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REFER TO

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July 28, 2004

MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: Initial Draft of MIL-DTL-3849 and MIL-DTL-3849/11, Cord, Electrical (TINSEL) project numbers 6145-2373-000 and 6145-2386-000.

The initial drafts of these documents, dated 21 July 2004, are now available for viewing and downloading from the DSCC-VA Web site:

<http://www.dsccl.dla.mil/Programs/MilSpec/DocSearch.asp>

These documents are being revised to replace cancelled references with their industry equivalents. In addition, MIL-DTL-3849 has an appendix added to replace the cancelled MIL-I-3930 requirements for SBR rubber.

Concurrence or comments are required at this Center within 60 days from the date of this letter. Late comments will be held for the next coordination of the document. Comments from military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians or this office, as applicable, in sufficient time to allow for consolidating departmental replies.

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NOTE: This draft, dated 21 July 2004 prepared by DLA-CC, has not been approved and is subject to modification. DO NOT USE PRIOR TO APPROVAL. (PROJECT 6145-2373-000)

INCH-POUND

MIL-DTL-3849C
NOT DATED
SUPERSEDING
MIL-C-3849B
21 February 1973

DETAIL SPECIFICATION
CORD, ELECTRICAL (TINSEL)

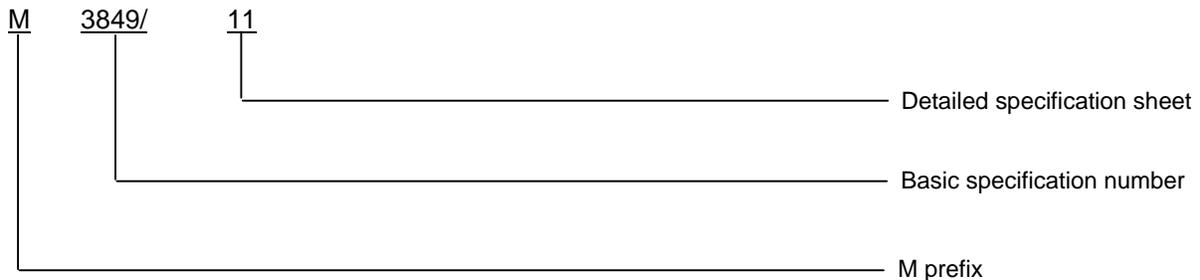
Inactive for new design after 7 October 1991

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers tinsel cords of various constructions, suitable for use with telephones, switchboards, microphones, and associated equipment under varying atmospheric conditions.

1.2.1 Part or identifying number (PIN). The PIN consists of the letter M, the basic specification number, a forward slash, and a detail specification number (see 3.1) as shown in the following example:



1.2 Classification. Cords covered by this specification shall be of the styles specified (see 3.1 and 6.2).

Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, Attn: VAI, 3990 East Broad Street, Columbus, Ohio, 43216-5000 or emailed to <mailto:WireCable@dsc.c.dla.mil>. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto cited in the solicitation (see 6.2).

FEDERAL STANDARDS

FED-STD-228 - Cable and Wire, Insulated; Methods of Testing

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-572 - Cord, Yarns and Monofilaments Organic Synthetic Fiber
MIL-W-3795 - Wire, Electrical (Tinsel)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-104 - Limits for Electrical Insulation Color

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

NCSL Z540.1 - Laboratories Calibration and Measuring and Test Equipment

(Copies of these documents are available online at www.ncsli.org/ or National Conference of Standards Laboratories (NCSL), 2995 Wilderness Place Suite 107, Boulder, CO 80301-5404).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1. Specification Sheets. The requirements for the individual cords under this specification shall be as specified herein and in accordance with the applicable military specification sheets. In the event of a discrepancy between this specification and the requirements of the applicable military specification sheet, the latter shall govern (see 6.2).

3.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Materials. Materials shall be as specified herein. When a material is not specified, the best material commercially available for the purpose shall be used. Substitute materials may be used only upon prior approval by the qualifying activity. However, such approval shall not be construed as a guaranty of acceptance of the finished product.

3.3.1 Tinsel wire. All uninsulated tinsel wire shall be in accordance with MIL-W-3795, type I, II, or V, as specified on the applicable specification sheet (see 3.1).

