MILITARY SPECIFICATION

CABLES, RADIO FREQUENCY, FLEXIBLE AND SEMIRIGID,
GENERAL SPECIFICATION FOR

This interim amendment is approved for use within the Space and Naval Warfare Systems, with MIL-C-17F, dated 18 January 1983.

PAGE 3

2.2, add the following publications:

"SPECIFICATIONS

FEDERAL

TT-I-735 - Isopropyl Alcohol.

MILITARY

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance.

MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5.

MIL-F-16884 - Fuel, Naval Distillate.

MIL-L-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service.

MIL-H-17672 - Hydraulic Fluid, Petroleum, Inhibited.

MIL-L-23699 - Lubricating Oil, Aircraft Turbine Engines, Synthetic Base.

MIL-L-24467 - Lubricating Oil, Steam Turbine, Vapor-Space Inhibited.

AMERICAN SOCIETY FOR TESTING MATERIALS

ASTM B-355 - Nickel-Coated Soft or Annealed Copper Wire.

ASTM D-2240 - Rubber Property-Durometer Hardness. (DoD adopted)

ASTM D-2565 - Standard Practice for Operating Xenon Arc-Type (Water-Cooled) Light-Exposure Apparatus Wire and Without Water for Exposure of Plastics.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

IEEE-STD-383 - IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

(Applications for copies should be addressed to The Institute of Electrical and Electronic Engineers, Inc., 345 East 47th Street, New York, NY 10017).

NAVAL ENGINEERING STANDARDS (NES)

711 - Determination of the Smoke Index of the Products of Combustion from Small Specimens of Materials.

713 - Determination of the Toxicity Index of the Products of Combustion from Small Specimens of Materials.

(Copies of Naval Engineering Standards are sponsored by the Procurement Executive, Ministry of Defense, Ship Department, Section TE112, Block G, Foxhill, Bath 5AB England.)"

PAGE 4

3.5.1.1f, delete in its entirety and substitute: "Silver-coated copper-clad steel wire. Silver-coated copper-clad steel wire shall conform to ASTM B-501, class 40 HS or 40A, except thickness of silver coating shall not be less than 40 microinches."

PAGE 5

3.5.2.1a: Delete "class I" and substitute "class L".

PAGE 8

3.5.6, add the following:

"o. Type XIV. Cross-linked polyolefin, cross-linked in accordance with ASTM D-470."

3.5.6b: Delete "class M" and substitute "class L".

PAGE 9

3.6.2, add the following to the end of paragraph:

"The dimensions shall be as specified in the detailed specification and out-of-roundness (the difference in diameter dimension in mutual perpendicular planes at any cross section) shall not exceed 50 percent of the difference between minimum and maximum diameters specified."

3.7.9, delete and substitute:

"3.7.9 Capacitance. When cables are tested as specified in 4.8.10, the maximum capacitance shall be as specified (see 3.1)."

PAGE 10

Add the following paragraphs:

"3.7.23 Flame propagation (when specified (see 3.1)). Samples of completed cable, when tested in accordance with 4.8.24, shall be self-extinguishing and shall not burn to the top of the tray.

"3.7.24 Acid gas generation. When cables are tested as specified (see 4.8.26), the acid equivalent shall not exceed the percentage, by weight of the sample, as specified (see 3.1).

"3.7.25 Halogen content. When cables are tested as specified (see 4.8.27), the halogen content shall not be greater than specified (see 3.1).

"3.7.26 Immersion tests. When cables are tested as specified (see 4.8.28), the tensile strength and elongation shall be no greater than that specified (see 3.1).

"3.7.27 Smoke index. When cables are tested as specified (see 4.8.29), the smoke index shall not be greater than that specified (see 3.1).

"3.7.28 Toxicity index. When cables are tested as specified (see 4.8.30), the toxicity index shall not be greater than that specified (see 3.1).

"3.7.29 Durometer hardness. When cables are tested as specified (see 4.8.31), the hardness shall be as specified (see 3.1).

"3.7.30 Weathering. When cables are tested as specified (see 4.8.32), the tensile strength and elongation retention shall be greater than 75 percent. The surface shall not exhibit signs of cracking when examined.

"3.7.31 Abrasion resistance. When tested as specified (see 4.8.33), failure shall be construed if electrical contact occurs between either abrading element and any specimen conductor (as evidenced by cessation of cylinder rotation) prior to completing the specified number of abrasive scrapes (see 3.1).

"3.7.32 Tear strength. When tested as specified (see 4.8.34), the median value of the measured tear strengths of all specimens shall not be less than that specified (see 3.1).

"3.7.33 Heat distortion. When tested as specified (see 4.8.35), the percentage of heat distortion shall not be greater than that specified (see 3.1).

"3.7.34 Physicals (aged). When tested as specified (see 4.8.36), the specimens tensile strength and elongation shall not be less than that specified (see 3.1).

"3.7.35 Tensile strength and elongation. When tested as specified (see 4.8.37), the cable jacket shall not have a tensile strength and elongation retention less than that specified (see 3.1).

"3.7.36 Shrinkage. When tested as specified (see 4.8.38), the total jacket shrinkage shall not exceed that specified (see 3.1).

"3.7.37 Jacket flaws. When tested as specified (see 4.8.39), the jacket material shall not exhibit any sign of deformation or damage. The voltage shall be as specified (see 3.1)."

PAGE 11

3.8b(1), second sentence, delete and substitute: "Cables with type V jackets shall be marked with tapes, or surface marked in ink."

3.8b(2), delete and substitute: "Types IX and XIII jackets shall be marked at intervals not exceeding 6 inches with marker tape or surface marking. Cables with type IX and XIII jackets whose nominal outside diameter is .150 inch or less need not be marked."

