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Specification
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Thermofit[®] Adhesive and Sealant SAS-1048

1. SCOPE

This specification covers the requirements for one type of electrical insulating and fluid resistant thermoplastic adhesive for protecting wiring harness or other similar constructions from the intrusion of various fluids. This material has very low flow in the melt, effectively localizing it in the area to be sealed.

2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of referenced documents applies. The following documents form a part of this specification to the extent specified herein.

2.1 GOVERNMENT-FURNISHED DOCUMENTS

Military

MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-A-8243	Anti-Icing and Deicing-Defrosting Fluid
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-C-87936	Cleaning Compounds, Aircraft Exterior Surfaces, Water Dilutable
MIL-C-43616	Cleaning Compound, Aircraft Surface

Federal

P-C-444	Cleaning Compound, Solvent Soluble, Grease Emulsifying
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2.2 OTHER PUBLICATIONS

American Society for Testing and Materials (ASTM)

D 149	Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
D 257	Resistance or Conductance of Insulating Material
D 570	Water Absorption of Plastics
D 792	Specific Gravity and Density of Plastics by Displacement
D 2671	Methods of Testing Heat Shrinkable Tubing for Electrical Use
D 3182	Compound and Sample Preparation for Physical Testing of Rubber Products
G 21	Determining Resistance of Synthetic Polymeric Materials to Fungi

3. REQUIREMENTS

3.1 MATERIAL

The adhesive shall be homogeneous and free of foreign particles or other contaminant materials and shall be essentially free of voids, pinholes or air entrapment.

3.2 PROPERTIES

The adhesive shall meet the requirements listed in Table 1.

3.3 COLOR

The adhesive shall be amber.

4. QUALITY ASSURANCE PROVISION

4.1 CLASSIFICATION OF TESTS

4.1.1 Qualification Tests

Qualification tests are those performed on adhesive submitted for qualification as a satisfactory product and shall consist of all tests listed in Table 1.

4.1.2 Acceptance Tests

Acceptance tests are those performed on adhesive submitted for acceptance under contract. Acceptance tests shall consist of visual examination, dimensions, softening point, and specific gravity.

4.2 SAMPLING INSTRUCTIONS

4.2.1 Test Sample Preparation

- 4.2.1.1 Test specimens in the form of compression-molded sheets shall be prepared from solid adhesive. The sheets shall be 6 x 6 x .050 ± .010 inches (*152 x 152 x 1.3 ± .25 mm*) as described in ASTM D 3182, (prepared in a heated press at 175°C [*350°F*]). The sheets shall be homogeneous and free from voids.
- 4.2.1.2 Test specimens in the form of tubing shall be extruded with an I.D. of .090 inches (*2.28 mm*), a wall thickness of .022 inches (*0.55 mm*) and cut to a length of 1 inch (*25.4 mm*) (Raychem part number SAS-090).
- 4.2.1.3 Test specimens in tape or strip form shall be approximately 6 inches (*150 mm*) long, 1 inch (*25 mm*) wide and .018 inch (*.46 mm*) thick. (Raychem specification RT-1050/3)

4.2.2 Qualification Test Samples

Sufficient adhesive must be prepared to satisfy all the test requirements listed in Table 1.

4.2.3 Acceptance Test Samples

Acceptance test samples shall be taken from each lot of material. A lot shall consist of all the adhesive from the same production run offered for inspection at the same time.

4.3 TEST PROCEDURES

4.3.1 Physical

4.3.1.1 Visual Inspection

The test specimens shall be visually examined to insure that the material is homogeneous and free of foreign particles or other contaminants, voids or pinholes.

4.3.1.2 Specific Gravity

The specific gravity shall be determined in accordance with ASTM D 792.

4.3.1.3 Flow

A specimen of adhesive 1 x 1 x .050 inches (*25 x 25 x 1.3 mm*) cut from a sheet in accordance with Section 4.2.1.1 shall be mounted on a smooth vertical metal surface that has been warmed sufficiently to allow the specimen to adhere with slight hand pressure. The specimen shall be oriented with the lower edge horizontal. A horizontal line shall be marked flush with the lower edge of the specimen and the assembly shall be placed vertically in an oven at $200 \pm 3^{\circ}\text{C}$ ($392 \pm 5^{\circ}\text{F}$) for 30 minutes. The assembly shall be removed from the oven and allowed to cool for 30 minutes and the distance between the lower edge of the adhesive and the marked line shall be measured.

4.3.1.4 Softening Point

The softening point of the adhesive shall be determined with a Thermomechanical Analyzer.

