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Standard Specification for Unused Rope with Special Electrical Properties¹

This standard is issued under the fixed designation F1701; 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.

1. Scope

1.1 This specification covers the requirements, sizes, construction, tests, and procedures for unused ropes for use by electrical utilities and related industries on energized lines operating at voltages higher than 1 kV.

1.2 This specification covers the minimum electrical, mechanical, and physical properties guaranteed by the manufacturer and the detailed procedures by which such properties are to be determined. The purchaser has the option to 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.

1.3 The rope to which this specification applies is designed to be used in a clean and dry condition, on or near energized lines.

1.4 A margin of safety shall be allowed between the maximum voltage and working distances on which it is used and the test voltage and lengths at which it is tested.

1.5 It is common practice for the user of this type of equipment to prepare complete instructions and regulations to govern in detail the correct and safe use of such equipment.

1.6 The use and maintenance of this equipment is beyond the scope of this specification.

1.7 The values stated in SI units are to be regarded as the standard.

1.8 The following safety hazards caveat pertains only to the test method portion, Section 11, 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.* 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. The test levels used in this standard are for testing under laboratory conditions and are not to be regarded as safe use levels.

2. Referenced Documents

2.1 ~~ASTM Standards:~~ ASTM Standards:²

C1500 [Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting](#)

D1125 [Test Methods for Electrical Conductivity and Resistivity of Water](#)

D4268 [Test Methods for Testing Fiber Ropes](#)

E4 [Practices for Force Verification of Testing Machines](#)

F711 [Specification for Fiberglass-Reinforced Plastic \(FRP\) Rod and Tube Used in Live Line Tools](#)

2.2 IEEE Standards:³

IEEE Std 4 [Standard Techniques for High Voltage Testing](#)

2.3 Other Standard:⁴

Cordage Institute CI-1301 [Polypropylene Fiber Rope 3-Strand and 8-Strand Constructions \(April 1999\)](#)

3. Terminology

3.1 *General*—The terms used in this specification are common to and well known by the industries that will be using them.

¹ This specification is under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.35 on Tools and 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 Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331.

⁴ Available from The Cordage Institute, 994 Old Eagle School Rd., Suite 1019, Wayne, PA 19087.

4. Ordering Information

4.1 Orders for rope under this specification should include the following information:

4.2 Manufacturer's designation of the rope.

4.3 *Length of Coil or Reel*:

4.3.1 *Lengths*—Each package shall be continuous throughout without splices or knots. Ends shall be taped, heat sealed, or served to prevent ravelling.

~~4.3.2 Rope should be shipped in reels. unraveling.~~

5. Physical Properties

5.1 *Hardness*—Refer to ~~11.6~~11.5.

5.2 *Diameter, Break Strength, and Elongation*—Refer to ~~11.6~~11.5.

5.3 *Melt Point*—Refer to ~~11.6~~.

6. Mechanical Properties

6.1 The primary mechanical property of rope is the breaking strength. Minimum breaking strengths, and associated nominal design characteristics (dimensions, mass, and acceptable variations) of ropes are available from manufacturer or the Cordage Institute.

7. Workmanship, Finish, and Appearance

7.1 All sizes of rope shall be evenly laid and well balanced in accordance with best rope making workmanship. Rope and strands shall be free from kinks, strand knots, and darting yarns or loose ends (inside yarns which project through cover yarns of strand at intervals along the rope).

8. Sampling and Number of Tests or Retests

8.1 *Composition of Batch to be Sampled*—Samples shall be taken from a homogeneous batch consisting of ropes of the same size and same dimensions and which have been subject to the same series of manufacturing operations and the same checking procedure.

8.2 *Selecting the Samples*—~~Unless otherwise agreed upon between the purchaser and manufacturer, take at random from the batch the number of samples, —Take at random from the batch the minimum number of samples, S , obtained from the following equation:~~

$$S = 0.4 \sqrt{N}$$

where N = number of coils making up the batch.