3.3.2 Fibers and yarns. All synthetic fibers and yarns employed as separators, fillers, binders, staycords, and braids shall be as specified herein.

3.3.2.1 Separator. Each tinsel conductor, prior to insulating, shall be closely covered with a separator yarn. The yarn shall be in accordance with MIL-C-572 and shall be of the following types:

- a. Polyester, type PSTR
- b. Cellulose acetate, type AR
- c. Polyamide, type P

NOTE: Vegetable and sulfonated oils shall not be applied as a lubricant to the textile yarns used in or in contact with the tinsel conductors.

3.3.2.2 Fillers and binders. Fillers shall be used between insulated conductors to form an essentially circular cross-section core and to provide slippage between the insulated conductors. Binders shall be applied over the cabled tinsel wire conductors as specified on the applicable specification sheets (see 3.1). Filler and binder yarn shall be either polypropylene yarn or one of the following yarns in accordance with MIL-C-572; polyamide type P, or polyester type PSTR.

3.3.2.3 Staycords. Each staycords shall consist of ply yarn, one or more braids, or yarn covered by braid. Each staycord shall meet the requirements of 3.7.1.1. The yarn shall in accordance with MIL-C-572 and shall be one of the following types:

- a. Polyamide, type P.
- b. Cellulose acetate, type AR.
- c. Cellulose triacetate, type CTA.

3.3.2.4 Outer braid. The outer braid shall be fabricated from polyamide, type P in accordance with MIL-C-572. The color of the braid shall be as specified (see 6.2).

3.3.3 Insulation. The compounds used for insulation shall be of the types specified in the applicable specification sheets (see 3.1).

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3.3.3.1 Insulation wall thickness. The minimum wall thickness of the insulation shall be specified in the applicable specification sheets (see 3.1).

3.3.3.2 Diameter of insulated conductors. The diameter of each insulated conductor shall be as follows:

<u>Tinsel wire (type, MIL-W-3795)</u>	<u>Diameter of insulated conductor inches (mm)</u>
I	.071 to .081 (1.80 to 2.06 mm)
II	.070 to .076 (1.78 to 1.93 mm)
V	.024 to .028 (0.61 to 0.71)

3.3.3.3 Insulation color coding. The color of the insulation shall be in accordance with MIL-STD-104. The color coding of the individual insulated conductors in a core complement shall be in the following sequence:

<u>Conductor number</u>	<u>Color</u>
1	Black
2	White
3	Red
4	Green
5	Orange

3.3.4 Jacket. The compounds used for jacketing shall be of the types specified on the applicable specification sheets (see 3.1). The jacket shall be black unless other wise specified (see 6.2). The jacket shall be smooth and free of surface irregularities.

3.3.4.1 Jacket wall thickness. The jacket wall thickness shall be as specified on the applicable specification sheet (see 3.1).

3.4 Outside diameter (cable). The outside diameter of the finished cable shall be as specified on the applicable specification sheet (see 3.1).

3.5 Finished cords. The finished cords shall be in accordance with the requirements of this specification and the applicable specification sheet (see 3.1).

3.6 Electrical requirements.

3.6.1 Dielectric withstanding voltage. The insulated conductors shall withstand, without breakdown, an applied voltage of 500 volts DC (350 volts AC rms), when tested as specified in 4.6.2.1.

3.6.2 Insulation resistance. Immediately after the insulated conductors have been subjected to the dielectric withstanding voltage test, the insulation resistance shall be measured as specified in 4.6.2.2. The insulation resistance of each insulated conductor shall be not less than the value specified on the applicable specification sheet (see 3.1).

3.6.3 Continuity. Each conductor of the finished cord shall be continuous when tested as specified in 4.6.2.3.

3.6.4 DC resistance. The DC resistance of each tinsel wire conductor in the finished cords shall not exceed the values specified in table I when tested as specified in 4.6.2.4.

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TABLE I. DC resistance.

Wire type	DC resistance per foot (ohms)
I	.28
II	.25
V	.26

3.7 Physical requirements.

3.7.1 Breaking load. The breaking load of the finished cable shall be not less than the value specified on the applicable specification sheet (see 3.1), when tested as specified in 4.6.3.1.