PAGE 12

TABLE II, add the following:

"

| Material | Requirement paragraph | Applicable documents |
|---|---|---|
| Polyolefin, cross-linked | 3.5.6o | ASTM D-470 |

"

TABLE III, add the following:

| Inspection | | Requirement paragraph | Method paragraph |
|---|---|---|---|
| Semirigid cable 1/ | All other cable 2/ | | |
| | Out-of-roundness of jacket measurements | 3.6.2 | 4.8.1.2 |

"

TABLE IV, delete and substitute:

" TABLE IV. Qualification inspection.

| Inspection | Number of specimens to be tested | Requirement paragraph | Method paragraph |
|---|---|---|---|
| Group I | | | |
| In-process inspection | Entire sample | | 4.5 |
| Continuity | Entire sample | 3.7.1 | 4.8.2 |
| Spark test | Entire sample | 3.7.2 | 4.8.3 |
| Jacket flaws | Entire sample | 3.7.37 | 4.8.39 |
| Voltage withstanding | Entire sample | 3.7.3 | 4.8.4 |
| Insulation resistance 1/ | Entire sample | 3.7.4 | 4.8.5 |
| Visual and mechanical inspection | Entire sample | 3.6 | 4.8.1 |
| Physical dimensions | Entire sample | 3.6 | 4.8.1 |
| Marking | Entire sample | 3.8 | 4.8.1 |
| Workmanship | Entire sample | 3.10 | 4.8.1 |
| Group II | | | |
| Corona extinction voltage 2/ | 1 | 3.7.5 | 4.8.6 |
| Characteristic impedance | 1 | 3.7.6 | 4.8.7 |
| Attenuation (insertion loss) 2/ | 2 | 3.7.7 | 4.8.8 |
| Structural return loss 2/ | 2 | 3.7.8 | 4.8.9 |
| Capacitance 2/ | 1 | 3.7.9 | 4.8.10 |
| Capacitance stability 2/ | 1 | 3.7.10 | 4.8.11 |
| Capacitance unbalance 3/ | 1 | 3.7.11 | 4.8.12 |
| Transmission unbalance 3/ | 1 | 3.7.12 | 4.8.13 |
| Mechanically induced noise voltage 4/ | 1 | 3.7.13 | 4.9.14 |
| Time delay 2/ | 2 | 3.7.14 | 4.8.15 |
| Aging stability 5/ | 4 | 3.7.15 | 4.8.16 |
| Stress-crack resistance 2/ | 4 | 3.7.16 | 4.8 17 |
| Outer conductor integrity 6/ | 4 | 3.7.17 | 4.8.18 |
| Cold bend 9/ | 4 | 3.7.18 | 4.8.19 |
| Dimensional stability 7/ | 1 | 3.7.19 | 4.8.20 |
| Contamination 8/ | 1 | 3.7.20 | 4.8.21 |
| Bendability 6/ | 2 | 3.7.21 | 4.8.22 |
| Flammability 2/ | 1 | 3.7.22 | 4.8.23 |
| Flame propagation 2/ | 1 | 3.7.23 | 4.8.25 |
| Acid gas generation 10/ | 1 | 3.7.24 | 4.8.26 |
| Halogen content 10/ | 1 | 3.7.25 | 4.8.27 |
| Immersion 10/ | 1 | 3.7.26 | 4.8.28 |
| Smoke index 10/ | 1 | 3.7.27 | 4.8.29 |
| Toxicity index 10/ | 1 | 3.7.28 | 4.8.30 |
| Durometer 10/ | 1 | 3.7.29 | 4.8.31 |
| Weathering 10/ | 1 | 3.7.30 | 4.8.32 |
| Abrasion resistance 10/ | 1 | 3.7.31 | 4.8.33 |
| Tear strength 10/ | 1 | 3.7.32 | 4.8.34 |
| Heat distortion 10/ | 1 | 3.7.33 | 4.8.35 |
| Physicals (aged) 10/ | 1 | 3.7.34 | 4.8.36 |
| Tensile strength and elongation 10/ | 1 | 3.7.35 | 4.8.37 |
| Shrinkage 10/ | 1 | 3.7.36 | 4.8.38 |
| Weight | 1 | 3.9 | 4.8.24 |

1/ Not applicable to solid types A and F dielectric cores.
2/ When specified.
3/ Applicable to two-conductor cables.
4/ Applicable to low noise cables.
5/ Not applicable to semirigid or cables with type IX jackets.
6/ Applicable to semirigid cables.
7/ Not applicable to time delay or braided inner conductor cables.
8/ Applicable to type IIa jackets.
9/ Not applicable to semirigid cables.
10/ Applicable to type XIV, polyolefin jacketed cables only."

PAGE 15

TABLE V, add the following:

"

| Inspection | Requirement paragraph | Method paragraph | AQL (percent defective) |
|---|---|---|---|
| Adhesion of conductors | 3.6.4 | 4.8.1.4 | 1 |
| Eccentricity of inner conductor | 3.6.3 | 4.8.1.3 | 1 |

"

TABLE VI, add the following:

"

| Inspection | Requirement paragraph | Method paragraph | AQL (percent defective) |
|---|---|---|---|
| Tear strength 1/ | 3.7.32 | 4.8.34 | 4 |

"

PAGE 16

TABLE VII, add the following:

"

| Inspection | Requirement paragraph | Method paragraph |
|---|---|---|
| Heat distortion 2/ | 3.7.33 | 4.8.35 |
| Tensile strength and elongation 2/ | 3.7.35 | 4.8.37 |
| Physicals (aged) | 3.7.34 | 4.8.36 |
| Shrinkage 2/ | 3.7.36 | 4.8.38 |

"

PAGE 19

4.8.1.4.1, add the following paragraph:

"c. When semirigid cables are tested in accordance with the preceding procedure and the conductor-to-core bond is not broken at the specified maximum force (see 3.1), the test shall be repeated with additional specimens and the following modifications:

(1) The length of the outer conductor section (see figure 1B), shall be 1.00 inch ±.12 inch (25.4 ±3.05 mm), in lieu of 6.00 ±.50 inches (152.40 ±12.70 mm).