Where the calculated value of S is not a whole number, the number obtained shall be rounded to the nearest whole number. For example, 27.5 and 30.35 shall be rounded to 28 and 30, respectively. Where $S < 1$, take one sample length.

8.2.1 *Specimen Selection Location*—~~For acceptance or retesting testing of rope shipped in reel lengths, specimens shall be selected from each end. One specimen shall be selected from the outside end and one from the inside (drum) end. This will require a re-reeling of the rope.~~

~~8.3 For routine production testing, single-finished~~ 8.3 *Single-finished* production runs of greater than 1828 m (6000 ft) tests shall be conducted at the beginning and end of the finished production length.

9. Specimen Preparation

9.1 Specimen preparation is included as a part of each test method. The ends of each rope specimen shall be ~~heat sealed~~sealed.

10. Recommended Working Load

10.1 Manufacturers furnishing rope under this specification shall specify a recommended maximum working load.

11. Test Methods and Performance Requirements

11.1 The ropes complying with these specifications shall undergo two different tests, electrical and mechanical/physical, and are to be termed “nonconductive” rope. Samples of rope selected in accordance with Section ~~7~~8 from every production lot (single finished production length) shall be tested and each reel identified by lot (see 15.3).

11.1.1 The test sequence is (1) visual (Refer to Section 7; (2) ~~electrical~~; (3) dry electrical (Refer to 11.3); (4) ~~mechanical/physical~~; (5) wet electrical (Refer to 11.4); (6) mechanical/physical (Refer to 11.5).

11.2 **Caution**—It is recommended that the test apparatus be designed to afford the operator full protection in performance of his duties. Reliable means of deenergizing and grounding the high-voltage circuit shall be provided.

~~11.3 Electrical Test Procedure—Wet Test—This is a routine production test.~~

11.3 Electrical Test Procedure Dry Test—This is a dry specimen test to be used on new rope prior to wet test.

11.3.1 *Specimen for Test*—When selected in accordance with Section ~~8.3~~8, the test specimen shall be at least ~~2.4~~1.8 m (~~8~~6 ft) long so that when the rope is held in a vertical position, there will be ~~1.5~~1.0 m (~~5~~3 ft) of rope free off knots, eyes, or splices (see Fig. 1).

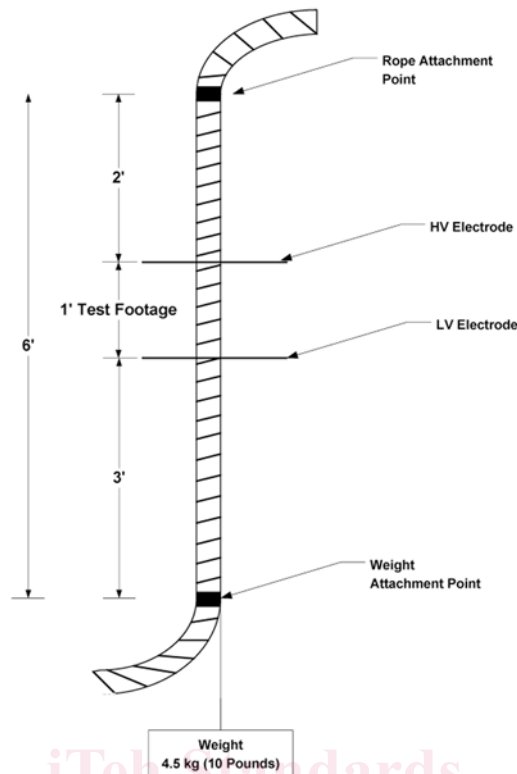


FIG. 1 Test Footage for Electrical Test

11.3.2 *Handling of Specimen*—When the specimen rope is handled, it shall always be outside the test footage (see Fig. 1).

11.3.3 *Attachment of Electrodes*—The electrodes shall be attached prior to wetting the specimen. See Fig. 1 for attachment points. The electrode shall be made of one wrap of 22 gage solid copper wire twisted tightly and pigtailed to ensure all filaments are in contact. See Fig. 1.