3.7.1.1 Staycord breaking load (see 3.3.2.3). The breaking load of staycords shall be not less than 40 pounds (18.14 kg), when tested as specified in 4.6.3.1. The diameter shall be approximately the same as that of the insulated tinsel wire conductors in the cord. The staycords shall not abrade or otherwise damage the insulation when the cord is bent or stretched.

3.7.2 Cold bend. The insulation of braided cable, consisting of the wire insulation and jacket of jacketed cable, shall not exhibit any evidence of cracks, flaws, or other damage when tested as specified in 4.6.3.2.

3.7.3 Sea-water resistance. When specified on the applicable specification sheet (see 3.1), the finished cord shall be tested for sea-water resistance as specified in 4.6.3.3. The weight change of the cord shall be not more than 5 milligrams per square inch (25.4 mm) of wetted surface, and there shall be no evidence of chemical reaction or other deleterious effects to the jacket when visually examined.

3.8 Workmanship. The tinsel wire used in manufacturing the cable shall not have any broken strands. The cable shall not have any missing tinsel wire. The wire insulation and cable jacket shall not have nicks, rips, cuts, peeled surfaces, and any imperfections that can affect performance. The insulation and jacket shall be uniform in shape and free of kinks. The jacket shall be properly centered over the tinsel wire.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Materials inspection (see 4.4).
- b. Conformance inspection (see 4.5).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspections shall be used. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NCSL Z540-1 or equivalent.

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4.3 Test conditions. Unless otherwise specified in the applicable test method, inspections shall be conducted under the following environmental conditions.

- a. Temperature: 15 °C to 35 °C.
- b. Pressure: Normal atmospheric.
- c. Humidity: Prevailing ambient (25 to 90 percent relative).

4.4 Materials inspection (see 3.3). Materials inspection shall consist of certification supported by verifying data that the materials listed in table II, used in fabricating the designated cord type classes (see 3.1 and 3.3), are in accordance with the applicable referenced specification or requirements. Materials inspections shall be performed prior to such fabrication.

TABLE II. Materials inspection.

Material	Requirement paragraph	Applicable specification
Tinsel wire	3.3.1	MIL-W-3795
Separators	3.3.2.1	MIL-C-572
Fillers and binders	3.3.2.2	MIL-C-572
Staycords	3.3.2.3	MIL-C-572
Outer braid	3.3.2.4	MIL-C-572
Insulation	3.3.3	Slash sheet
Jacket	3.3.4	Slash sheet

4.5 Conformance inspection. Conformance inspection shall consist of Group A (see 4.5.2) and Group B (see 4.5.3) inspections, and shall be performed on every lot of cord procured under this specification (see 4.5.4.1).

4.5.2 Group A inspection. Group A inspection shall consist of the inspections specified in table III. Group A inspection may be performed at an appropriate stage of the manufacturing operation rather than on the finished cord.

TABLE III. Group A inspection.

Inspection	Requirement	Verification paragraph
Materials	3.3	4.4
Visual and dimensional	3.1, 3.8	4.6.1
Workmanship	3.8	4.6.1
Construction	3.1	4.6.1
Insulation wall thickness	3.3.3.1	4.6.1
Diameter of insulated conductors	3.3.3.2	4.6.1
Insulation color coding	3.3.3.3	4.6.1
Jacket wall thickness	3.3.4.1	4.6.1
Outside diameter (cable)	3.4	4.6.1
Electrical		
Dielectric withstanding voltage	3.6.1	4.6.2.1
Insulation resistance	3.6.2	4.6.2.2
Continuity	3.6.3	4.6.2.3
DC resistance	3.6.4	4.6.2.4

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4.5.3 Group B inspection. Group B inspection shall consist of the inspections in table IV conducted on a sampling basis in accordance with 4.5.4.1.

Table IV. Group B inspection.

Inspection	Requirement	Verification
Breaking load	3.7.1, 3.7.1.1	4.6.3.1
Staycord breaking load	3.7.1.1	4.6.3.1
Cold bend Visual examination	3.7.2	4.6.3.2
Sea-water resistance Visual examination	3.7.3	4.6.3.3

4.5.4 Sampling.

4.5.4.1 Lot. A lot shall consist of all cable of a single cable designation offered for inspection at one time, except that the lot shall not exceed 1,000,000 feet or one week's production, whichever is less. The lot size shall be expressed in units of thousands of feet (total footage in lot divided by 1,000).

