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Standard Specification for In-Service Care of Insulating Line Hose and Covers[1]

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1. Scope

1.1 This specification covers the in-service care, inspection, testing, and use voltage of insulating line hose and covers for protection of workers from accidental contact with energized electrical wires or equipment.

1.2 The following safety hazards caveat applies only to the test method portion, Section 7, of this specification:*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.*Specific precautionary statements are given in 7.2.1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1049 Specification for Rubber Insulating Covers

D1050 Specification for Rubber Insulating Line Hose

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 Standards:*

C 84.1 Voltage Ratings for Electric Power Systems and Equipment (60 Hz)[3]

C 39.5 Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation[3]

2.3 *IEEE Standard:*

IEEE Standard 4 Techniques for High Voltage Testing[4]

3. Terminology

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

3.2 *bulk storage*— the storage of hose or covers together with one or more layers piled neatly, but without the benefit of spacers, supports, or special protective containers.

3.3 *cover*—an electrically insulated enclosure designed to be installed temporarily on various types of irregularly shaped electrical equipment to protect personnel and equipment working in the close proximity.

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

3.5 *distorted*—physically changed from the natural and original shape, caused by stress of any type.

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

3.7 *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.

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

3.9 *hose*—an electrical insulating tube with a longitudinal slit designed to be installed temporarily on energized electrical wires.

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

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

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

3.13 *voltage, maximum retest*—voltage, either ac rms or dc average, that is equal to the proof test voltage for new protective 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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854-4150.

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

3.16 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 line hose and covers of known and acceptable quality after initial acceptance in accordance with Specifications D1050 and D1049. The standards herein are to be considered as minimum requirements.

4.2 A margin of safety shall be provided between the maximum use voltage and their class proof voltage in accordance with Specifications D1050 and D1049, as shown in Table 1.

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

5. Classification

5.1 Line hose covered in this specification are designed as Type I or Type II; Class 0, Class 1, Class 2, Class 3 or Class 4; Style A, Style B, Style C or Style D. Covers covered in this standard are designated as Type I or Type II; Class 0, Class 1, Class 2, Class 3 or Class 4; Style A, Style B, Style C, Style D or Style E.

5.1.1 *Type I*—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 designations are based on the electrical properties in Specifications D1050 and D1049.

5.1.4 The style designations are based on the designs and descriptions in Specifications D1050 and D1049.

6. Washing and Inspection

6.1 The recommended sequence of washing and inspection of contaminated insulating line hose and covers is as follows:

6.1.1 Washing,

6.1.2 Drying,

6.1.3 Inspection,

6.1.4 Marking, and

TABLE 1 Voltage Requirements Line Hose and Covers

Class Designation of Hose and Covers	AC Use Voltage, rms, max	DC Max Use Voltage avg, V	AC Retest Voltage, rms	DC Retest Voltage, avg
0	1000	1500	5000	20 000
1	7500	11250	10 000	40 000
2	17 000	25500	20 000	50 000
3	26 500	39750	30 000	60 000
4	36 000	54000	40 000	70 000

6.1.5 Packing for storage and shipment.

6.2 The hose and covers may be washed with a soap, mild non-bleaching detergent, or a cleaner recommended by the equipment manufacturer. After washing, the hose and covers shall be rinsed thoroughly with water.

6.2.1 The cleaning agent shall not degrade the insulating qualities of the line hose and covers.

6.2.2 A commercial tumble-type washing machine may be used, where practicable, but caution must be observed to eliminate any interior surfaces or edges that will cut, abrade, puncture, or pinch the hose or covers.

6.3 The hose and covers shall be air dried. The air temperature shall not be over 150°F (65.5°C). They may be suspended to allow drainage and air circulation or dried in a commercial tumble-type automatic dryer. In an automatic dryer, caution must be observed to eliminate any ozone-producing lamps and interior surfaces that will cut, abrade, puncture, or pinch the hose and covers.

6.4 Insulating line hose and covers shall be given a detailed inspection over the entire inner and outer surface for punctures, cuts, severe ozone cutting, or any other obvious condition that would adversely affect performance.

6.5 The hose and covers shall be marked in accordance with Section 12.

7. Electrical Tests

7.1 Where the inspection specified in Section 6 indicates that there may be reason to suspect the electrical integrity of a line hose or cover, an electrical test shall be performed before reissuing the line hose or cover for service.

7.2 Both ac and dc voltage retest methods are included in this section and either or both methods may be selected for electrical test.

7.2.1 **Warning**—In addition to other precautions, it is recommended that the test apparatus be designed to afford the operator full protection in the performance of 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. See ANSI C 39.5.

7.2.2 To eliminate damaging ozone and possible flashover along the line hose and cover openings, there should be a sufficient flow of air into and around the line hose or cover 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.

7.3 Any electrical retest shall be performed at normal room temperatures and on clean hose or covers at an electrical testing facility.

7.4 *Electrodes:*

7.4.1 The entire area of each hose and cover shall be tested, as nearly as practicable, between electrodes that apply the electrical stress uniformly over the test area without producing damaging corona or mechanical strain in the hose or cover. The

electrodes shall be of such dimensions and so placed as to avoid flashover at the edges.

7.4.2 For hose, the inside electrode shall be a metal mandrel of the size in Table 2. The outer electrode should be a close-fitting wet sponge or wet fabric blanket, metal foil, or a smooth metal form; extending to within ½ in. (13 mm) of the edge of the lip of the hose, and extending to a distance from the end of the hose as specified in Table 3. If the hose has a connector end, the form should extend to within ½ in. (13 mm) of the connector end. When Style C line hose is tested, the outer electrode may fit around the outside diameter of the hose, but not the extended lip (Note 1).