11.3.4 *Wetting of Specimen* Electrodes:

11.3.4.1 A clean nonmetallic tank or trough shall be rinsed with the same type water to be used during the wetting.

11.3.4.2 The entire rope specimen shall be kept submerged horizontally in test water at a depth of 305 mm (1 ft) using non-metallic device(s) for a period of 15 min. There shall be no bends in this specimen.

11.3.5 *Water for Wetting*—The electrical resistivity of the water used for wetting shall meet the requirements of IEEE Standard 4, that is 100 Ω m at ambient temperature $\pm 15^\circ\text{C}$. The resistivity may be measured by using the test methods as described in Test Methods D1125.

11.3.6 *Drying of Specimen*—Within 1 min after removing specimen from wetting tank, the specimen shall be hung in a vertical position with an unrestrained weight of 4.5 kg (10 lb) attached. Allow to dry at as near standard atmospheric conditions as practical with rope attachment point and weight attachment point as described in Fig. 1. The specimen shall be allowed to dry for 15 min.

11.3.7 *Leakage Readings*:

11.3.7.1 The 60 Hz voltage shall be applied immediately after the 15-min drying period and shall be raised from 0 to 30 kV in not less than 5 nor more than 15 s. The voltage shall be held at 30 kV for 30 s. The leakage current obtained over the 2-ft test section shall not exceed 50 μA from the time of initial application of voltage until the end of the test. If the current exceeds 50 μA , the lot will be rejected. Refer to

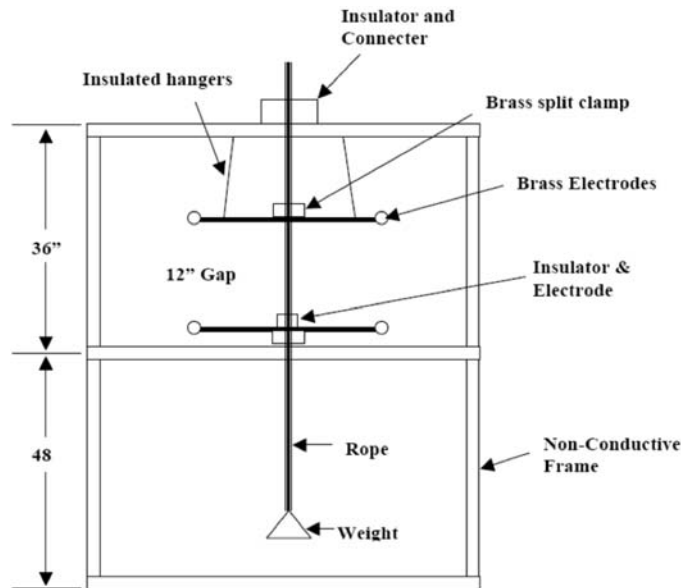
11.3.3.1 The electrodes shall be designed to shield out the majority of stray capacitive currents.

11.3.3.2 The electrodes and configuration shall be the same as those in Fig. 2 for test circuit.

11.3.7.2 The wet test in 11.3 is a discriminatory test used as a method of determining the rope quality, not as a method of determining the rope's ability to operate properly under wet conditions in the field.

11.4 *Electrical Test Procedure—Acceptance Test*—This is a dry specimen acceptance test, or the alternate setup in Fig. 3, which are similar to those specified in Specification F711 for testing FRP rod and tube (see Fig. 4). Electrical contact is made through clamps that fit snugly around the rope. The electrodes shall be mounted in a suitable frame like Fig. 2 to allow the suspension of the 305 mm (12 in.) \pm 13 mm ($\frac{1}{2}$ in.) test section between the electrodes. A 4.5 kg (10 lb) weight shall be attached to the rope to maintain good electrical contact. (See Fig. 5 for clamp and plate details of Fig. 2).

