

MIL-I-7444D

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~~SUPERSEDING~~

MIL-I-7444C

22 December 1964

## MILITARY SPECIFICATION

## INSULATION SLEEVING, ELECTRICAL, FLEXIBLE

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

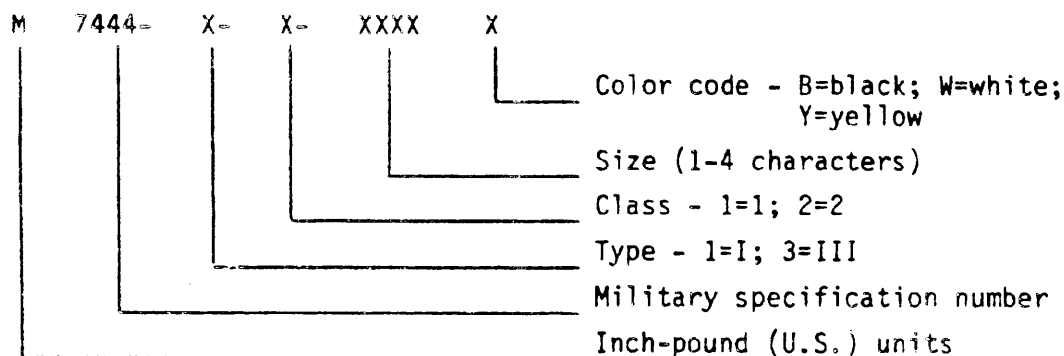
## 1. SCOPE

1.1 Scope. This specification covers flexible extruded, vinyl plastic tubing.

1.2 Classification. The insulation sleeving (tubing) shall be of the following types and classes, as specified:

- Type I - Clear (colorless).
- Type III - Colored black, white, or yellow.
- Class 1 - Cold brittle point at -90°F (-67.8°C) and flame resistance of 45 seconds.
- Class 2 - Cold brittle point at -67°F (-55°C) and flame resistance of 15 seconds.

1.3 Part numbers. Part numbers to identify the insulation sleeving shall be formatted as shown below.



Example: M7444-3-1-7/16Y

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AFWAL/MLSE, Wright-Patterson AFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## FEDERAL

QQ-A-250/4	-	Aluminum Alloy 2024, Plate and Sheet.
QQ-C-576	-	Copper Flat Products with Slit, Slit and Edged-Rolled, Sheared, Sawed or Machined Edges (Plate, Bar, Sheet, and Strip).
TT-S-735	-	Standard Test Fluids, Hydrocarbon.
PPP-B-585	-	Box, Wood, Wirebound.
PPP-B-591	-	Boxes, Shipping, Fiberboard, Wood-Cleated.
PPP-B-601	-	Boxes, Wood, Cleated-Plywood.
PPP-B-621	-	Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636	-	Boxes, Shipping, Fiberboard.
PPP-T-76	-	Tape, Pressure-Sensitive Adhesive, Packaging/Paper (for Carton Sealing).

## MILITARY

MIL-P-116	-	Preservation, Methods of.
MIL-L-10547	-	Liner, Case, and Sheet, Overwrap, Water Vaporproof or Waterproof, Flexible.

## STANDARDS

## MILITARY

MIL-STD-104	-	Limits for Electrical Insulation Color.
MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	-	Marking for Shipment and Storage.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

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2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 412	-	Rubber Properties in Tension, Test Methods for.
ASTM D 746	-	Brittleness Temperature of Plastics and Elastomers by Impact, Test Method for.
ASTM D 792	-	Specific Gravity and Density of Plastics By Displacement, Test Methods for.
ASTM D 876	-	Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation, Testing.
ASTM D 3767	-	Rubber - Measurement of Dimensions, Practice for.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

#### UNIFORM CLASSIFICATION COMMITTEE AGENT

##### Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

### 3. REQUIREMENTS

3.1 Preproduction. This specification provides for preproduction inspection (see 4.3 and 6.2).

3.2 Data. Unless otherwise specified in the contract or order, no data (other than reports accompanying preproduction samples) are required by this specification or any of the documents referenced in section 2, herein (see 6.2).

