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Superseding AS85080

Insulation Sleeving, Electrical, Shrinkable Without Heat,
General Specification For

FSC 5970

RATIONALE

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This document has been taken directly from U.S. Military specification MIL-I-85080(AS), Amendment 1, Notice 1, Notice 2 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE Technical Standards. The initial release of this document is intended to replace MIL-I-85080(AS), Amendment 1, Notice 1, Notice 2. Any part numbers established by the original specification remain unchanged.

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1. SCOPE:

1.1 Scope:

This specification establishes requirements for chemically expanded, flexible, electrical insulating sleeving that shrinks to a predetermined size upon solvent evaporation.

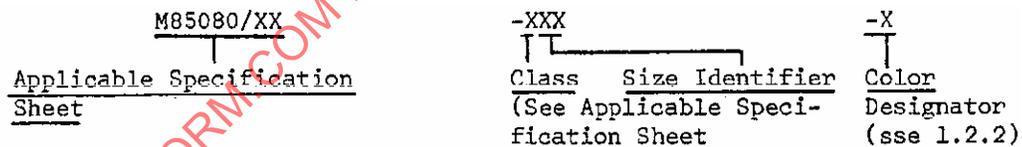
1.2 Classification:

The shrinkable sleeving shall be as specified in the applicable military specification sheet.

1.2.1 Colors: Colors, when applicable, shall be identified in accordance with the following:

<u>Designator</u>	<u>Color</u>	<u>Designator</u>	<u>Color</u>
0	Black	6	Blue
1	Brown	7	Violet (Purple)
2	Red	8	Gray (Slate)
3	Orange	9	White
4	Yellow	0	Clear
5	Green		

1.2.2 Part number designation: Part number designations under this specification shall be as follows:



2. APPLICABLE DOCUMENTS:

2.1 Issues of documents:

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

SPECIFICATIONS

FEDERAL

SS-S-550	Sodium Chloride, Technical, For Water Softening Units
PPP-B-585	Box, Wood, Wirebound
PPP-B-601	Box, Wood, Cleated Plywood
PPP-B-621	Box, Wood, Nailed and Lock-Corners
PPP-B-636	Box, Shipping, Fiberboard
PPP-C-96	Can, Metal, 28 Gauge and Lighter

MILITARY

MIL-B-117	Bag, Sleeve and Tubing, Interior Packaging
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-A-8243	Anti-icing and Deicing-Defrosting Fluid
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-C-43616	Cleaning compound, Aircraft Surface

2.1 (Continued):

STANDARDS

FEDERAL

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

MILITARY

MIL-STD-104 Limit for Electrical Insulation Color

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

MIL-STD-120 Gage Inspection

MIL-STD-129 Marking for Shipment and Storage

SUPPLEMENT

MIL-I-85080/1 Insulation Sleeving, Electrical, Shrinkable Without Heat, Polyvinyl Chloride, Flexible, Non-Crosslinked

MIL-I-85080/2 Insulation Sleeving, Electrical, Shrinkable Without Heat, Silicone Rubber, Flexible

MIL-I-85080/3 Insulation Sleeving, Electrical, Shrinkable Without Heat, Polyurethane, Flexible

MIL-I-85080/4 Insulation Sleeving, Electrical, Shrinkable Without Heat, Chlorosulfonated Polyethylene, Flexible

MIL-I-85080/5 Insulation Sleeving, Electrical, Shrinkable Without Heat, Polychloroprene

(Copies of specifications, standards, drawings, and publications required by contractors 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 the date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 149-75	Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies.
D 374-74	Tests for thickness of Solid Electrical Insulation
D 412-75	Tension Testing of Vulcanized Rubber
D 570-63	Testing for Water Absorption of Plastics
D 638-72	Test for Tensile Properties of Plastic
D 876-71	Testing for Nonrigid Vinyl Chloride Polymer Tubing
D 882-73	Test for Tensile Properties of thin Plastic Sheeting
G 21-70	Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 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 Specification sheets:

The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Data:

No data is required by this specification or by the applicable documents referenced in section 2 of this specification unless specified by the contracting officer.