(2) The force grip (see figure 2B) shall be applied to the core in lieu of the inner conductor.

(3) Conductor adhesion shall not exceed the specified maximum value (see 3.1)."

PAGE 20

4.8.4c, delete and substitute:

"c. For two-conductor cables. The test voltage shall be applied individually between each inner conductor and the outer conductor with the outer conductor and the other inner conductor grounded."

PAGE 25

TABLE IX, step 3, Type A dielectric °C temperature: Delete "+40 ±2" and substitute "-40 ±2".

PAGE 30

4.8.16.1, line 3: Delete "125 ±1 feet times" and substitute "125 ±1 times". Also, line 4: Delete "95 ±1 feet times" and substitute "95 ±1 times".

PAGE 31

4.8.17.2, first sentence, delete and substitute: "Clamp one end of each specimen to a mandrel whose diameter is three times the nominal jacket diameter of the cable unless otherwise specified (see 3.1). Wrap each specimen for 10 turns around the mandrel and clamp the specimen to the mandrel at this point."

PAGE 32

4.8.19.1a(2), last sentence, delete and substitute: "For those cables that have been previously subjected to the aging stability and stress-crack resistance tests, the test temperature shall be -35°C ±2°C."

PAGE 35

Add the following paragraphs:

"4.8.25 Flame propagation (see 3.7.23). This test determines the relative ability of grouped cable to resist the propagation of fire along its length.

"4.8.25.1 Specimen. Each specimen shall consist of a piece of completed cable which shall have a length of not less than 8 feet. The total number of specimens required shall be as specified in the vertical tray flame test of IEEE-STD-383.

"4.8.25.2 Special apparatus. The apparatus shall include all equipment specified in the vertical tray flame test of IEEE-STD-383.

"4.8.25.3 Procedure. The specimens shall be tested as specified in the vertical tray flame test of IEEE-STD-383.

"4.8.25.4 Observation. Specimen failure shall be construed when any portion of any specimen burns to the top of the tray, either during or after operation of the ribbon burner. The following information (which does not constitute failure criteria) shall additionally be reported to help expand a performance data base: Flame temperature, period of time between burner shutoff and cessation of flame on the specimen, overall distance of specimen jacket damage above the burner, overall distance of specimen conductor damage above the burner, and a brief description of any dripping or flaming material which falls from the specimen to the floor during the test.

"4.8.26 Acid gas generation. The method given below is to determine the total emission of any strong soluble acids (pH less than 3). The required apparatus is shown on figure 10. A weighed sample of the jacket, and insulation materials (for component wire, use insulation removed from a 22 AWG wire), normally 1/4 to 1/2 gram, shall be placed in a silica boat which is put into the center of a silica tube, length 50/60 centimeters and internal diameter 20/22 millimeters. The materials shall be tested individually. The silica tube shall be placed in the tube furnace. An air supply, derived from a blower or compressed air