4.5.4.2 Sample. A sample shall consist of individual lengths of cable chosen at random from any one lot for the purpose of inspection or test. The sample size or number of lengths to be chosen from each lot shall be determined by the sampling plan.

4.5.4.3 Specimen length. Unless otherwise specified herein, the specimen shall be of the length specified in the applicable test method.

4.5.4.4 Sample unit. A sample unit shall consist of one of the individual lengths of the sample.

4.5.4.5 Specimen. A specimen shall consist of the portion of one sample unit upon which a particular inspection or test is to be made.

4.5.5 Rejected lot. Failure of a lot to pass any test or inspection constitutes failure of the lot and the lot shall be rejected. If an inspection lot is rejected, the contractor may rework the lot to correct the defects, or screen out the defective units and resubmit the lot for re-inspection. Such lots shall be separated from new lots and shall be identified as re-inspected lots.

4.5.6 Non compliance. If a sample fails to pass Group B inspection (see 4.5.3), the contractor shall notify the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, on all units of the product. Acceptance and shipment of the product shall be discontinued until corrective action has been taken. After the corrective action has been taken, sampling inspection shall be repeated on replacement articles. (This includes all tests and examinations, or only the test that the original sample failed, at the option of the cognizant inspection activity.) Final acceptance and shipment will be withheld until Group B inspection has shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure shall be provided to the cognizant inspection activity.

4.6 Methods of inspection.

4.6.1 Visual and dimensional inspection. The finished cords shall be given a visual and dimensional inspection for conformance with applicable requirements of 3.1, 3.8 and table III.

4.6.2 Electrical inspections.

4.6.2.1 Dielectric withstanding voltage (DWV (see 3.6.1)). The finished cords shall be tested as specified in FED-STD-228, method 6111, and shall meet the requirements of 3.6.1. The following exceptions shall apply:

- a. The test shall be performed on finished cords only.
- b. The immersion period shall be not less than 9 hours.
- c. One terminal shall be each conductor in turn, and the other terminal shall be all the remaining conductors tied together in electrical contact with the water.
- d. Immediately after the DWV test the insulation resistance shall be measured as specified in 3.6.2

4.6.2.2 Insulation resistance (see 3.6.2). The insulation resistance of the finished cords shall be determined as specified in FED-STD-228, method 6031, and shall meet the requirements of 3.6.2. The following exceptions shall apply:

- a. The test shall be performed on finished cords only.
- b. The immersion period shall be not less than 9 hours.
- c. The test voltage shall be not less than 500 volts dc.
- d. The polarity of the conductor shall be maintained negative with respect to the water.
- e. One terminal shall be each conductor in turn. The other terminal shall be all the remaining conductors tied together in electrical contact with the water.
- f. If measurements are made at a temperature other than 15.6° C, the measured insulation resistance values shall be corrected to 15.6° C.

4.6.2.3 Continuity (see 3.6.3). Each conductor of the finished cord shall be tested for continuity using a maximum test voltage of 10 volts, and shall meet the requirements of 3.6.3.

4.6.2.4 DC resistance (see 3.6.4). The DC resistance of each conductor shall be determined in accordance with FED-STD-228, method 6021 and shall meet the requirements of 3.6.4.

4.6.3 Physical inspections.

4.6.3.1 Breaking load (see 3.7.1 or 3.7.1.1). The finished cords shall be tested as specified in FED-STD-228, method 3211 and shall meet the requirements of 3.7.1 or 3.7.1.1 as applicable. The following exceptions shall apply:

- a. Each test specimen shall be the whole cable.
- b. Each specimen shall be 1 foot in length, cut from the sample unit.
- c. The test specimens shall be subjected to the tensile strength test only.
- d. The breaking load of the test specimens shall meet the requirements of 3.7.1 or 3.7.1.1 as applicable.