NOTE 1—These end clearances are intended to serve as a guide and under some conditions may have to be increased to prevent flashover.

7.4.3 For covers, the electrodes shall be one of those described in the following methods:

7.4.3.1 *Method 1 for Types I and II*—Water as inner and outer electrodes.

7.4.3.2 *Method 2 for Types I and II*—Wet sponge or wet felt inner electrode; and wet sponge, wet felt, or metal foil outer electrode.

7.4.3.3 *Method 3 for Type II*—Fixed form metal or metal foil inner or outer electrodes, or both.

NOTE 2—Method 3 electrodes shall not be used with Type I materials when testing with alternating current due to the possibility of corona cutting.

7.5 *AC Test:*

7.5.1 *Voltage Supply and Regulation:*

7.5.1.1 The voltage supply and control equipment should 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.

7.5.1.2 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)* an ac voltmeter connected in series with appropriate high voltage type resistors directly across the high-voltage circuit. 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 or IEEE Standard 4.

7.5.1.3 The crest factor may be checked by the use 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.

7.5.2 *AC Retest*—Electrical retest of a hose or cover shall be in accordance with the requirements of Section 8.

NOTE 3—It is recommended that the retest voltage be applied initially at a low value and increased gradually at a constant rate-of-rise of approximately 1000 V/s ac until the prescribed test voltage level is reached. Unless an electrical puncture has occurred already, the applied voltage should be reduced to at least half value at the end of the test period before opening the test circuit.

7.6 *DC Test:*

7.6.1 *Voltage Supply and Regulation:*

7.6.1.1 The dc test voltage can 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.

7.6.1.2 The dc test voltage shall be measured by a method that provides the average value of the voltage applied to the test specimen. It is recommended that the voltage be measured by the 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 ±1 kV of the test voltage . The test equipment shall be calibrated at least annually, in accordance with the latest revision of Practice D2865 or the latest revision of IEEE Standard 4.

7.6.2 *DC Retest*—Electrical retest of a hose or cover shall be in accordance with the requirements of Section 8.

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

TABLE 2 Line Hose Test Mandrel Size

Hose Size, Inside Diameter, in. (mm)	Recommended Test Mandrel Size, Outside Diameter, in. (mm)
¼ (6.4)	3⁄16 (4.8)
5⁄8 (16)	9⁄16 (14.3)
1 (25)	15⁄16 (23.8)
1¼ (32)	1 3⁄16 (30)
1½ (38)	1¼ (31.8)
2 (51)	1¾ (44.4)
2½ (63.5)	2¼ (57.2)

TABLE 3 Flashover Clearances Between Electrodes[A]

Class Designation, Line Hose or Cover	AC Retest		DC Retest	
	in.	mm	in.	mm
0	3	76	3	76
1	3	76	4	102
2	5	127	6	152
3	7	178	8	203
4	10	254	12	305

[A] Flashover clearances are stated in terms of the shortest electrical air path between electrodes around the edge of the item being tested. In those cases where atmospheric conditions make the specified clearances impractical, the distance may be increased by the maximum of 2 in. (51 mm).

8. Rejection Criteria

8.1 Any hose or cover that fails to comply with the electrical retest requirements as indicated in this section shall be rejected.

8.2 Each hose or cover tested, as required by 7.1, shall withstand the 60-Hz ac retest voltage (rms value) or the dc retest voltage (average value) specified in Table 1. The test

voltage shall be applied continuously for not less than 1 min and not more than 3 min.

8.3 Any hose or cover that upon inspection is found to have punctures, deep cuts, severe corona or ozone cutting, contamination from injurious materials, or has lost its normal elasticity, shall be rejected.

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

9. Precision and Bias

9.1 No statement is made about either the precision or the bias of the test methods in this specification for measuring the dielectric strength since the results merely state whether there is conformance to the criteria for success specified in the procedure.

10. Repairs

10.1 Hose and covers shall not be repaired. Hose may be used in shorter lengths if the defective portion is cut off.

11. Field Care, Inspection, and Storage

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

11.2 Before use and installation on energized conductors, devices, or equipment, line hose and covers shall be inspected visually for defects and at other times if there is cause to suspect any damage.

11.3 Line hose and covers shall be wiped clean of any oil, grease, or other damaging substances as soon as practicable. Line hose and covers whose surface becomes otherwise contaminated shall be set aside and cleaned in accordance with Section 6.

11.4 Loose bulk storage or packaging may be used for hose or covers in transit or in temporary holding operations provided such storage is limited to periods not in excess of 1 month, and there is not severe distortion.

11.5 Line hose and covers shall be stored without distortion and mechanical stress in a location as cool, dark, and dry as possible. They shall be stored or packaged in a suitable compartment or in containers such as boxes or bags. The area shall be as free as possible of ozone, chemicals, oils, solvents, damaging vapors and fumes, and away from electrical discharges and sunlight.

11.6 Line hose and covers shall not have any identifying adhesive tapes or labels applied to them by other than authorized personnel. Tape shall not be used to secure line hose and covers for shipment or storage.

11.7 Line hose and covers with any of the following defects shall not be used:

11.7.1 Holes other than factory produced openings on the top, sides, or lips of the line hose or covers, tears and punctures, serious cuts, and rope or wire burns that extend more than one third the depth of the thickness of the rubber.

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

11.7.3 Other defects that damage the insulating properties.

11.8 Line hose and cover should be left in service on energized lines for minimum necessary periods of time as exposure may result in ozone checking, corona cutting, or excessive weathering.

12. Marking

12.1 If the hose and covers are not readily identifiable as to class, they shall be marked.

12.2 Hose or covers 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. Keywords

13.1 electrical insulating covers; electrical insulating line hose; lineman; lineman protective equipment