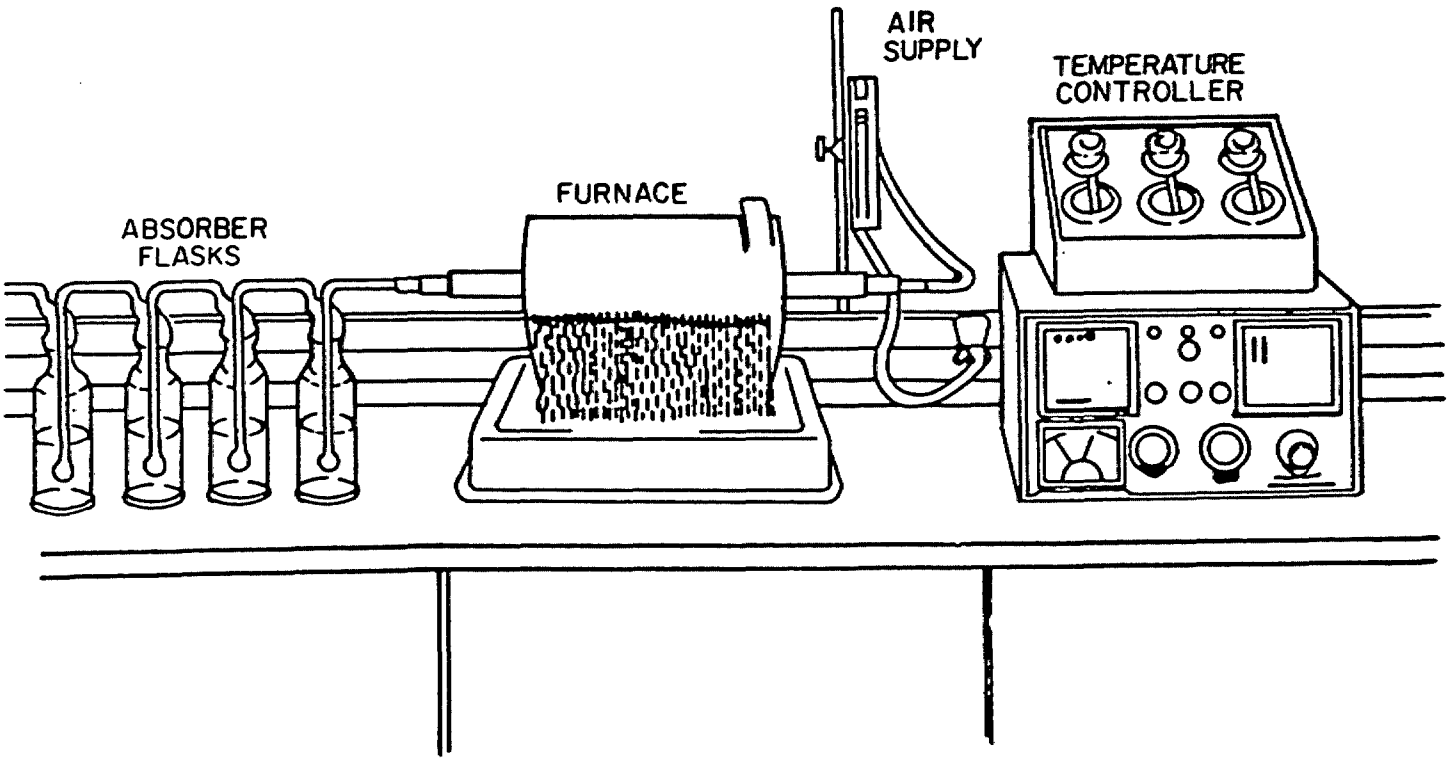


FIGURE 10. Acid gas test apparatus.

cylinder, at the rate of 1 liter per minute plus or minus 5 pecent shall be passed through the silica tube and then through four absorber flasks each containing 30 milliliters of deionized water. The furnace heating shall be commenced and the temperature of the tube and sample shall be raised to 800 ±10°C over a period of approximately 40 minutes and then held at temperature for a further 20 minutes. During the heating period, any acid gases produced will be carried over into the absorber flasks. On completion of the heating cycle, the acid content of the fluids in the absorber flasks shall be titrated against 0.1 N sodium hydroxide solution using congo red as an indicator. The total titre indicates the total soluble acids. 1.0 mL of 0.1 N sodium hydroxide solution is equivalent to 3.65 mg of acid expressed as 'acid equivalent relative to hydrochloric acid'.

"4.8.26.1 Observation. Specimen failure shall be construed if the acid equivalent exceeds the percentage, by weight of the sample, specified (see 3.1).

"4.8.27 Halogen content. The halogen content of the cable jacket or fillers shall be determined by X-ray fluorescence or analytically following an examination and analyses of the chemical composition of all ingredients used.

"4.8.27.1 Observation. Specimen failure shall be construed if the halogen content is greater than that specified (see 3.1).

"4.8.28 Immersion tests. Specimens of the cable jacket material shall be immersed in the fluids shown in table XIII for 24 hours at the temperatures specified. The specimens shall then be removed, blotted to remove excess fluid, then suspended in air at room temperature for not less than 3 1/2 nor more than 4 1/2 hours. Each specimen shall be tested as specified in 4.8.37.

"4.8.28.1 Observation. Any of the following shall construe specimen failure:

a. A specimen tensile strength which is less than that specified (see 3.1).

b. A specimen elongation which is less than that specified (see 3.1).

c. There shall be no evidence of cracks, flaws, or other damage to the jacket material.

TABLE XIII. Immersion test temperatures.

| Fluid | Test temperature |
|---|---|
| Fuel oil, MIL-F-16884 | 98 to 100°C |
| Turbine fuel, JP-4, MIL-T-5624 | 48 to 50°C |
| Turbine fuel, JP-5, MIL-T-5624 | 48 to 50°C |
| Cleaner, isopropyl alcohol, TT-I-735 | 20 to 25°C |
| Hydraulic fluid, MIL-H-5606 | 48 to 50°C |
| Hydraulic fluid, MIL-H-17672 | 48 to 50°C |
| Lubricating oil, MIL-L-23699 | 98 to 100°C |
| Lubricating oil, MIL-L-24467 | 98 to 100°C |
| Coolant, Monsanto Coolanol 25 or equivalent | 20 to 25°C |

"4.8.29 Smoke index. The smoke index shall be measured as specified in NES 711 except the specimens for test shall be as follows:

a. Jacket: Each specimen shall consist of a sufficient number of 75 mm long strips cut from the cable jacket to completely cover the face area of the sample holder. To prevent excessive buckling and distortion of the specimen during test, a wire mesh, manufactured from 1.0 mm diameter stainless steel wire with a spacing of 12.5 mm and a square mesh configuration, shall be placed inside and across the face of the sample holder. The specimen shall be fabricated by placing the specimen holder

(with wire mesh) test face down onto a flat surface and positioning each 75 mm length in the holder in a parallel arrangement so that when the holder is in the test position the strips will be vertical. An insulating block 10 mm thick completely wrapped in aluminum foil shall be placed on top of the strips followed by a tension spring and locking pin.

b. Insulation: The test specimen shall be a 1-meter length of 22 AWG finished wire.

c. Fillers (when applicable): The test specimen shall be 3 by 3 inches of 0.070 inch thick block of the same material used in the cable.

"4.8.29.1 Observation. Specimen failure shall be construed if any smoke index is greater than that specified (see 3.1).

"4.8.30 Toxicity index. The toxicity index shall be determined as specified in NES 713. For insulation materials, the toxicity index shall be calculated on the mass of insulation on 1-meter length of finished wire size 22 AWG with a 0.5 mm wall thickness of insulation. For jacket and filler materials, the toxicity index shall be calculated on 100 grams of material. (The toxicity index is derived from the chemical analysis of the products of combustion of the materials.)