4.6.3.2 Cold bend (see 3.7.2). Each specimen for the cold bend test shall be divided into two parts, one for checking the finished (jacketed) cord as a whole, and the other for checking the insulated conductors apart from the finished cord. After completion of the cold bend tests specified in 4.6.3.2.1 and 4.6.3.2.2, the jacketed specimens and the insulated conductor specimens shall meet the requirements cold bend test specified in 3.7.2.

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4.6.3.2.1 Cold bend (Jacketed cord) (see 3.7.2). The specimens selected for checking the cord as a whole shall be attached to the proper size mandrel, as specified in table VI and tested as follows:

TABLE VI. Mandrel sizes for cold bend tests.

Outside diameter of specimen in inches (mm)	Outside diameter of mandrel in inches (mm)
0.000 to 0.090 (0.00 to 2.29 mm)	.0625 (15.88)
0.091 to 0.125 (3.31 to 3.18 mm)	.09375 (2.38)
0.126 to 0.180 (3.20 to 4.57 mm)	.125 (3.18)
0.181 to 0.240 (4.60 to 6.10 mm)	.25 (6.35)
0.241 to 0.300 (6.12 to 7.62 mm)	.375 (9.53)
0.301 to 0.360 (7.65 to 9.14 mm)	.500 (12.70)

- a. The specimens shall be suspended vertically with lower ends weighted sufficiently to keep specimens taut and to permit bending them without handling.
- b. The mandrels and specimens shall be placed in the cold chamber for at least 20 hours at the temperature specified on the applicable specification sheet (see 3.1).
- c. While at this temperature, the specimens shall be bent for 5 close turns around the mandrel at the rate of approximately 1 turn per second.
- d. After the test has been completed, the jacket shall be examined through a magnifying glass of at least 3X magnification for cracks, flaws, or other damage.
- e. The jacket shall then be removed, and the insulation beneath the jacket shall be examined as specified in step d above.

4.6.3.2.2 Cold bend (insulated conductors) (see 3.7.2). The specimens selected for checking the insulation apart from the cord shall have the jacket (or braid) removed, and each insulated tinsel wire conductor shall be tested and examined in accordance with the procedures specified in 4.6.3.2.1.

4.6.3.3 Sea-water resistance (see 3.7.3). After exposure to a salt water solution the specimens shall meet the requirements of 3.7.3. The following details shall apply:

- a. One specimen from each sample unit, at least 3 feet (0.91 m) in length, shall be weighed and the weight recorded.
- b. The specimen shall then be immersed in a salt-water solution composed of distilled water and a 3.5 percent solution of sodium chloride for a period of 10 days at room temperature.
- c. After removal from the solution, each specimen shall be wiped clean and weighed again to determine weight change before and after immersion.
- d. The specimens shall also be examined for evidence of chemical reaction or other deleterious effects.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Controls Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The cords covered by this specification are intended for low-voltage, audio-frequency use, where extreme flexibility is required. These cords are primarily for use with telephones, switchboards, microphones, and associated communications equipments. The cables covered by this specification are militarily unique because of requirements to survive salt water submersion, sea-water resistance (weight change of the cord), and bend at -40°C . Commercial electronic cable components are not designed to withstand these extreme conditions or sudden environmental changes, and would experience catastrophic failure.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Title, number and date of applicable specification sheet (see 3.1).
- c. Class and style of cord, and number of tinsel wire conductors required (see 3.1).
- d. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1, 2.3 and appendix A).
- e. Color code of outer braid, if applicable (see 3.1 and 3.3.2.4).
- f. Color code of jacket, if other than black (see 3.3.4).
- g. Length and quantity of finished cords to be delivered.
- h. Packaging requirements (see 5.1). The cords should be furnished on spools, in spool or reel-type packages, or on reels.

6.3 Subject term (key word) listing.

Telephones
 Switchboards
 Microphones
 Polyamide
 Polyester
 Cellulose acetate
 Polypropylene
 Cellulose triacetate

6.4 Definitions

- Binder - Thread spirally wound with a long lay and low pickage.
- Lay - The length measured along the axis of a wire or cable required for a single conductor (in cable) to make one complete turn about the axis of the cable.
- Tinsel wire - A low voltage stranded wire with each strand consisting of a very thin conductor; metallic conductor is spirally wrapped around a flexible textile yarn or plastic core.

