywords

14.1 electrical insulating blankets; lineman; lineman protective equipment