3.3 Toxicity:

The material shall have no adverse affect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate departmental medical service who will act as advisor to the procuring agency.

3.4 Dimensions:

Dimensions and tolerances for "as supplied" ID, after unrestricted shrinkage ID, wall thickness and longitudinal change shall be measured as specified in 4.6.4 and be in accordance with the applicable specification sheet.

3.5 Unit of Issue:

Procurement documents should specify unit of issue as foot. Packaging "put-ups" shall be in lengths as specified in the contract or order (See 6.2).

3.6 Properties:

Properties shall be as specified in Table I. Unless otherwise specified, data shall be obtained on recovered (shrunk) sleeving.

Table I. Properties

Property	Requirement	Test Method
Water absorption	Specification sheet	4.6.2 ASTM D 570 <u>2/</u>
Dielectric Strength	Specification sheet	4.6.2 ASTM D 876
Volume Resistivity	Specification sheet	4.6.2 ASTM D 876
Fungus resistance	No growth	4.6.2 ASTM G 21
Color	MIL-STD-104	Visual inspection
Voltage withstand	Specification sheet	4.6.5
Low Temperature flexibility	Specification sheet	4.6.6
Heat shock	Specification sheet	4.6.7
Heat resistance	Specification sheet	4.6.8
Corrosion	Specification sheet	4.6.9 <u>1/</u>
Fluid resistance	Specification sheet	4.6.10
Odor	No objectionable pungent aroma	4.6.11
Modulus	Specification sheet	4.6.12
Tensile strength	Specification sheet	4.6.13
Ultimate elongation	Specification sheet	4.6.13
Flammability	Specification sheet	4.6.14
Color stability	Conforms to as received limits	4.6.15
<u>1/</u> See specification sheet for test method		
<u>2/</u> When testing small (ID) sleeving, special care shall be taken to remove all surface water from the inner wall before reweighing.		

3.7 Shelf life:

The manufacturer shall certify that the sleeving in original unopened containers, when stored as specified in 4.6.16 shall conform to the dimensional requirements of 3.4

3.8 Workmanship:

When examined visually, the sleeving shall be free from voids, blisters, lumps, tears, pinholes, seams, foreign matter and other defects which could affect performance before, during and after shrinkage.

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 Classification of inspection:

The examination and testing of the sleeving shall be classified as Quality Conformance inspection (See 4.3).

4.3 Quality conformance:

4.3.1 Lot formation: Unless otherwise specified, a lot shall consist of all the non-heat shrink sleeving of one specification sheet, class, color and size that has been processed into the sleeving from one batch and submitted for inspection at one time.

4.3.2 Sampling:

4.3.2.1 Visual and dimensional inspection of end item: Samples for the inspection shall be selected in accordance with Inspection Level S-3 of MIL-STD-105. The samples shall be selected just prior to cutting for "packaging put-up". The sampling unit shall be one foot of sleeving. Each sample shall be inspected as specified in 4.3.3.1.

4.3.2.2 Physical property tests: The lot size for this inspection shall be the total amount of sleeving of one specification sheet and class offered for inspection. Thirty feet of sleeving shall be selected at random from each lot and tested as specified in 4.3.3.2. Sleeving selected and visually inspected in 4.3.3.1 may be used to "make-up" the sample for tests.

4.3.2.3 Preparation for delivery: A quantity of shipping containers fully prepared for delivery, just prior to closure, shall be selected at random from each lot in accordance with Inspection Level S-2 of MIL-STD-105. The lot size shall be the number of shipping containers.

4.3.3 Inspections and tests:

4.3.3.1 Visual and Dimensional inspections: Samples selected in 4.3.2.1 shall be examined for conformance to the requirements in Table II. The Acceptable Quality Level (AQL) for this inspection shall be as specified in Table II. The number of determinations on each sample shall be as specified in Table IV.