6.5 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table VII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

Table VII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1, - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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APPENDIX

A.1. SCOPE

A.1 Scope. This appendix details the test requirements for medium-low temperature styrene-butadiene rubber (SBR) insulating compounds. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 SBR Insulating compounds.

A.2.1 Ozone-protective wax. SBR compounds shall incorporate an "ozone protective" wax to protect the insulation and jacket against cracking due to exposure. SBR insulating compounds shall contain not less than 4 parts by weight of ozone protective wax per 100 parts by weight of base rubber-polymer when tested in accordance with ASTM D297.

A.2.2 Free elemental sulfur. Rubber latex and rubber latex-chloroprene rubber latex compounds shall not contain more than .5 percent free elemental sulfur, natural rubber compounds not more than .1 percent free elemental sulfur, and styrene-butadiene rubber compounds and ethylene-propylene-diene rubber compounds not more than .25 percent free elemental sulfur.

A.2.3 Free elemental sulfur. Free elemental sulfur content shall be determined in accordance with method 16211 of FED-STD-601, except that where greater sensitivity is required, a .01 iodine solution shall be used and the blue end point shall last 3 to 4 seconds.

A.3 Physical properties. Physical property requirements shall be as specified in table A1.

Table A1. Physical property requirements.

Test	Examination	Test method paragraph
<u>Unaged:</u> Tensile strength, minimum Elongation, minimum percent of original Set, maximum	1600 psi 300% .375 inch (9.53 mm)	A.4 A.5 A.6
After 95 ± ½ hour oxygen bomb aging at 70°C Tensile strength, minimum Elongation, minimum percent of original	75 psi 65%	A.7 A.4 A.5
<u>Ozone resistance (after air-oven conditioning) and 168 ± 1 hour in ozone:</u> At 38°C	No visible cracks	A.8
<u>Brittleness temperature:</u> Unaged Aged	-40°C Max -40°C Max	A.9 A.9.d (1)
<u>Cold tension recovery:</u> At -40°C	20% minimum	A.10

A.3.1 Condition and age. Specimens shall not be heated, immersed in water, or subjected to any mechanical or chemical treatment not specified herein. No tests shall be made within 24 hours after manufacture unless agreed to by the manufacturer.

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A.3.2 Calculation of percent change in values. The calculation of percent change in tensile strength, elongation, etc., after specified conditioning or aging period shall be made for each individual specimen. When unaged specimens are destroyed during testing, the basis for percent change shall be the arithmetic mean (average) value of the unaged specimens, which meet the qualifying value.

A.4 Tensile stress. Apparatus and procedure shall be as specified in method 3041 of FED-STD-228. Tensile strength shall be determined in accordance with method 3021 of FED-STD-228, except that flat, smooth, steel grips of the self-aligning type may be used.

A.4.1 Sample size. For a conductor smaller than AWG size 6, the insulation test specimen may be an entire section of the insulation, 6.000 inches long. When the full cross section is used, the specimen shall not be cut longitudinally unless necessary to remove the conductor. The preferred specimen of the jacket is a 6.000 inches (152.4 mm) length with a die-cut reduced section 2.313 inches (58.75 mm) long by .250 inches (6.35 mm) wide. Gage marks shall be applied before conditioning.

A.5 Elongation. Elongation shall be determined in accordance with method 3030 of FED-STD-228, except that bench marks shall be 2 inches (50.8 mm) apart, and flat, smooth, steel grips of the self-aligning type may be used. The elongation after aging shall be based on the bench marks applied before aging.

A.6 Set. Set shall be determined in accordance with method 3161 of FED-STD-228, the following details shall apply:

- a. Bench marks shall be 2 inches (50.8 mm) apart.
- b. The test specimens shall be stretched so that the distance between bench marks is 6 inches (152 mm); They shall then be released within 5 seconds.
- c. Set shall be determined 1 minute after the beginning of the release.
- d. Flat, smooth, steel grips of the self-aligning type may be used.

A.7 Oxygen bomb aging. Specimens shall be subjected to oxygen-bomb aging requirements specified in FED-STD-228, method 4011. The required conditions of time and temperature shall be as specified in table A1. Specimens of insulation shall remain on the wire during aging.