3.3 Material. The material shall be a vinyl chloride or vinyl chloride acetate copolymer. The material shall be homogeneous, free from flaws, defects, pinholes, bubbles, seams, cracks, or inclusions.

3.4 Dimensions. The dimensions and tolerances of the tubing shall be in accordance with table I.

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TABLE 1. Inside diameters and wall thicknesses of tubing.

Size No. AWG	Inside diameter (inches)			Wall thickness (inches)		
	Nominal	Minimum	Maximum	Minimum	Maximum	Nominal
24	0.022	0.020	0.027	0.010	0.014	0.012
22	.027	.025	.032	.010	.014	.012
20	.034	.032	.039	.013	.019	.016
19	.038	.036	.044	.013	.019	.016
18	.042	.040	.049	.013	.019	.016
17	.047	.045	.054	.013	.019	.016
16	.053	.051	.061	.013	.019	.016
15	.059	.057	.067	.013	.019	.016
14	.066	.064	.072	.013	.019	.016
13	.076	.072	.080	.013	.019	.016
12	.085	.081	.089	.013	.019	.016
11	.095	.091	.101	.013	.019	.016
10	.106	.102	.112	.013	.019	.016
9	.118	.114	.124	.017	.023	.020
8	.133	.129	.141	.017	.023	.020
7	.148	.144	.158	.017	.023	.020
6	.166	.162	.178	.017	.023	.020
5	.186	.182	.198	.017	.023	.020
4	.208	.204	.224	.017	.023	.020
3	.234	.229	.249	.017	.023	.020
2	.263	.258	.275	.017	.023	.020
1	.294	.289	.311	.017	.023	.020
0	.330	.325	.347	.017	.023	.020
Inches						
5/16		.313	.334	.022	.028	.025
3/8		.375	.399	.022	.028	.025
7/16		.438	.462	.022	.028	.025
1/2		.500	.524	.022	.028	.025
9/16		.562	.592	.025	.035	.030
5/8		.625	.655	.025	.035	.030
3/4		.750	.786	.030	.040	.035
7/8		.875	.911	.030	.040	.035
1.0		1.000	1.036	.030	.040	.035
1 1/4		1.250	1.290	.035	.045	.040
1 1/2		1.500	1.550	.039	.051	.045
1 3/4		1.750	1.812	.047	.063	.055
2.0		2.000	2.070	.050	.070	.060
2 1/4		2.250	2.330	.055	.075	.065
2 1/2		2.500	2.590	.060	.080	.070

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3.5 Length and put-up. The tubing shall be evenly wound in a non-returnable manner (spools or rolls) in lengths not less than 100 feet for tubing under 1 inch and not less than 50 feet for tubing in sizes 1 inch and over. The tubing shall not exceed 3 pieces for 100 feet lengths and shall not exceed 2 pieces for 50 feet lengths.

### 3.6 Color.

3.6.1 Type I. Type I tubing shall be clear (colorless). The tubing shall not be color tinted more than the No. 2 glass of the Hellige Color Comparator when tested in accordance with 4.6.1.

3.6.2 Type III. The color of type III tubing shall conform to class 1 of MIL-STD-104 and shall be black, white, or yellow.

3.7 Tensile strength. When tested in accordance with 4.6.2, the original tensile strength of the tubing shall be not less than 1,800 pounds per square inch. When tested in accordance with 4.6.2.1, the tensile strength of tubing aged for 168 hours at  $158 \pm 2^\circ\text{F}$  ( $70 \pm 1.1^\circ\text{C}$ ) shall be within  $\pm 15$  percent of the original.

3.8 Ultimate elongation. When tested in accordance with 4.6.3, the original ultimate elongation of the tubing shall be not less than 200 percent. When tested in accordance with 4.6.3.1, the ultimate elongation of tubing aged for 168 hours at  $158 \pm 2^\circ\text{F}$  ( $70 \pm 1.1^\circ\text{C}$ ) shall be within  $\pm 15$  percent of the ultimate elongation of the original (unaged) specimen.