TABLE II VISUAL AND DIMENSIONAL INSPECTION

Inspection	Requirement	AQL
Workmanship	3.8	2.5 As supplied ID
After unrestricted shrinkage	3.4	1.0
ID	3.4	1.0
Wall thickness	3.4	1.0
Longitudinal/change	3.4	1.0
Color	Table I	1.0

4.3.3.2 Physical property tests: Test specimens shall be prepared from the sample selected in 4.3.2.2 and tested to the requirements of Table I. Whenever possible, the material utilized for 4.3.3.1 shall be used as test specimens for this inspection. The number of specimens tested and reporting of results shall be in accordance with Table IV. Nonconformance of a specimen to any requirement shall be cause to reject the lot represented by the sample.

4.3.3.3 Packaging inspection: Each sample selected in accordance with 4.3.2.3 shall be examined for the defects specified in Table III and to all other requirements of section 5 of this specification. The AQL for this inspection shall be 4.0. In addition, shipping containers fully prepared for delivery shall be examined after closing for closure defects.

Table III. Packaging Inspection

Examine	Defect
Packaging	Not level required by contract or purchase order Material or construction not as specified.
Packing	Not level required by contract or purchase order. Material or construction not as specified. Any nonconforming component, incomplete closures, inadequate strapping, bulged or damaged containers.
Count	Less than specified or indicated quantity per shipping container.
Markings	Warning labels or marking missing. Omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.

4.4 Manufacturer's Data:

For each procurement the manufacturer shall include with data required by the contract or order, a certification that the sleeving meets or exceeds the shelf life requirement of 3.7 and 4.6.16.

4.5 Report of test results:

Table IV shall be used to prepare test reports. The number of specimens per test and method of reporting the results are contained therein.

4.6 Test methods:

4.6.1 Test conditions:

- 4.6.1.1 General: Unless otherwise specified herein, the sleeving, in packages, and measurement gages shall be conditioned for 4 hours at $23 \pm 1^\circ\text{C}$ ($73.4 \pm 2^\circ\text{F}$) and a relative humidity of 50 ± 2 percent prior to testing. When the sleeving is tested after shrinkage conditioning of the sleeving shall take place after completion of the shrinking procedure. Unless otherwise specified in the specification sheet, an oven with a circulating air velocity of 100 to 200 feet per minute shall be used whenever heating is required.

Table IV. Quality conformance inspection

Property	Requirements	Number of Determinations Per Sample	Results Reported as	
			Pass or Fail <u>1/</u>	Average or Multiple Determinations <u>2/</u>
Inside diameter, as supplied	3.4	Two	X	
Inside diameter, after unrestricted shrinkage	3.4	Two	X	
Wall thickness, after unrestricted shrinkage.	3.4	Two	X	
Longitudinal change	3.4	Two	X	
Color	3.6	One	X	
Color Stability	3.6	Three	X	
Workmanship	3.8	One	X	
Fungus resistance	3.6	Three	X	
Corrosion	3.6	Three	X	
Odor	3.6	Three	X	
Tensile Strength	3.6	Three		X
Ultimate elongation	3.6	Three		X
Dielectric strength	3.6	Three	X	
Volume resistivity	3.6	Three	X	
Low temperature flex	3.6	Three	X	
Heat resistance	3.6	<u>3/</u>		<u>3/</u>
Water absorption	3.6	Three		<u>3/</u>
Flammability	3.6	Three	X	
Fluid resistance	3.6	<u>3/</u>		<u>3/</u>
Heat shock	3.6	Three	X	
Restricted shrinkage	3.6	Three	X	
Modulus	3.6	Three		X

1/ Nonconformance of one determination shall constitute failure of the sample. A description of the numerical point of the failure shall also be recorded.

2/ All values on which the average is based shall be recorded.

3/ Sample must pass all requirements in the specification sheet. See tensile strength, ultimate elongation, and dielectric strength (as applicable) for number of determinations per sample and how to report results.