"4.8.30.1 Observation. Specimen failure shall be construed if any toxicity index is greater than that specified (see 3.1).

"4.8.31 Durometer hardness. This test shall be to determine whether or not jacketing material exhibit sufficient hardness (see 4.8.31.4) for use in cable construction.

"4.8.31.1 Specimen. The specimen shall consist of a block of material, of the dimensions specified in ASTM D-2240, which shall have been cured in effectively the same manner as when used in cable manufacture.

"4.8.31.2 Special apparatus. Apparatus shall include a type A or type D durometer, as specified (see 3.1), which shall be in accordance with ASTM D-2240.

"4.8.31.3 Procedure. The specimen shall be tested in accordance with ASTM D-2240.

"4.8.31.4 Observation. Specimen failure shall be construed if the specimen exhibits a durometer hardness other than that specified (see 3.1).

"4.8.32 Weathering. Jacket material shall be tested in accordance with ASTM D-2565. The following conditions shall apply:

Xenon arc lamp
6500 Watt
Borosilicate glass filters
Irradiance: 1.75 w/m$^2$ .nm at 500 nm
Exposure: Arc lamp on: 18 hours
Black panel temperature 50 ±2°C
Relative humidity 50 ±2 percent
(for 18 minutes every 2 hours, water is sprayed onto specimen)
Arc lamp off: 6 hours
Temperature 25 ±2°C
Relative humidity 90-95 percent
Total exposure time: 1000 hours.

"4.8.32.1 Observation. Specimen failure shall be construed if the tensile strength and elongation retention is less than 75 percent or if the specimen surface exhibits signs of cracking when examined using 3X magnification.

"4.8.33 Abrasion resistance. Abrasion resistance of cable jacket material shall be determined as specified in 4.8.33.1 through 4.8.33.4.

"4.8.33.1 Specimen. Cable jacket: One cable jacket test specimen shall be prepared by extruding material onto a 16 AWG (19/29) conductor. The material shall be manufactured using process conditions as close as possible to those used to produce the overall cable jacket and shall have an overall diameter of 0.119 plus 0.001, minus 0.000 inch.

"4.8.33.2 Special apparatus. Apparatus shall include the following:

a. Abrading machine: A cylinder, which incorporates two abrading elements on its surface, which is motor driven to rotate about a horizontal axis at 17 plus 3, minus 2 revolutions per minute (r/min) and over which the specimen is draped, as shown on figures 11 and 12, and as described below:

(1) Each abrading element shall consist of 5/16 inch square, high-speed tool bit (Cleveland Twist Drill Company number 855 or its equivalent) which has been ground on two adjacent, longitudinal sides to produce a single, sharp 90 degree longitudinal edge, free of visible nicks. A medium grade grinding wheel (Norton Company Number 39C6018VK or its equivalent) shall be used for this grinding. Abrading elements shall be reground as required; in no case shall an abrading element be used in excess of 5 hours without regrinding. Whenever the perpendicular distance between either pair of opposite longitudinal sides of an abrading element becomes less than 0.3085 inch (as by repeated regrinding) then that abrading element shall be discarded and replaced.

(2) The cylinder shall be 8 ±1/8 inches in diameter and shall be rigidly fabricated from metal.

(3) Each of the two abrading elements shall be maintained in electrical contact with the metal cylinder by securing each in a notch cut into the cylinder surface, parallel to the cylinder axis; the two notches required shall be spaced 180 ±2 degrees apart around the circumference of the cylinder. These notches shall be cut such that the sharpened 90 degree longitudinal edge of each element shall be facing outward from the cylinder surface, and such that the midpoint of a straight line drawn between the two longitudinal edges adjacent to the sharpened edge is tangential plus or minus 0.003 inch to the cylinder surface.

(4) An automatic counter shall be provided to totalize the number of times that the specimen is scraped by abrading elements during the test.

(5) A 1 pound ±0.5 ounce weight shall be provided for applying tension to the specimen.

b. Short circuit monitor: A voltage source of not less than 12 V (either direct current (dc) or root mean square (rms) alternating current (ac) which can be applied between the specimen shield and both abrading elements of the abrading machine as shown on figure 11. (The connection to the abrasion elements may be provided by a wiping contact on the cylinder.) A means (such as an electrical relay) shall be provided whereby an electrical connection between either abrading element and the specimen conductor shall automatically stop rotation of the cylinder on the abrading machine (as by removing motor power).