3.9 Flame resistance. When tested in accordance with 4.6.4, the average duration of burning of the tubing shall not exceed 45 seconds for class 1, types I and III tubing and 15 seconds for class 2, types I and III tubing, and the paper indicator shall show no evidence of having been affected.

3.10 Brittle point. When tested as specified in 4.6.5, the original tubing and tubing aged for 168 hours at  $158 \pm 2^\circ\text{F}$  ( $70 \pm 1.1^\circ\text{C}$ ) shall not fail at  $-90 \pm 1.8^\circ\text{F}$  ( $-67.8 \pm 1^\circ\text{C}$ ) for class 1, types I and III tubing and  $-67 \pm 2^\circ\text{F}$  ( $-55 \pm 1.1^\circ\text{C}$ ) for class 2, types I and III tubing.

3.11 Corrosion. The tubing shall not accelerate corrosion of any metals with which it may come in contact (see 4.6.9).

3.12 Oil aging. When tested in accordance with 4.6.10, tubing aged in oil for eight hours at  $212 \pm 2^\circ\text{F}$  ( $100 \pm 1.1^\circ\text{C}$ ) shall neither be tacky nor show signs of decomposition, and when flexed shall neither crack nor split.

3.13 Fungus resistance. The tubing shall not support fungus growth and the fungicide shall not contain mercury (see 4.6.11).

3.14 Specific gravity. The specific gravity shall be a maximum of 1.45.

3.15 Dielectric strength. When tested in accordance with 4.6.7, the dielectric strength of the tubing shall be not less than 200 volts per mil.

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3.16 Wet dielectric strength. When tested in accordance with 4.6.8, the dielectric strength of the tubing immediately after water immersion shall be not less than 200 volts per mil and shall be within  $\pm 20$  percent of the original.

3.17 Marking. Each spool shall be durably and legibly marked with the following information, either upon each spool or on a durable tag securely fastened to each spool:

INSULATION SLEEVING, ELECTRICAL, FLEXIBLE  
Specification, MIL-I-74440  
Stock No.  
Part No.  
Length  
Contract No.

3.18 Workmanship. Workmanship shall be such as to enable the insulation sleeving to meet all applicable requirements of the specification when inspected in accordance with section 4.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection. The inspection of the tubing shall be classified as follows:

- a. Preproduction inspection (4.3).
- b. Quality conformance inspection (4.4).

#### 4.3 Preproduction inspection.

4.3.1 Preproduction sample. The preproduction sample shall consist of any size within the size range specified in 4.3.2 and table II.

TABLE II. Ranges of sizes for tubing.

Range	Number
24 AWG to 1/2 inch	I
9/16 inch to 1 1/2 inch	II
1 3/4 inch to 2 1/2 inch	III

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4.3.2 Preproduction tests. Preproduction tests are required for the size of tubing from each of the following:

Type I, class 1, range I	Type I, class 2, range I
Type I, class 1, range II	Type I, class 2, range II
Type I, class 1, range III	Type I, class 2, range III

Preproduction tests are not required for type III, colored, if there has been previous approval of a type I, colorless, tubing of the same class and range. A type III material should be a type I tubing with a color agent added.

4.3.3 Previous approval. The preproduction testing need not be repeated for new orders, provided the materials and processes have not been changed and a certified statement to this effect is furnished to the procuring activity. The test reports shall certify that material is in accordance with 3.3.

#### 4.4 Quality conformance inspection.

##### 4.4.1 Sampling for quality conformance inspection.

4.4.1.1 Lot. For purposes of sampling, an inspection lot for examination and tests shall consist of all tubing of the same type, class, size, and formulation submitted for acceptance and delivery at one time.