- 4.6.2 ASTM tests: ASTM tests shall be performed in accordance with ASTM Standard Methods of Test (see 2.2) with any exceptions that may be specified herein or in the specification sheets.
- 4.6.3 Shrinkage conditions:
- 4.6.3.1 Unrestricted: Six inch lengths of sleeving shall be permitted to recover at standard condition for the time specified in the applicable specification sheet. Specimens shall be examined as specified.
- 4.6.3.2 Restricted: A length of sleeving shall be placed over the mandrel shown in Figure 1 in a manner that will, after shrinking, slightly expose each end for electrical connections. Shrinkage time shall be at least 36 hours for all sleeveings. After the recovery period, the specimen shall be observed for fit and cracking. Any movement on the mandrel or cracks shall be cause for rejection. The specimen shall then be used for the voltage withstand test.
- 4.6.4 Dimensions and tolerances: Micrometer measurements shall be made in accordance with ASTM D 374.
- 4.6.4.1 Inside diameter (I.D.):
- 4.6.4.1.1 I.D. (as supplied): To measure the I.D. of the sleeving, select a smooth gage rod that has a diameter equal (plus 0, minus 0.002 inch, or 2 percent, whichever is less) to the minimum acceptable I.D. of the "as supplied" sleeving. The I.D. shall be considered acceptable when the gage rod shall pass freely into the sleeving sample without expanding the wall of the sleeving.
- 4.6.4.1.2 I.D. after unrestricted shrinkage: Sleeving shall be shrunk as specified in 4.6.3.1. Select a smooth gage rod that has a diameter equal (minus 0, plus 0.002 inch, or 2 percent, whichever is less) to the maximum acceptable sleeving I.D. after unrestricted shrinkage. The max I.D. dimension of the sleeving shall be considered acceptable when the wall of the sleeving is expanded by the insertion of the gage rod, when there is no visible air space between the end of the sleeving and the rod, or when the gage rod cannot be inserted in the sleeving.
- 4.6.4.2 Wall thickness: Wall thickness shall be determined by one of the following methods:
- 4.6.4.2.1 Micrometer method: After the unrestricted shrinkage specified in 4.6.3.1, the sleeving shall be slit lengthwise into two hemicylindrical pieces. A smooth gage rod shall be selected, measured, and placed in contact with the inside surface of the sleeving. The total thickness of the gage rod plus sleeving wall shall then be measured. The maximum and minimum wall thickness shall be calculated by subtracting the gage rod measurement from the measurement of the gage rod plus sleeving wall.

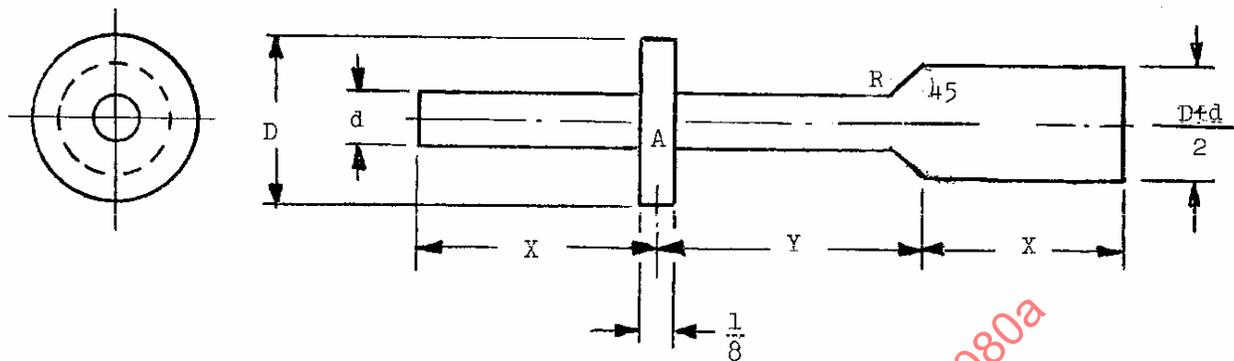
- 4.6.4.2.2 Optical method: The wall thickness of the sleeving, after the unrestricted shrinkage specified in 4.6.3.1 shall be measured with a contour projector as specified in MIL-STD-120 or with a calibrated microscope.
- 4.6.4.3 Longitudinal change: The sleeving shall be measured in the "as supplied" condition and after the unrestricted shrinkage specified in 4.6.3.1 Longitudinal change shall be calculated as percent. Measurements shall be made with an accurate rule.