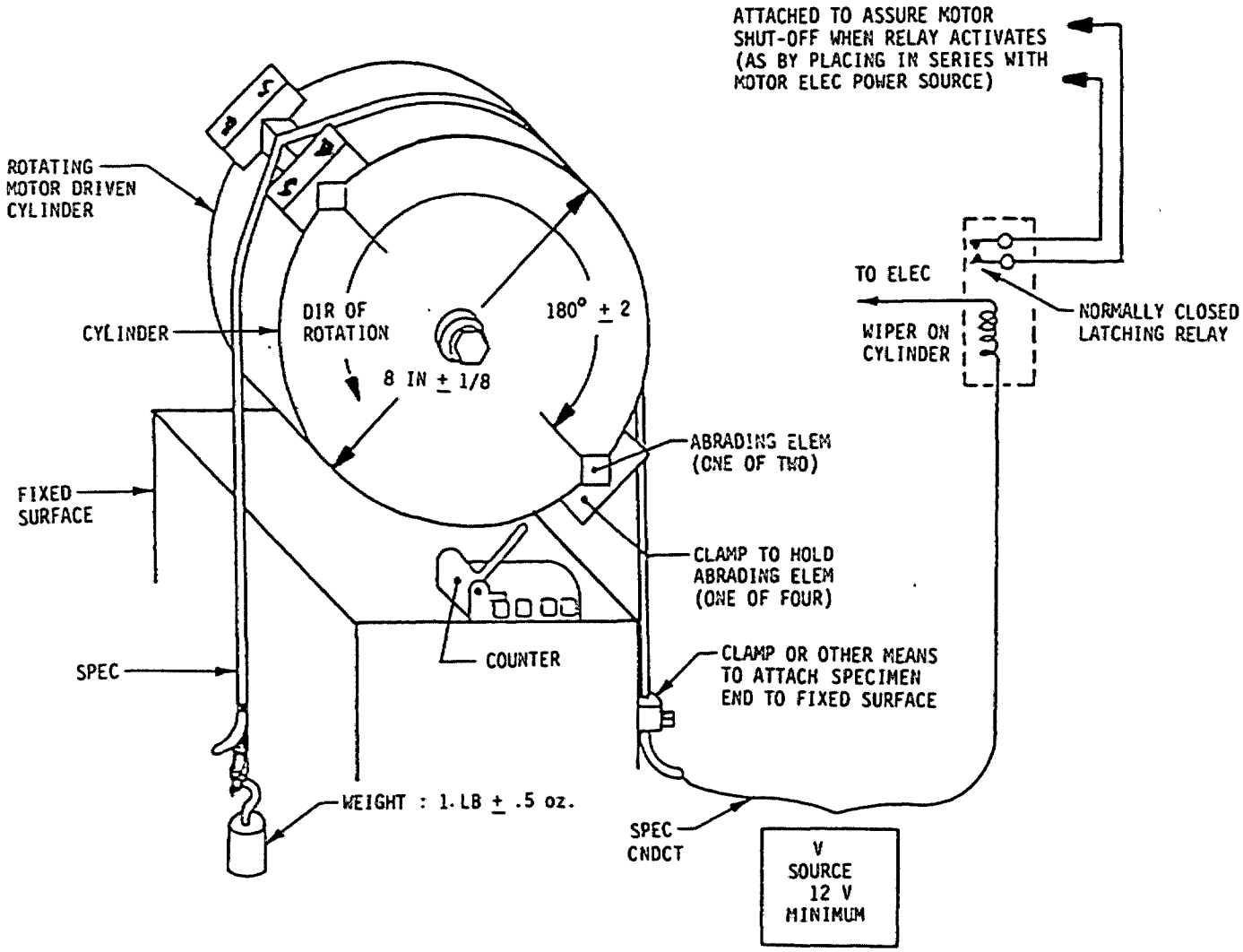


FIGURE 11. Diagram of abrading machine for the abrasion resistance test.

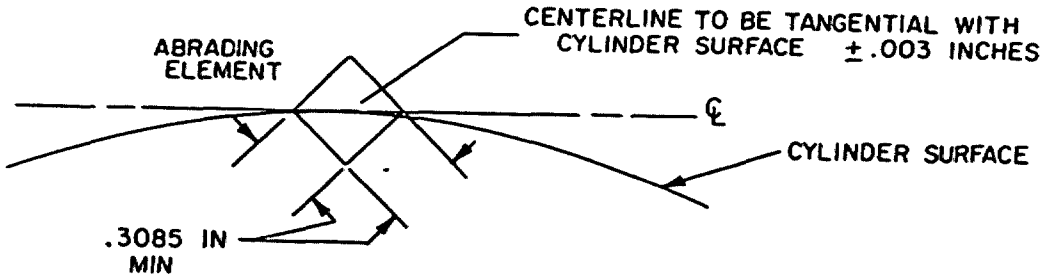


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FIGURE 12. Detail diagram of abrading element fit on cylinder surface.

"4.8.33.3 Procedure. Specimens shall be wiped with a clean, dry cloth to remove any lubricant or dirt. Each specimen shall then be tested (either simultaneously or one at a time) as follows. Each specimen shall be hung circumferentially over the cylinder of the abrading machine, such that each specimen shall form an arc of not less than 170 degrees around the cylinder for the remainder of the test. One end of each specimen shall then be secured to a fixed surface. The abrading machine weight shall be attached to the opposite specimen end, such that both this specimen end and the weight shall be freely suspended. The automatic counter shall be set initially to zero, and the short circuit monitor shall be applied between both abrading elements on the abrading machine and the conductor of each specimen. The cylinder motor shall then be turned on, allowing the cylinder to rotate beneath each specimen, from secured end to weighted end.

"4.8.33.4 Observation. Specimen failure shall be construed if electrical contact occurs between either abrading element and any specimen conductor (as evidenced by cessation of cylinder rotation) prior to completing the specified number of abrasive scrapes (see 3.1).

"4.8.34 Tear strength. This test shall determine the ability of elastomeric jacketing material to withstand the propagation of a cut passing through a portion of its length.

"4.8.34.1 Specimen. Each specimen shall consist of a piece of jacketing material, which shall have been cut to the dimensions specified in ASTM D-470. Specimens shall be removed from completed cable. Not fewer than five specimens shall be required.