4.4.1.2 Sampling for examination of end item. For examination of the end item, sampling shall be in accordance with MIL-STD-105. Samples selected shall be examined as specified in 4.5.1.1 and 4.5.1.2.

- a. The unit of product for the examination specified in 4.5.1.1 shall be 1 linear foot and the lot size shall be expressed in units of 1 foot each. The sample size shall be in accordance with inspection level III of MIL-STD-105 and the acceptable quality level (AQL) shall be equal to 2.5 percent defective. An approximately equal number of feet shall be examined from each length (spool) of tubing selected.
- b. The unit of product for the examination specified in 4.5.1.2 shall be one spool. The spools examined shall be those spools from which the lengths for the samples specified in 4.4.1.2(a) were selected. The AQL shall be equal to 1.0 percent defective.

##### 4.4.2 Sampling for examination of preservation, packaging, packing, and marking.

4.4.2.1 Preservation and packaging. Sampling for preservation and packaging examination (see 4.5.2) shall be in accordance with the applicable portions of MIL-P-116.



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4.4.2.2 Packing and marking. Sampling for packing and marking examination (see 4.5.2) shall be in accordance with the applicable subsidiary specification specified herein or as specified by the procuring activity (see 6.2).

4.4.3 Sampling for end item tests. A minimum of five lengths of tubing at least 6 feet long shall be selected at random from each lot of tubing and subjected to the tests specified in table III. No more than one length shall be selected from any one spool and each of the specimens required for a given test shall be cut from a different length of tubing so as to be representative of the entire lot submitted for acceptance.

TABLE III. Quality conformance tests.

Property	Requirement reference	Test reference
Color (type I)	3.6.1	4.6.1
Tensile strength (original)	3.7	4.6.2
Ultimate elongation (original)	3.8	4.6.3
Flame resistance	3.9	4.6.4
Brittle point (original)	3.10	4.6.5
Specific gravity	3.14	4.6.6
Dielectric strength	3.15	4.6.7
Wet dielectric strength	3.16	4.6.8

4.4.3.1 Rejection. If the sample fails one or more of the tests specified in table III, the lot represented by the sample shall be rejected.

#### 4.5 Examinations.

##### 4.5.1 Examination of the end item.

4.5.1.1 Dimensions, tolerances, and workmanship. Samples selected in accordance with 4.4.1.2 and 4.4.1.2(a) shall be examined for conformance to the applicable dimensions and tolerances specified in 3.4 and workmanship as specified in 3.18. Type III tubing shall be examined for conformance to the color requirement specified in 3.6.2. MIL-STD-104 shall be used for this examination.

4.5.1.2 Length and marking. Samples selected in accordance with 4.4.1.2 and 4.4.1.2(b) shall be examined for conformance to 3.5 and 3.17.

4.5.2 Examination of preservation, packaging, packing, and marking. Samples selected in accordance with 4.4.2.1 and 4.4.2.2 shall be examined for conformance to section 5.

#### 4.6 Test methods.

4.6.1 Color (type I). The Hellige Color Comparator for varnishes shall be used; only the disk shall be used, not the viewer. The disk



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and a single thickness of tubing shall be placed side by side on a piece of white bond paper and compared visually under 4,500°K cool white fluorescent light. Three specimens shall be tested to determine conformance to 4.6.1.

4.6.2 Tensile strength (original). The tensile strength of three specimens of the original tubing shall be determined in accordance with ASTM D 412, except that the thickness of the specimens shall be measured in accordance with ASTM D 3767 (section 8.2, method A1), where applicable. The dumbbell-shaped specimens shall be cut with a No. VI die; if the tubing is too small for die cutting, the tubing shall be tested in full section.

4.6.2.1 Tensile strength after aging. The thickness of three specimens shall be measured and the specimens then aged in a convection oven for 168 hours at  $158^{\circ} \pm 2^{\circ}\text{F}$  ( $70^{\circ} \pm 1.1^{\circ}\text{C}$ ). The specimens shall be cooled at  $77^{\circ} \pm 2^{\circ}\text{F}$  ( $25^{\circ} \pm 1.1^{\circ}\text{C}$ ) for a period of 16 to 48 hours and subjected to the test specified in 4.6.2.