L_1 = original length

$$\% \text{ change} = \frac{L_2 - L_1}{L_1} \times 100$$

L_2 = length after unrestricted shrinkage

- 4.6.5 Voltage withstand: Using the specimen prepared in 4.6.3.2, tightly wrap the first layer of the outer electrode, a strip of metal foil, around the sleeving specimen. The outer electrode shall conform closely to the shape of the sleeving particularly at the areas A and R shown in Figure 1. Allow sufficient sleeving area at each end to remain unwrapped so that flashover between the mandrel and the foil will not occur. Wrap two or more layers of foil over the first wrap allowing a free end of 1/2 inch for connection of the electrode. 2000 volts shall be applied for one minute in accordance with the test procedure of ASTM D 149.
- 4.6.6 Low temperature flexibility: For sleeving sizes less than 0.400 inch (max I.D. nominal after unrestricted shrinkage), the sleeving shall be shrunk and conditioned as specified in 4.6.3.2 onto a stranded AWG (nearest AWG wire) which is larger than the sleeving max I.D. nominal after unrestricted shrinkage). For sleeving sizes 0.400 inch and larger, a 6 by 0.25 inch longitudinal strip shall be cut from sleeving that has been shrink and conditioned as specified in 4.6.3.1. The specimen (strip or sleeving) and a steel mandrel of the size specified in Table V shall be conditioned in a cold chamber for four hours at the temperature specified in the applicable specification sheet. After completion of the conditioning period and while still in the cold chamber at the specified temperature, the specimen shall be bent around the mandrel through not less than 360 degrees. Unless otherwise specified in the specification sheet, the time to complete the bend shall be 10 ± 2 seconds. Visually examine the sleeving for cracks.



d = max. I.D. of sleeving, nominal, after unrestricted shrinkage $\begin{matrix} +5 \\ -0 \end{matrix}$ percent.

D = min. I.D., nominal, of "as supplied" sleeving $\begin{matrix} +5 \\ -0 \end{matrix}$ percent.

A = That part of the mandrel shaped as shown with a width of $\frac{1}{8}$ inch and a diameter D .

B = That part of the mandrel shaped as shown with a 45° angle between the $\frac{D+d}{2}$ and d dimensions.

All edges involved in this mandrel shall have no burrs.

Section B can be provided with a longitudinal V-groove to facilitate removal of the sample with a knife or razor blade after the testing is complete.

Max I.D. of sleeving (nominal) after unrestricted shrinkage in inches	Mandrel section in inches	
	X	Y
Less than 0.050 ^{1/}	0.50	0.25
0.050 to 0.125	0.50	0.25
0.126 to 0.374	1	0.50
0.375 to 2.000	2	2
2.001 to 3.000	3	3

^{1/} For sleeving sizes less than 0.050 I.D. inch (after unrestricted) shrinkage), a straight cylindrical mandrel shall be made with an O.D. equal to D .

TABLE V. Mandrel size for bend tests

Nominal sleeving I. D. (max., after unrestricted shrinkage inches)	Mandrel diameter ¹ / _{inches}
0.023 to 0.125	5/16 ± 0.002
0.126 to 0.250	3/8 ± 0.003
0.251 to 1.000	7/16 ± 0.004
1.001 to 2.000	7/8 ± 0.005
2.001 to 3.000	1 ± 0.005
1/ Unless otherwise specified in the specification sheet.	