"4.8.34.2 Special apparatus. Apparatus shall include the following:

a. A micrometer with flat, parallel measurement surfaces on both spindle and anvil, which shall be for the specimen measurements as specified in 4.8.34 and which shall exhibit a measurement error of not more than plus or minus 0.001 inch.

b. A motor driven tensile machine which shall be for applying increasing tension to the specimen, and which shall automatically indicate within plus or minus 1 percent the maximim tension experienced by the specimen prior to tearing. This tensile machine shall incorporate two parallel and opposing jaws, between which the specimen can be secured, as specified in 4.8.34.3. The two jaws shall increase their separation at the uniform rate of 20 ±2 inches per minute by means of the tensile machine motor.

"4.8.34.3 Procedure. The specimen shall be tested in accordance with ASTM D-470.

"4.8.34.4 Observation. Specimen failure shall be construed if the median value of the measured tear strengths of all specimens is less than that specified (see 3.1).

"4.8.35 Heat distortion. This test shall determine the ability of the jacket material to resist physical deformation when subjected to an elevated temperature.

"4.8.35.1 Specimen. Each specimen shall be removed from completed cable in accordance with 4.8.35.1.2.

"4.8.35.1.2 Cable jacket. Each specimen shall consist of a piece of jacketing that has been removed from a finished cable and cut to form a rectangular strip. This strip shall be not less than 7/8 inch long nor less than 9/16 ±1/16 inch wide, and shall be ground and buffed to a thickness of 0.050 ±0.010 inch with a grinding apparatus (see 4.8.35.2b). The thickness of this specimen shall be made as uniform as practicable.

"4.8.35.2 Special apparatus. Apparatus shall include the following:

a. A self-standing thickness gauge, for supporting the requirements as specified in 4.8.35.3, which shall exhibit a measurement error of not more than plus or minus 0.001 inch. This gauge shall incorporate a flat horizontal platen upon which an entire specimen shall be laid flat during measurement, and shall incorporate a foot which rests upon the top of the specimen during measurement. This foot shall be attached to a plunger which moves freely in the vertical direction, and which is attached to a dial or other indicating device from which the specimen thickness may be read. The foot shall present a horizontal disk of 3/8 plus 0, minus 1/64 inch diameter to the specimen, shall bear down upon the specimen with a force of 85 plus 0, minus 4 grams and shall be loaded with weights (see 4.8.35.3) to present additional force to the specimen.

b. A motor driven grinding wheel and a motor driven buffing wheel, or their equal, for the specimen preparation as specified in 4.8.35.1.2. Guides shall be provided to assure that the specimen is pulled tangentially to the surface of each wheel during grinding and buffing.

c. An oven, for accommodating the gauge with specimen inserted and for supporting the requirements as specified in 4.8.35.3. The oven air temperature shall be measured in the immediate vicinity of the specimen.

"4.8.35.3 Procedure. The initial jacket material thickness of each specimen (T in formula below) shall be determined (see a below) and the oven shall be preheated to 121 ±1°C. This oven temperature shall be maintained for the remainder of the test. The gauge foot shall then be loaded with weights (see b below) and the gauge placed within the oven. Not less than 1 hour later, one specimen shall be selected and also placed within the oven. Not less than 1 hour after placing the specimen within the oven, the specimen shall be placed beneath the gauge foot such that the gauge indicates the specimen thickness. Not less than 1 hour after placing the specimen beneath the gauge foot, the final specimen thickness or diameter (as appropriate) shall be read from the gauge and the final insulation thickness (t in formula below) determined (see c below). In an identical manner, the remaining specimens shall also be tested. The percentage heat distortion of the jacket material shall then be calculated by using the following formula:

Percentage heat distortion = Median value of 100(T-t)/T for all tested specimens.

Where: T = Initial jacket material thickness of the specimen, in thousandths of an inch (see a below).
t = Final jacket material thickness of the specimen, in thousandths of an inch (see a below).

The following additional details apply: (Rectangular strip specimens).

a. The initial jacket material thickness (T) shall be the initial specimen thickness, as measured with the gauge, prior to loading the gauge with weights and prior to inserting either the gauge or the specimen into the oven.

b. The gauge foot shall be loaded with 2000 ±100 grams.

c. The final jacket material thickness (t) shall be the final specimen thickness, measured as specified.

"4.8.35.4 Observation. The specimen shall be considered to have failed the test if the percentage heat distortion is greater than that specified on the applicable specification sheet.

"4.8.36 Physical tests on aged jacket. This test shall determine whether or not various jacketing materials have been properly processed, by means of tensile measurements. This test makes provision for making tensile measurements both before and after these materials have been artificially aged.

"4.8.36.1 Specimens. Each specimen shall consist of a single piece of jacketing, which shall have sufficient length for use in the tests as specified in 4.8.37, as specified (see 3.1). Specimens shall be removed from completed cable.

"4.8.36.2 Special apparatus. Apparatus shall include the following:

a. A forced-fresh-air circulating oven for supporting the requirements as specified in 4.8.36.3a). The oven air temperature shall be measured in the immediate vicinity of the specimens.

b. A heated container, which shall be filled with lubricating oil in accordance with symbol number 2190 TEP of MIL-L-17331, and which shall be for the specimen immersion as specified in 4.8.36.3b. The oil shall be maintained at a temperature of 121 ±1°C during specimen immersion.

"4.8.36.3 Procedure. Specimens shall be maintained at ambient temperature for a period of not less than 30 minutes immediately prior to any accelerated aging or testing. Each of the specified accelerated aging procedures shall be performed as follows, using one specimen for each procedure. The same specimen shall not be used for more than one procedure. Each of the specified tests shall be performed as specified in 4.8.37.

a. Air oven accelerated aging: Each specimen shall be freely suspended vertically, secured by one end, within the oven. The air temperature within the oven shall then be raised to the value specified in table XIV, and shall be maintained at this value for a continuous period of not less than that specified in table XIV. Each specimen shall then be removed from the oven and tested as specified in 4.8.37.

b. Hot-oil immersion accelerated aging: Each specimen shall be submerged within the hot oil bath for a continuous period of not less than that specified in table XIV. Each specimen shall then be removed from the hot oil bath, blotted lightly to remove excessive oil and then suspended in air, to ambient room temperature, for 4 ±1/2 hours. Each specimen shall then be tested as specified in 4.8.37.