A.8 Ozone resistance. The test for ozone resistance shall be performed in accordance with the procedures prescribed in ASTM D1149 except as indicated below for ozone concentration and test temperature. After testing in accordance with A.4, the rubber test specimen shall exhibit no visible cracks when examined under a seven power optical magnifier.

A.8.1 Test specimens. The test specimen shall be a length of completed cable for jacket evaluation or a length of insulated wire taken from a completed cable. Not less than six specimens each of jacketed cable and six specimens each of all color insulation shall be tested (see A.8.2).

A.8.2 Specimens. Specimens shall be taken from each sample length (see A.8.3). The number of specimens specified in the applicable test method shall be prepared as described therein from the jacket and from the insulation of each conductor. For small runs of cable or cord where only one basic solid color insulation is used and coding is accomplished by striping, lettering, numbering, or a non-adhering tape or braid, each conductor need not be tested. At least one shielded conductor and one unshielded conductor (as applicable) from each layer of the cable core shall be tested; the applicability of this provision for reduced number of conductors to be tested shall be as determined by the contracting officer. The shield shall be removed from the shielded conductor prior to subsection to test conditions and tests.

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A.8.3 Selection of sample units. The number of sample units required for inspection shall be chosen by selecting one spool, reel, or coil for each sample unit. Samples shall be selected at random intervals throughout the lot. After which the selected spool, reel, or coil shall be treated as the sample unit for purposes of inspection.

A.8.4 Preparation. The length of the specimen shall be sufficient for at least five turns on the appropriate mandrel as listed below plus fastening to the mandrel; three turns may be used for cables greater than one inch in diameter. Shielding, separators, and braid shall be removed from the insulated wire specimens.

A.8.5 Conditioning of specimens. Samples of the cable from which specimens are to be taken shall be maintained at room temperature for at least one week prior to preparation of specimens. One set of specimens (minimum of three specimens of jacket and three specimens of each color insulation) shall then be air-oven aged in an unstressed condition for 70 +1/2 hours at 70°C and then kept at room temperature at least four days prior to ozone exposure. The second set (consisting of a minimum of three each jacket and three of each insulation color) shall be exposed to ozone as required without oven conditioning. Each specimen shall be wrapped around a mandrel of diameter indicated in table A2 and exposed thus in the ozone chamber.

TABLE A2. Mandrel diameter.

Specimen diameter (Inch)	Mandrel diameter
Up to .500	4 X cable OD
.501 to .750	5 X cable OD
.751 to 1.250	6 X cable OD
1.251 to 1.750	8 X cable OD
1.751 and over	10 X cable OD

A.8.6 Chamber environment. The ozone concentration used in this test shall be 50 ± 3 parts of ozone per 100,000,000 parts of air. The temperature shall be as specified in the applicable specification sheet.

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A.9 Brittleness.

a. Apparatus. The test apparatus shall conform to Method 5311 or Method 5321 of FED-STD-601, with air as the heat transfer medium. If the instrument specified in Method 5321 is used, no more than one specimen shall be tested at one time.

b. Specimens:

- (1). Unless otherwise specifically authorized, test specimens shall be cut from samples of cord or cable to obtain specimens .080 inch (2.03 mm) wide, 1.500 inches (38.10 mm) long with .250 inch (6.35 mm) square stubs at each end (T-50 specimens). The thickness of specimens shall be .075, +.010 /-.035 inch (19.05, +2.54/ -0.89 mm). The specimens shall be cut with a sharp die.
- (2). Specimens conforming to ASTM D746 may be used.

c. Number of specimens. Four jacket specimens and four specimens of each color of insulation shall be cut from the sample unit.

d. Procedure:

- (1). Two specimens shall be air-oven aged for a minimum of 48 hours at $71^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and allowed to cool at room temperature prior to conditioning at sub-zero temperatures.
- (2). The aged and unaged specimens shall be conditioned in the low temperature cabinet for a period of 7 days at a temperature of $-55^{\circ}\text{C} \pm 1^{\circ}\text{C}$.
- (3). The test apparatus shall be conditioned for not less than 2 hours at the applicable temperature specified in table A1. The test shall be conducted while the tester and specimens are at the same temperature.
- (4). After the impact blow is delivered, specimens shall be examined.

e. Failure of the test is considered to have occurred if fractures or cracks result.

A.10 Cold tension recovery.

a. Apparatus. The test instrument shall consist of a measuring board on which several devices can be mounted. Each stretching device shall have one movable clamp and one fixed clamp. The board shall have lines engraved at intervals corresponding to each 10 percent stretch, based on the length of the specimen between the .250 inch square (6.35 mm) stubs.

b. Specimens.

c. Description. Specimens shall be as described in A.9.b.1. The following exceptions may apply:

- (1) A tube specimen as specified in method 3021 of FED-STD-228 for insulation on conductors AWG sizes 16 and 18.
- (2) A modified T-50 specimen .125 inch (3.18 mm) wide by 1.500 inch (38.10 mm) long with .250 inch-square (6.35 mm) stub for insulation on all other conductor sizes, and for all jacket stocks.
- (3) Specimens prescribed in A.9.b.1 cut from sheets may be used in lieu of specimens cut from insulation or jackets if the minimum allowed thickness of the insulation of jacket is less than .040 inch. The following details shall apply:

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- (a) Molded sheets of .075 to .085 inch (1.91 to 2.16 mm) thick may be furnished for certain tests of small size cables.
 - (b) The stock of these sheets shall be taken from the same batch as the insulation or jacket that they represent (preferably uncured rubber for these sheets will be taken from the feed to the extruder and record kept of the cable produced from that run).
 - (c) The sheets shall be at the same state of cure as the insulation or jacket that they represent. The state of cure shall be considered the same if the tensile stress of the sheet at 200 percent elongation is within 20 percent of that of the insulation or jacket it represents.
 - (d) The sheets shall be marked to show the direction of calendar or mill grain.
- d. Number of specimens. Three jacket specimens and three specimens of each type of insulation shall be cut from the sample unit. Specimens shall be taken from each sample length (see A.8.3).
- e. Procedure.
- (1) With the specimens at temperatures specified in table A1, they shall be clamped in the stretching devices along the edges of the studs adjacent to the linear part of the specimen and laid on the board. The movable clamp shall be pulled back until the 1.500 inch (38.10 mm) long portion of the specimen has been stretched to 100-percent elongation, and fixed in that position.
 - (2) The stretching devices and the specimens shall be conditioned in the low-temperature chamber for 7 days at the temperature specified in the applicable specification sheet. The measuring board shall be conditioned for not less than 2 hours at the same temperature.
 - (3) With the test instrument and specimens still in the low-temperature chamber, the movable clamp shall be released from its fixed position, and the assembly shall be conditioned for an additional period of 30 minutes at the low temperature specified in table A1.
 - (4) The final length of the specimen shall be determined with the board stretching devices, and specimens held at a 15° angle from the vertical.
 - (5) The cold-tension-recovery percentage for each specimen shall be calculated.
- f. Calculation. The percentage of cold-tension-recovery shall be computed from the formula:

Percentage cold-tension-recovery

$$= \frac{(L_S - L_F) \times 100}{(L_S - L_O)}$$

Where:

L_S = Stretched length of specimen.

L_F = Final length of specimen.

L_O = Initial length of specimen.

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A.2. APPLICABLE DOCUMENTS

FEDERAL STANDARDS

FED-STD-228	-	Cable and Wire, Insulated; Methods of Testing
FED-STD-601	-	Rubber: Sampling and Testing

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://www.dodssp.daps.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

A.2.1 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM D297	-	Standard Test Methods for Rubber Products - Chemical Analysis
ASTM D746	-	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1149	-	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber

(Copies of these documents are available from <http://www.astm.org/> or ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959.)

A.3 Order of precedence. In the event of a conflict between the text of this appendix and the references cited herein (except for related specification sheets), the text of this appendix takes precedence. Nothing in this appendix, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

A.3 Order of precedence. In the event of a conflict between the text of this appendix and the references cited herein, the text of this appendix shall take precedence.

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CONCLUDING MATERIAL

Custodians:

Army - CR
Navy - SH
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 6145-2373-000)

Review activities:

Army - AR
Navy - MC, MS, SA, YD2
Air Force - 80

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