4.6.3 Ultimate elongation (original). The ultimate elongation of three specimens of the original tubing shall be determined in accordance with ASTM D 412.

4.6.3.1 Ultimate elongation after aging. Three specimens shall be aged and cooled as specified in 4.6.2.1 and then tested in accordance with 4.6.3.

#### 4.6.4 Flame resistance.

##### 4.6.4.1 Test apparatus.

4.6.4.1.1 Sheet-metal enclosure. A three-wall sheet-metal enclosure shall be used, measuring 12 inches wide by 14 inches long by 29 inches high. The two walls facing each other shall support two parallel horizontal steel rods. The two rods shall be one-fourth inch in diameter and shall be separated 16 to 21 inches, as required, with the lower rod closer to the back wall. The steel rods shall be so located that they define a plane which is set at an angle of 70 degrees to the horizontal.

4.6.4.1.2 Bare steel wire. A length of bare steel wire approximately 0.029 inch in diameter for all sizes of specimens shall be attached at one of its ends to the center of the upper rod. The other end of the wire shall pass over the center of the lower rod and shall have a 1-pound weight so attached that the wire is in a straight line across the two rods.

4.6.4.1.3 Tirrill burner. A Tirrill-type burner shall be used having a nominal bore of three-eighth inch and a length of approximately 4 inches above the primary outlets.

4.6.4.1.4 Gas supply. A supply of ordinary illuminating gas at normal pressure shall be available.

4.6.4.1.5 Timer. A timer measuring seconds shall be used.

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4.6.4.1.6 Flame indicators. Strips of gummed paper shall be used as flame indicators.

4.6.4.2 Test specimens. For tubing having an inside diameter of seven-eighth inch or less, five test specimens 17 inches long shall be cut from the sample. For tubing having an inside diameter of more than seven-eighth inch, five test specimens 20 inches long shall be cut from the sample.

4.6.4.3 Preparation of specimen and apparatus for test.

4.6.4.3.1 Round tubing. The specimen shall be drawn onto the wire and the covered wire fastened into position. The length of the wire shall be so adjusted that the weight hangs free and maintains such tension as to support the specimen in a straight line at an angle of 70 degrees to the horizontal. One end of the specimen shall be near the lower rod and the other end shall be drawn to the upper rod and closed by clamping to prevent a draft throughout the specimen. The paper indicator shall be applied to the upper end of the specimen as follows:

- a. For tubing seven-eighth inch and less in inside diameter, the lower edge of the paper indicator shall be 10 inches away from the point at which the inner cone of the test flame is to be applied.
- b. For tubing more than seven-eighth inch in inside diameter, the lower edge of the paper indicator shall be 15 inches away from the point at which the inner cone of the test flame is to be applied.

The indicator shall be wrapped and pasted around the specimen.

4.6.4.3.2 Flat tubing. The wire shall support the specimen by one of the two small curvatures found in flat tubing. The flats of the tubing shall be directed vertically downward. The distance of 1½ inches from burner to specimens (see 4.6.4.4) shall be between the tip of the stem and the surface of the narrow side of the flat specimen.

4.6.4.4 Application of flame (test procedure). The height of the flame with the burner in a vertical position shall be adjusted to 5 inches with an inner cone 1½ inches high. The burner shall be placed on a base at an angle of 25 degrees to the horizontal. The burner, on the base, shall be so positioned that there is a distance of 1½ inches between the tip of the stem and the surface of the specimen along the axis of the burner. The flame shall be applied to the surface of the specimen, not the end, for 15 seconds. The duration of burning upon removal of the flame shall be determined for compliance with 3.9.

4.6.5 Brittle point test. The low-temperature brittle point test shall be performed on original tubing and on tubing aged for 168 hours at 158° ±2°F (70° ±1.1°C). Size 7-AWG tubing and smaller tubing shall be tested in full section. Only motor-driven apparatus shall be used. The testing shall be in accordance with ASTM D 746, except as follows: Samples of the tubing shall be tested at -67°±2°F (-55° ±1.1°C) or -90°

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$\pm 1.8^{\circ}\text{F}$  ( $-67.8^{\circ} \pm 1^{\circ}\text{C}$ ), as applicable, using five specimens at a time. This procedure shall be repeated until 20 specimens have been tested or until five failures have been encountered, whichever comes first. A maximum of 4 failures out of 20 will be permitted; five failures shall constitute failure of the sample. When test specimens retain the natural curvature of the tubing, the specimens shall be struck on the convex side. The heat transfer medium shall be methyl alcohol.

4.6.6 Specific gravity. The specific gravity of three specimens of the tubing shall be determined in accordance with ASTM D 792.

4.6.7 Dielectric strength. Three specimens in the original condition shall be subjected to the dielectric strength test in accordance with ASTM D 876, except that air shall be the surrounding medium.

4.6.8 Wet dielectric strength. Three specimens shall be immersed for 24 hours in distilled water at  $77^{\circ} \pm 2^{\circ}\text{F}$  ( $25^{\circ} \pm 1.1^{\circ}\text{C}$ ), removed, blotted dry, and within five minutes subjected to the test specified in 4.6.7.

4.6.9 Corrosion. A sufficient amount of tubing to insure at least 1 square inch of contact area shall be conditioned for a minimum of 72 hours in a desiccator or similar humidity chamber maintained at 90 to 95 percent relative humidity and  $77^{\circ} \pm 2^{\circ}\text{F}$  ( $25^{\circ} \pm 1.1^{\circ}\text{C}$ ).<sup>1</sup> The tubing shall then be clamped between two metal plates that have been polished with either grade FF or grade FFF powdered pumice. One plate shall be copper conforming to QQ-C-576 and the other shall be aluminum alloy conforming to condition T4 of QQ-A-250/4. The plates shall be clamped sufficiently tight to flatten the tubing and insure intimate contact. The assembly shall then be placed horizontally in the same humidity chamber for 14 days. After the exposure period, the metal plates shall be washed with acetone and examined for signs of pitting or corrosion. Pitting or corrosion shall be cause for rejection of the compound and all tubing made from that compound. A slight discoloration of the metal shall not be cause for rejection.

4.6.10 Oil aging. Three specimens, each approximately 6 inches long, shall be immersed in petroleum base oil conforming to type VI of TT-S-735. The oil shall be maintained at  $212^{\circ} \pm 2^{\circ}\text{F}$  ( $100^{\circ} \pm 1.1^{\circ}\text{C}$ ). At the end of eight hours, the specimens shall be removed from the oil, blotted dry with a paper towel, cooled at room temperature for 30 minutes, and bent 180 degrees over a one-fourth inch diameter mandrel at a rate of approximately 60 degrees per second. The bending test shall be conducted at room temperature and the tubing shall be examined for evidence of tackiness, decomposition, and signs of cracking or splitting when bent.

<sup>1</sup> A constant humidity system for which the  $77^{\circ}\text{F}$  condition is appropriate shall be selected. One such system for a 93 percent relative humidity at  $77^{\circ}\text{F}$  ( $25^{\circ}\text{C}$ ) uses a saturated aqueous solution of ammonium di-hydrogen phosphate,  $\text{NH}_4\text{H}_2\text{PO}_4$ .

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4.6.11 Fungus resistance. Fungus resistance shall be determined in accordance with the procedure specified hereinafter.

4.6.11.1 Preparation of specimen. The tubing shall be kept dust-free. Three test specimens, each 3 inches long, shall be cut at random from the samples of the tubing. These specimens shall be cut and handled with clean instruments. Each of the three specimens shall be used as test specimens.

4.6.11.2 Glassware. One covered container, such as a 6-inch petri dish, shall be used for each specimen to be inoculated with fungi. Approximately 60 milliliters of the culture medium shall be used in each dish.

4.6.11.3 Culture medium. The culture medium shall be composed of the following ingredients and prepared as follows:

$\text{NH}_4\text{NO}_3$	3.0 grams
$\text{K}_2\text{HPO}_4$	1.0 grams
$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	0.25 grams
KCL	0.25 grams
Agar	15.0 to 20.0 grams
Distilled water	1000.0 milliliters

Place the above ingredients in a suitable flask, plug with cotton, and melt the medium in an autoclave. Adjust pH, if necessary, to 5.5 to 6.5 with HCL or NaOH, as required. Replace plug and sterilize in an autoclave for 20 minutes at  $250^\circ \pm 2^\circ\text{F}$  ( $121^\circ \pm 1.1^\circ\text{C}$ ). Using aseptic technique, pour the volume of agar into containers of the type suggested in 4.6.11.2 and allow the medium to harden.

4.6.11.4 Test fungi. The following fungi shall be used in this fungus resistance test (see 6.3):

Aspergillus niger	ATCC-9642
Aspergillus flavus	ATCC-9643
Trichoderma sp. T-1	ATCC-9645

4.6.11.5 Viability control. Several 2- to 3-inch pieces of heavy untreated cotton twine shall be cut and placed in a deep covered dish. Tap water and a trace of nontoxic wetting agent, such as dioctyl sodium sulfosuccinate, shall be added and the dish shaken vigorously. The pieces shall be rinsed several times in distilled water and the excess water squeezed out. The pieces shall be separated, replaced in the dish, and sterilized in an autoclave for one hour at  $250^\circ \pm 2^\circ\text{F}$  ( $121^\circ \pm 1.1^\circ\text{C}$ ).

4.6.11.6 Preparation of inoculum. Five milliliters of sterile distilled water containing 0.05 percent of a nontoxic wetting agent,

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such as dioctyl sodium sulfosuccinate, shall be added to a test tube of each required test fungus. Each test fungus shall be in a ripe, actively growing, fruiting condition and shall be used within three weeks after the beginning of refrigerated storage. After addition of the water, the fungus culture tube shall be used within three weeks after the beginning of refrigerated storage. After addition of the water, the fungus culture tube shall be agitated gently to bring spores into suspension. The water in the culture tube shall be translucent in appearance and shall contain no small piece of agar. If the solution is not translucent, the agar slant shall be scraped gently with a sterile transfer needle to dislodge the spores. Each of the suspensions shall then be poured into about 35 milliliters of sterile distilled water containing 0.05 percent of a nontoxic wetting agent and the culture tube discarded. The flask shall be gently shaken or rotated to thoroughly disperse the spores. The spore suspension is then ready for use and shall be used within an eight-hour period.

4.6.11.7 Inoculation. Using sterile forceps and aseptic technique, one test specimen shall be placed on the center of the hardened agar medium in each container. Under aseptic conditions and with a pipette, approximately one-third to one-half milliliter of the inoculum shall be used to inoculate each tubing test specimen, depending on the diameter of the tubing. The inoculum shall be distributed evenly, lengthwise, and around the open ends of the test specimen without flooding the agar medium. In addition, the viability control, specified in 4.6.11.5, shall also be placed on the hardened agar medium 1 inch from the test specimen and inoculated with a few drops of the inoculum.

4.6.11.8 Incubation. The period of incubation shall be 14 days at  $86^{\circ} \pm 4^{\circ}\text{F}$  ( $30^{\circ} \pm 2^{\circ}\text{C}$ ).

4.6.11.9 Evaluation of results. At the end of the incubation period, the inoculated and exposed specimens shall be observed for hyphal and spore-forming fungus growth with the aid of bright, natural, or artificial lighting. Questionable evidence shall be investigated with the aid of a microscope. Specimens shall show no scattered, sparse surface growth nor mycelial bridges between specimen and agar.