11.3.4 *Dry Test Leakage Readings*—The 60 Hz voltage shall be raised from 0 to 100 kV rms in not less than 5 nor more than 15 s. The voltage shall be held at 100 kV rms for 5 min. If at the end of 5 min the current is stable or dropping and has not exceeded 100 μA at any time during the test, or flashed over, the specimen has passed the test. If at the end of 5 min the current is rising



NOTE—Split Die Cast Clamps modified to firmly clamp circumference of rope.

FIG. 2 Electrical Test Configuration

and not stable but does not exceed 100 μ A, or flashover, the test shall continue for an additional 25 min. If at the end of that time the rope has not flashed over and the current has stabilized at less than 100 μ A, the specimen has passed.

11.4 Electrical Test Procedure-Wet Test:

11.4.1 Specimen for Test—When selected in accordance with Section 8.38, the test specimen shall be at least 2.41.8 m (8(6 ft) long so that when the rope is held in a vertical position, there will be 1.51.0 m (5(3 ft) of rope free from knots, eyes, or splices (see Fig. 1).

11.4.2 Handling of Specimen—When the rope is handled, it shall always be outside the test footage (see Fig. 1).

11.4.3 Electrodes:

11.4.3.1 The electrodes shall be designed to shield out the majority of stray capacitive currents.

11.4.3.2 The electrodes shall be similar to those specified in Specification F711 for testing FRP rod and tube. Electrical contact is made through washers that fit snugly around the rope. The electrodes shall be mounted in a suitable frame to allow the suspension of the 305 mm (12 in.) test section between the electrodes. A 4.5 kg (10 lb) weight shall be attached to the rope to maintain good electrical contact. See

11.4.3.2 The electrodes and configuration shall be the same as those in Fig. 2, or the alternate setup in Fig. 3. For alternative electrode design, see, which are similar to those specified in Specification F711 for testing FRP rod and tube (see Fig. 4-). Electrical contact is made through clamps that fit snugly around the rope. The electrodes shall be mounted in a suitable frame like Fig. 2 to allow the suspension of the 305 mm (12 in.) \pm 13 mm ($\frac{1}{2}$ in.) test section between the electrodes. A 4.5 kg (10 lb) weight shall be attached to the rope to maintain good electrical contact. (See Fig. 5 for clamp and plate details of Fig. 2).

11.4.4 Dry Test Leakage Readings—The 60 Hz voltage shall be raised from 0 to 100 kV rms in not less than 5 nor more than 15 s. The voltage shall be held at 100 kV rms for 5 min. If at the end of 5 min the current is stable and has not exceeded 100 μ A or flashed over, the specimen has passed the test. If at the end of 5 min the current is not stable and does not exceed 100 μ A, or flashover, the test shall continue for an additional 25 min. If at the end of that time the rope has not flashed over and the current has stabilized at less than 100 μ A, the specimen has passed.

NOTE1—The acceptance tests may be performed at the option of the purchaser to verify that the product meets the criteria of 11.4 and 11.5. The cost of these tests is negotiable between the purchaser and the manufacturer.

11.5 Wet Acceptance Test Conditioning of Specimen:

11.5.1 Specimen for Test—When selected in accordance with 8.3, the test specimen shall be at least 2.4 m (8 ft) long so that when the rope is held in a vertical position, there will be 1.5 m (5 ft) of rope free from knots, eyes, or splices (see Fig. 1)

11.4.4.1 The weight of the preconditioned sample should be taken and recorded to the nearest milligram. Loss of hydrophobic coating could reduce weight saturation and should be considered a failure.

11.4.4.2 The entire rope specimen shall be subjected to 99 % RH for not less than 16 h, (at room temperature \pm 10°F). Samples should be coiled into coils of 10 to 12 in. diameter and hung in place with non-conductive ties (see Fig. 6).

11.5.2 Handling of Specimen—When the rope is handled, it shall always be outside the test footage (see Fig. 1).

11.5.3 Electrodes: