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SUPERSEDING
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MILITARY SPECIFICATION

INSULATION TUBING, SILICONE RUBBER, HEAT SHRINKABLE

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for one type of silicone rubber heat shrinkable insulating tubing.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-I-7444	Insulation Sleeving, Electrical, Flexible
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

FSC 5970

STANDARDS

Federal

FED-STD-406	Plastics, Methods of Testing

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM D 149	Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 150	Test for A-Class Characteristics and Dielectric Constant (Permittivity) of Solid Electrical Insulating Materials.
ASTM D 257	Tests for Electrical Resistance of Insulating Materials
ASTM D 374	Tests for Thickness of Solid Electrical Insulation
ASTM D 412	Tension Testing of Vulcanized Rubber

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

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

3. REQUIREMENTS

3.1 Preproduction sample. Unless otherwise specified (see 6.2), a preproduction sample of silicone rubber heat shrinkable tubing shall meet the requirements of this specification.

3.2 Material. The material shall be silicone rubber tubing supplied in an expanded form capable of being shrunk by the application of heat (see 3.6.1.2).

3.3 Chemical properties.

3.3.1 Odor. The recovered tubing shall not be noxious.

3.3.2 Fungus resistance. The recovered tubing shall not support fungus growth.

3.3.3 Corrosion. The recovered tubing shall not accelerate the corrosion of copper or aluminum upon contact.

3.4 Electrical properties. The recovered tubing shall meet the requirements specified in Table I.

Table I. Electrical Properties

Property	Requirement
Dielectric Strength (1/16 inch thickness)	400 volts/mil, minimum
Dielectric Constant	3.10, maximum
Volume Resistivity	1×10^{14} ohms-cm, minimum

3.5 Mechanical properties. The recovered tubing shall meet the requirements specified in Table II.

Table II. Mechanical properties

Property	Requirement	
Tensile Strength	1200 psi, minimum	
Ultimate Elongation	450%, minimum	
Heat Shock	Tensile Strength (psi, min.)	Ultimate Elongation (% min.)
	800	200
Resistance to Fluids	Tensile Strength (psi, min.)	Ultimate Elongation (% min.)
Hydraulic Fluid (MIL-H-5606)	450	240
JP-4 Fuel (MIL-T-5624)	200	175
Lubricating Oil (MIL-L-7808)	775	375
Water	1050	400

3.6 Physical properties. The recovered tubing shall meet the requirements specified in Table III.

Table III. Physical properties

Property	Requirement
Flammability	3 inches, maximum
Specific Gravity	1.20, maximum
Water Absorption	0.5 percent, maximum
Longitudinal Change	5.0 percent, maximum
Heat Resistance	Shall remain flexible and free from cracks
Low Temperature Flexibility	Shall remain flexible and free from cracks

3.6.1 Dimensions.

3.6.1.1 Inside diameter and wall thickness. The heat shrinkable tubing shall be furnished in the inside diameters and wall thicknesses as specified in Table IV (see 6.2).

3.6.1.2 Dimensional recovery. After being heated at 150 to 180 degrees celsius (C) (302 to 356 degrees Fahrenheit (F)) and conditioned at this temperature for 2 minutes minimum, the tubing shall recover to the dimensions specified in Table IV.

Table IV. Inside diameter and wall thickness of tubing

Size no.	Expanded as supplied	Recovered dimensions after heating	
	Inside diameter (inches) minimum	Inside diameter (inches) maximum	Wall thickness (inches) nominal
1	0.125	0.067	0.020
2	0.250	0.125	0.035
3	0.375	0.187	0.040
4	0.500	0.250	0.048

Table IV. (Continued)

Size no.	Expanded as supplied	Recovered dimensions after heating	
	Inside diameter (inches) minimum	Inside diameter (inches) maximum	Wall thickness (inches) nominal
5	0.750	0.375	0.057
6	1.000	0.500	0.070
7	1.500	0.750	0.095
8	2.000	1.000	0.110 and 0.190
9	2.500	1.250	0.110 and 0.190
10	3.000	1.500	0.110 and 0.190

3.6.1.3 Length. Unless otherwise specified (see 6.2), the tubing shall be supplied in 20 foot lengths.

3.6.2. Appearance. The tubing shall be free of defects such as blisters, pinholes, inclusions, cracks, seams, and other imperfections.

3.7 Workmanship. The workmanship shall insure a product which is uniform and in conformance with this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 Preproduction samples. The preproduction sample shall be prepared using the same methods proposed for the preparation of subsequent production lots of material. Preproduction samples which do not meet all the requirements of this specification shall be subject to rejection and return to the supplier.

4.3 Classification of tests. The examination and testing of material shall be classified as follows:

a. Preproduction tests.

b. Quality conformance tests.

4.3.1 Preproduction tests. Preproduction tests shall be conducted only on the preproduction sample and shall consist of all the examinations and tests specified herein.

4.3.2 Quality conformance tests. Quality conformance tests for acceptance of material shall consist of the following examinations and tests:

a. Inside diameter and wall thickness.

b. Dimensional recovery.

c. Length.

d. Appearance.

4.3.2.1 Lot size. Lot size shall consist of all the tubing of the same size manufactured at one time from one batch, forming part of one contract or order and submitted for acceptance at the same time and place.

4.3.2.2 Sampling. Unless otherwise specified (see 6.2), sample pieces of tubing shall be selected at random in accordance with MIL-STD-105 at Inspection Level II from each lot for quality conformance testing. Any piece of tubing having one or more defects shall be rejected. If the number of defective samples exceeds the acceptable number for the appropriate sampling plan of MIL-STD-105 at acceptance quality level (AQL) 2.5 percent, the lot represented by the samples shall be rejected.

4.4 Test methods.

4.4.1 Test conditions.

4.4.1.1 Tubing (recovered). Tests shall be conducted on recovered tubing which has been heated and conditioned for 2 minutes minimum at 150 to 180 degrees C (302 to 356 degrees F).

4.4.1.2 Tubing (as supplied). Tests shall be conducted on tubing in the as supplied condition which has been conditioned for 4 hours minimum at a temperature of 24 plus or minus 3 degrees C (75.2 plus or minus 5.4 degrees F).

4.4.2 Chemical property tests.

4.4.2.1 Odor. A 6-inch long piece of recovered tubing shall be placed in a 1-quart, air tight container. The container shall be maintained at 24 plus or minus 3 degrees C (75.2 plus or minus 5.4 degrees F) for 24 hours minimum. The container shall then be opened. A noxious odor shall not be perceptible.

4.4.2.2 Fungus resistance. The fungus resistance of the recovered tubing shall be determined in accordance with MIL-I-7444. The tubing shall be non-nutrient.

4.4.2.3 Corrosion. The recovered tubing shall be tested in accordance with MIL-I-7444 to determine compliance with 3.3.3.

4.4.3 Electrical property tests.

4.4.3.1 Dielectric strength. The dielectric strength of the recovered tubing shall be determined in accordance with ASTM D 149. The dielectric strength shall be as specified in Table I.

4.4.3.2 Dielectric constant. The dielectric constant of the recovered tubing shall be determined in accordance with ASTM D 150. The dielectric constant shall be as specified in Table I.

4.4.3.3 Volume resistivity. The volume resistivity of the recovered tubing shall be determined in accordance with ASTM D 257. The volume resistivity shall be as specified in Table I.

4.4.4 Mechanical property tests.

4.4.4.1 Tensile strength and ultimate elongation. The tensile strength and ultimate elongation of recovered tubing shall be determined in accordance with ASTM D 412. The tensile strength and ultimate elongation shall be as specified in Table II.

4.4.4.2 Heat shock. Compliance with the heat shock requirement specified in Table II shall be determined by testing recovered tubing

in accordance with ASTM D 412-68. The recovered specimens shall be heated for 168 hours minimum at 250 plus or minus 5 degrees C (482 plus or minus 9 degrees F) prior to test.

4.4.4.3 Resistance to fluids. Three 7-inch lengths of recovered tubing shall be immersed in each of the fluids specified in Table II for a minimum of 24 hours at 24 plus or minus 3 degrees C (75.2 plus or minus 5.4 degrees F). The volume of fluid shall not be less than 20 times that of the specimens. The conditioned specimens shall be lightly wiped, air dried for 30 to 60 minutes and then tested in accordance with 4.4.4.1 to determine compliance with the tensile strength and ultimate elongation specified in Table II.

4.4.5 Physical property tests.

4.4.5.1 Flammability. Five 5-inch specimens of recovered tubing shall be marked 1 inch from each end with a contrasting color of ink. Each specimen shall be mounted at a 45 degree angle in a draft-free chamber by a clamp that completely closes the upper end of the tubing. A 1-inch high blue flame from a standard 0.375-inch diameter Bunsen burner then shall be applied to the lower end of each specimen. When the specimen has burned to the lower ink mark, the flame shall be removed and the specimen shall remain undisturbed until burning ceases. Each specimen shall extinguish within 3 inches.

4.4.5.2 Specific gravity. The specific gravity of recovered tubing shall be determined in accordance with FED-STD-406, Method 5012. The specific gravity shall be as specified in Table III.

4.4.5.3 Water absorption. The water absorption of the recovered tubing shall be determined in accordance with FED-STD-406, Method 7031 after conditioning specimens in water for 24 hours minimum at 24 plus or minus 3 degrees C (75.2 plus or minus 5.4 degrees F). The water absorption shall be as specified in Table III.

4.4.5.4 Longitudinal change. The lengths of three 6-inch specimens of tubing in the as supplied condition shall be measured within tolerance of plus or minus 1/16 inch prior to being conditioned as specified in 4.4.1.1. The lengths of recovered tubing shall be remeasured. Longitudinal change shall be calculated as a percentage of the original length and shall meet the requirement specified in Table III.

4.4.5.5 Heat resistance. Three specimens of tubing, each 6 inches in length, shall be heated in an oven for 4 hours minimum at 316 plus or minus 5 degrees C (600 plus or minus 9 degrees F). The

oven shall be either a gravity or mechanical convection type providing a maximum air velocity of 50 feet per minute past the specimens. The specimens shall then be bent through 180 degrees over a mandrel of the diameter specified in Table V to determine compliance with the heat resistance requirement specified in Table III. Any side cracking occurring because of the flattening of the specimen on the rod shall be disregarded.

Table V. Tubing and mandrel sizes

Tubing Diameter (inches, as supplied)	Mandrel Diameter (inches)
0.125 through 0.375	0.250
0.500 through 2.000	0.500
2.500 through 3.000	0.750

4.4.5.6 Low temperature flexibility. An 18-inch long piece of recovered tubing shall be conditioned for 4 hours minimum at minus 90 to minus 100 degrees C (minus 130 to minus 148 degrees F). A mandrel, selected for the given size tubing in accordance with Table V shall be conditioned at the same temperature. After completion of conditioning and at the same temperature, the specimen shall be rapidly wrapped around the mandrel for not less than one complete wrap. The speed of wrapping shall be approximately 2 seconds for each wrap of 360 degrees. The low temperature flexibility shall be as specified in Table III.

4.4.5.7 Inside diameter and wall thickness. Standard gage rods with hemispherical ends shall be used to measure the inside diameter and wall thickness of the insulation tubing to determine compliance with the dimensions specified in Table IV. The rods shall be made of steel and shall have smooth surfaces. A set of two is required for each size of tubing. Each rod in a set shall have a diameter within plus or minus 0.002 inch of the diameter listed as maximum and minimum in Table IV. Diameters above 0.300 inch shall be measured with tapered aluminum gages. The gages shall have a uniform taper of 0.010 inch in diameter per 1 inch of length and shall be graduated with circular lathecut rings every 0.5 inch of length. The graduations shall then represent a uniform increase in diameter of 0.005 inch in diameter per 0.5 inch of length.

4.4.5.7.1 Inside diameters, 0.300 inch and smaller. To measure expanded tubing (as supplied), the minimum gage rod for the size sleeving under test shall pass into the specimen for a distance of 2 inches without expanding the wall of the tubing. If the rod has a fairly snug fit, then the specimen shall be considered as having an inside diameter equal to the diameter of the rod. To measure recovered tubing (after shrinking), the maximum gage rod for the size tubing under test shall not pass freely into the specimen. If the gage rod has a fairly snug fit, the specimen shall be considered as having an inside diameter equal to the diameter of the rod.

4.4.5.7.2 Inside diameters greater than 0.300 inch. The ends of all tubing specimens shall be cut squarely. The appropriate tapered aluminum gage shall be inserted into the end of the specimen, so that it is snug, without flaring the end of the tubing. Measurements shall be made by means of the graduations on the gage.

4.4.5.7.3 Wall thickness. This test shall be conducted on the recovered tubing which has been heated and conditioned as specified in 4.4.1.1. A standard gage rod or tapered gage which will pass freely into the tubing shall be inserted in the specimen. A micrometer shall then be applied over the specimen and thickness measurements made in accordance with ASTM D 374, Method A. The wall thickness shall be determined by subtracting the diameter of the gage rod from the outside measured diameter. One half of this difference shall be considered the wall thickness.

4.4.5.8 Dimensional recovery. The inside diameter of three 6-inch specimens of recovered tubing shall be determined using standard gage rods as specified in 4.4.5.7. The recovered tubing shall be conditioned for 5 minutes minimum at 24 plus or minus 3 degrees C (75.2 plus or minus 5.4 degrees F) prior to measurement. The dimensional recovery shall be as specified in Table IV.

4.4.5.9 Length. The tubing shall be laid flat and in a straight line and measured with a yardstick or any other suitable device to determine compliance with 3.6.1.3.

4.4.5.10 Appearance. The tubing shall be visually examined to determine compliance with 3.6.2.

4.6 Preservation, packaging, packing, and marking. The preservation, packaging, packing, and marking shall be examined for compliance with Section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking shall be Level A, B, or C as specified (see 6.2) in accordance with MIL-I-7444.

6. NOTES

6.1 Intended use. The silicone rubber heat shrinkable tubing covered by this specification is intended for use where insulation and protection of wires and components are required.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.

b. Whether a preproduction sample is required (see 3.1) and if so, pertinent details.

c. Size required (see 3.6.1.1), including wall thickness for sizes 8, 9, and 10.

d. Tubing length, if other than specified (see 3.6.1.3).

e. Sampling plan if other than specified (see 4.3.2.2).

f. Selection of applicable level of preservation, packaging, and packing.

6.3 Supersession data. This specification includes the requirements of MIS-14316, dated 1 May 1965.

Custodian:
ARMY-MI

Preparing Activity:
ARMY-MI
Project No. 5970-A440

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

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