- 4.6.7 Heat shock: A 6 inch length of the sleeving or a 6 by 1/2 inch strip cut longitudinally from sleeving that has a nominal I.D. greater than 1/2 inch as supplied shall be shrunk as specified in 4.6.3.1, then placed in the oven for 4 hours at the temperature specified in the specification sheet. The specimen may be suspended vertically in the oven by means of a wire attached to a hole in the specimen. While in the oven and after removal from the oven, the specimen shall be examined for evidence of cracking, flowing nor dripping. The specimen shall then be conditioned as specified in 4.6.1.1 and bent through 360 degrees in two to four seconds over the steel mandrel specified in Table V. The specimen shall then be visually examined for cracks. Disregard longitudinal side cracking.
- 4.6.8 Heat resistance: The sleeving shall be shrunk and conditioned as specified in 4.6.3.1. A suitable number of four inch lengths of the sleeving shall then be placed in an oven at the temperature and for the time specified in the specification sheet. After removal from the oven, the sleeving shall be conditioned as specified in 4.6.1.1. The sleeving shall then be tested for conformance to the ultimate elongation, tensile strength, and dielectric strength requirements (as applicable) of the specification sheet.
- 4.6.9 Corrosion: Prior to corrosion testing, the sleeving sample shall be shrunk as specified in 4.6.3.1. The applicable corrosion test procedure(s) specified in the specification sheets shall be followed.
- 4.6.9 Corrosion in contact with copper: A six inch length of shrunk sleeving shall be slid over a straight, clean, bare copper conductor. For sleeving of 0.25 inch inside diameter and smaller (max. I.D. after unrestricted shrinkage), a single conductor shall be used; for larger sleeving, a twisted bundle of several conductors shall be used, each AWG 18 or smaller. The specimens on the conductor shall be heated in an air-circulating oven for the time and the temperature specified in the applicable specification sheet. The specimen shall then be removed from the oven, cooled, and conditioned in accordance with 4.6.1.1. The sleeving shall be slit open and the copper examined for pitting and blackening. The sleeving shall be considered noncorrosive only if the copper is not pitted or blackened. Darkening of the copper due to normal air oxidation shall not be cause for rejection.

- 4.6.9.2 Copper mirror corrosion: For sizes 0.400 inch and larger (max. I.D. nominal after unrestricted shrinkage), a 1/4 by 1 inch strip shall be cut longitudinally from the shrunk sleeving. For sizes smaller than 0.400 inch (max. I.D. nominal after unrestricted), a number of pieces of shrunk sleeving having an area of approximately 0.25 square inch on one side shall be used. The strip or piece of sleeving shall be placed in the bottom of a clean, dry 1/2 by 12 inch test tube. A copper glass mirror about 1/4 inch by 1 inch and a calibrated thermometer shall be suspended 6 to 7 inches above the bottom of the test tube by means of a fine, clean copper wire attached to a cork that has been wrapped in clean aluminum foil. A second clean test tube containing only the mirror and the thermometer shall be used as a control. The lower two inches of the test tube shall be immersed in an oil bath at the temperature and for the time specified in the applicable specification sheet. The temperature of that portion of the test tube containing the copper mirror shall be below 60°C. After removal from the oil bath and cooling to room temperature, visually examine the mirror for corrosion by placing it on a white background in good light. Evidence of corrosion shall be the removal of the copper film from any part of the mirror as evidenced by the white background showing through. Disregard removal of copper from the bottom 1/16 inch of the mirror. Discoloration of the copper film or reduction of its thickness should not be considered corrosion. The mirrors shall be vacuum deposited copper with a thickness equal to 10 ± 5 percent transmission of normal light of 5000 Angstroms. They shall be stored in a vacuum and shall be used only if no oxide film is present and the copper is not visually damaged or contaminated.
- 4.6.10 Fluid resistance: The sleeving shall be shrunk as specified in 4.6.3.1. A suitable number of 4 inch lengths of sleeving shall be totally immersed in each of the fluids specified in Table VI. The volume of the fluid shall not be less than 20 times that of the sleeving. After 24 hours immersion at $24 \pm 3^\circ\text{C}$ ($75 \pm 5.4^\circ\text{F}$), the sleeving shall be lightly wiped and then conditioned for 45 ± 15 minutes at room temperature. The sleeving from each of the test fluids shall then be tested for conformance to the tensile strength, ultimate elongation, and dielectric strength (as applicable) of the specification sheet.

Table VI. Test Fluids

Fluid	Conforming to
Hydraulic fluid, petroleum base	MIL-H-56066
JP-4 fuel	MIL-T-5624
Lubricating oil	MIL-L-7808
Lubricating oil	MIL-L-23699
5% NaCl	SS-S-550
Deicing fluid	MIL-A-8243
Cleaning fluid, aircraft	MIL-C-43616