"4.8.36.4 Observation. Any of the following shall constitute specimen failure:

a. A specimen tensile strength which is less than that specified (see 3.1).

b. A specimen elongation which is less than that specified (see 3.1).

"4.8.37 Tensile strength and elongation. Both aged and unaged specimens of the insulation and jacket material shall be tested in accordance with methods 3021 and 3031 of FED-STD-228. Unless otherwise specified on the applicable specification sheet, there shall be 1-inch bench marks, 1-inch jaw separation, and a rate of jaw travel of 10 inches per minute. The thickness of the specimen shall be measured using any suitable micrometer.

"4.8.37.1 Observation. Specimen failure shall be construed if the tensile strength and elongation retention is less than that specified herein or in the applicable specification sheet.

TABLE XIV. Details for accelerated aging procedures.

| Specimen material | Procedure | Temperature (°C) | Minimum period (hours) |
|---|---|---|---|
| Jacketing specimen: | | | |
| Cross-linked polyolefin | Air oven | 136 ±2 | 168 |
| | Hot-oil immersion | 121 ±1 | 18 |

"4.8.38 Shrinkage. A 12-inch specimen of cable shall be cut so that all components are flush at both ends. Unless otherwise specified in the applicable specification sheet, the specimen shall then be aged at 136 ±3°C for 6 hours in an air-circulating oven. At the end of this period, the specimen shall be removed from the oven and allowed to cool to room temperature. Shrinkage of the jacket shall then be measured to determine the total distance the jacket has receded from both ends of the conductor.

"4.8.38.1 Observation. Specimen failure shall be construed if the total shrinkage of the jacket is greater than 0.25 inch.

"4.8.39 Jacket flaws. One hundred percent of all finished cables with overall shields shall be passed through a chain electrode spark test device using 3.0 kV rms (minimum) and a frequency of 50 or 60 Hz. The conductor, or shield as applicable, shall be grounded at one or both ends. The electrode shall be of a suitable bead chain or fine mesh construction that will give intimate metallic contact with practically all the insulation surface. Electrode length and speed of specimen movement shall be such that the insulation is subjected to the test voltage for a minimum of 0.2 second.

"4.8.39.1 Observation. Specimen failure shall be construed if jacket material exhibits any sign of deformation or damage."

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30, 30.1, delete and substitute:

"30. EXTENT OF QUALIFICATION

"30.1 Group qualification. The cable types listed in column 3 of table XV are eligible for group qualification. The groups are based on similar characteristics and requirements. At the discretion of the Government, qualification may be extended to cover any or all cable types in a group, based on compliance of one cable type in that group with the qualification inspection. The Government reserves the right to authorize performance of any or all qualification inspection on additional types in the group that are considered necessary to the extension of qualification within each group. Cable types not included in these groups are not eligible for group qualification. Group qualification will be granted final acceptance contingent upon receipt of successful retention of qualification data for individual cables within 2 years.

TABLE XV. Group qualification. 1/ 2/ 3/

| Group | Submission and qualification of any of the following cable types | Qualifies the following cable types |
|---|---|---|
| I | M17/84-RG223 | M17/167-00001 |
| II | M17/60-RG142 | M17/111-RG303, M17/158-00001, M17/170-00001 |
| III | M17/67-RG177 | M17/79-RG218, M17/78-RG217, M17/160-00001, M17/165-00001, M17/166-00001 |
| IV | M17/137-00001 | M17/139-00001 |
| V | M17/65-RG165 | M17/86-00001, M17/159-00001 |

See footnotes at end of table.

TABLE XV. Group qualification - Continued.

| Group | Submission and qualification of any of the following cable types | Qualifies the following cable types |
|---|---|---|
| VI | M17/152-00001 | M17/113-RG316 |
| VII | M17/131-RG403 | M17/93-RG178, M17/169-00001 |
| VIII | M17/28-RG058 | M17/155-00001 |
| IX | M17/52-RG119 | M17/156-00001 |
| X | M17/54-RG122 | M17/157-00001 |
| XI | M17/72-RG211 | M17/161-00001 |
| XII | M17/73-RG212 | M17/162-00001 |
| XIII | M17/74-RG213 | M17/74-RG215, M17/163-00001 |
| XIV | M17/75-RG214 | M17/164-00001 |
| XV | M17/92-RG115 | M17/168-00001 |
| XVI | M17/112-RG304 | M17/171-00001 |
| XVII | M17/119-RG174 | M17/173-00001 |
| XVIII | M17/127-RG393 | M17/174-00001 |
| XIX | M17/128-RG400 | M17/175-00001 |
| XX | M17/93-RG178 | M17/169-00001 |

1/ Swept cables automatically qualify their nonswept counterpart (i.e., M17/28-RG058 qualifies M17/155-00001).

2/ Qualification of an unarmored cable automatically qualifies its armored version, when requested by the manufacturer.

3/ Qualification of any semi-rigid cable in a series described by a single detail specification sheet automatically qualifies any other version in the same series, when requested by the manufacturer."

Review activity:
Navy - SH

User activities:
Navy - AS, MC, OS

Preparing activity:
Navy - EC

Agent:
DLA - ES

(Project 6145-N327)