## 5. PACKAGING

5.1 Preservation-packaging. Packaging shall be level A or C as specified. Do not use polystyrene foam because of possible reaction with the tubing.

5.1.1 Level A. The tubing shall be packaged in accordance with method III of MIL-P-116. If the unit packs are small and intermediate packaging is required, quantities shall be specified (see 6.2).

5.1.2 Level C. The tubing shall be packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2).

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5.2.1 Level A. The tubing, packaged in accordance with 5.1.1, shall be packed in overseas-type wood-cleated fiberboard, nailed wood, wirebound wood, corrugated or solid fiberboard, wood-cleated paper overlaid or wood-cleated plywood boxes conforming to PPP-B-591; PPP-B-621; PPP-B-585; PPP-B-636, CF or SF; or PPP-B-601, respectively, at the option of the contractor. Unless otherwise specified, shipping containers shall have caseliners conforming to MIL-L-10547 and shall be closed and sealed in accordance with the appendix thereto. Caseliners for boxes conforming to PPP-B-636 may be omitted, provided all joints and corners of the boxes are sealed with a minimum 1½-inch wide tape conforming to PPP-T-76. Box closures shall be as specified in the applicable box specification or appendix hereto. The gross weight of wood boxes shall not exceed 200 pounds. Fiberboard boxes shall not exceed the gross weight limitation and shall conform to the special requirements of the applicable box specification.

5.2.2 Level B. The tubing, packaged in accordance with 5.1.1, shall be packed in domestic-type wood-cleated fiberboard, nailed wood, wirebound wood, corrugated or solid fiberboard, wood-cleated plywood, or wood-cleated paper overlaid boxes conforming to PPP-B-591; PPP-B-621; PPP-B-585; PPP-B-636, CF or SF; or PPP-B-601, respectively, at the option of the contractor. Box closure shall be as specified in the applicable box specification or appendix thereto. The gross weight of wood boxes shall not exceed 200 pounds; fiberboard boxes shall not exceed the gross weight limitation and shall conform to the special requirements of the applicable box specification.

5.2.3 Level C. The tubing, packaged in accordance with 5.1.2, shall be packed in containers in a manner to insure safe delivery and acceptance at destination. Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations applicable to the mode of transportation.

5.3 Marking. In addition to any special marking specified in the contract or order or herein, each unit and intermediate package and shipping container shall be marked in accordance with MIL-STD-129. The nomenclature shall be as follows:

INSULATION SLEEVING, ELECTRICAL, FLEXIBLE

## 6. NOTES

6.1 Intended use. The tubing covered by this specification is intended for use as flexible conduits.

6.1.1 Operating temperature range. Tests conducted in accordance with this specification indicate that the tubing is satisfactory over a temperature range of -90°F (-67.8°C) for class 1 tubing and -67°F (-55°C) for class 2 tubing. This, however, does not limit the use of the material to these temperatures. If the tubing is to be used at other temperatures, the suitability of the material should be proved by the using activity.



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6.2 Ordering data. Acquisition documents should specify the following:

- a. Title and date of this specification.
- b. Part number (see 1.3).
- c. Data requirements (see 3.2).
- d. Length of tubing desired (see 3.5).
- e. Point of preproduction testing (see 3.1 and 4.3.1).
- f. Applicable levels of preservation-packaging and packing (see 5.1 and 5.2).
- g. Intermediate pack quantity, if required.

6.3 Source of fungus cultures. Test fungi may be obtained upon request from the American Type Culture Collection, 12301 Parklawn Drive, Rockville, MD 20852.

6.4 Change from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

*	Custodians: Army - ER Navy - AS Air Force - 20	Preparing Activity: Air Force - 20  (Project Number: 5970-0578)
*	Reviewer activities: Navy - SH Air Force - 80, 85, 99	



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1. DOCUMENT NUMBER MIL-I-7444D		2. DOCUMENT TITLE Insulation Sleeving, Electrical, Flexible	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
		<input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
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6. REMARKS			
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