4.3.1.4.1 Apparatus

DuPont 943006-914 Thermomechanical Analyzer
DuPont 9900 control unit
DuPont 7475A XY recorder

4.3.1.4.2 Procedure

A .25-inch (*6.4-mm*) diameter specimen shall be punched from a 6 x 6 x .050-inch (*152 x 152 x 1.3-mm*) slab of adhesive. A 50-gram weight shall be placed on the upper weight platform. The expansion probe shall be placed top center on the specimen. The test shall be run starting at 23°C and using a 5°C per minute temperature rise, with the analyzer in the expansion mode and the recorder X-axis on the millivolt per inch scale. When the viscous flow curve is determined, draw slope intercept lines as shown in Figure 1. The intersection of these lines shall be recorded as the softening point.

4.3.1.5 Low Temperature Flexibility

The specimens in strip form in accordance with section 4.2.1.3, and a .25 inch diameter mandrel shall be placed in a cold chamber at $-55 \pm 2^{\circ}\text{C}$ ($-67 \pm 4^{\circ}\text{F}$) for 4 hours. While still in the chamber, the specimens shall be wrapped 360° around the mandrel in approximately 2 seconds, and examined for cracks.

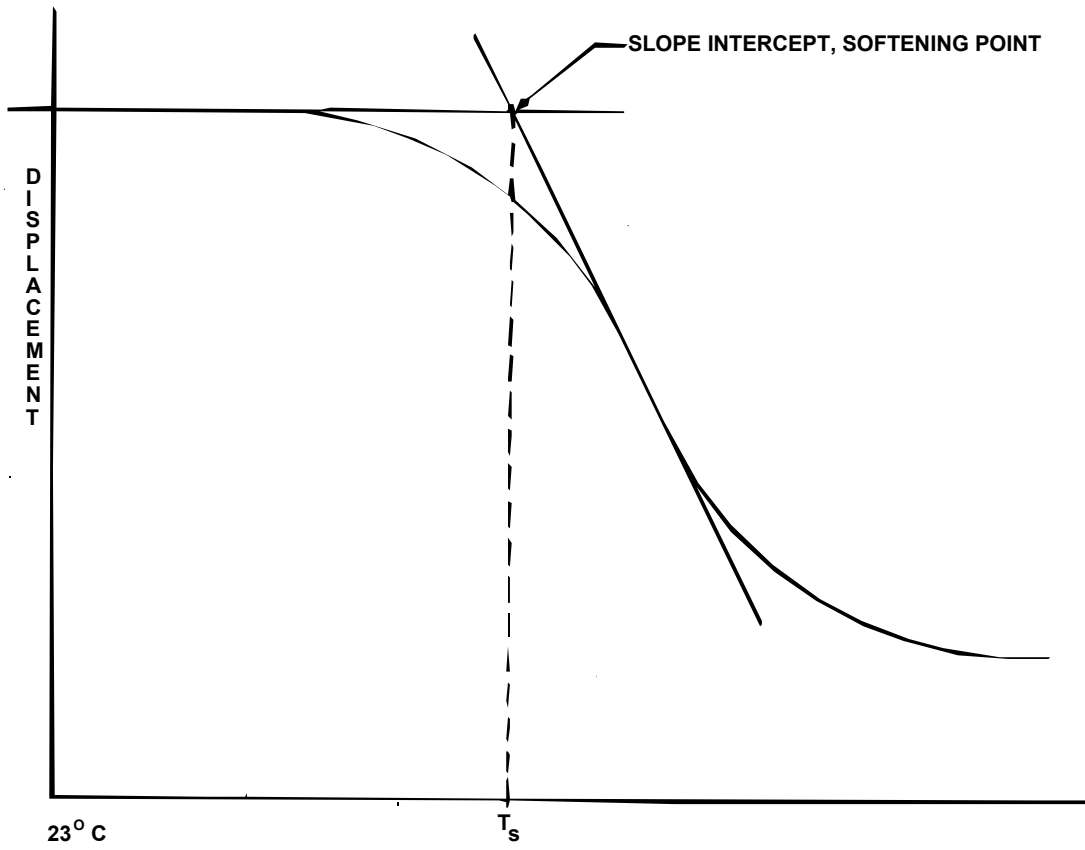
4.3.1.6 Adhesive Peel

4.3.1.6.1 Polyethylene to Polyethylene

A 6-inch length of size 1-1/2 inch Thermofit RNF-100 in accordance with Thermofit RT-350 shall be recovered on a glass-laminated plastic or metal tube, 1 inch in diameter, and approximately 1 foot long, with a Thermofit Model 500B Thermogun or equivalent. The specimen shall be cooled to room temperature, lightly abraded with No. 320 emery cloth, and wiped with MEK. S-1048 tape shall be spiral wrapped on the recovered tubing, with a 50% overlap. A strip of 3/4-inch-wide masking tape shall be placed lengthwise on the adhesive tape to hold it in place and to provide unbonded ends for insertion into the tensile tester.

The inside surface of three 1-1/2-inch lengths of size 1-1/2 inch RNF-100 shall be abraded and cleaned. The lengths shall be placed on the prepared mandrel so that they are about 1/2 inch apart, and recovered with the Thermogun. The assembly shall be placed in an oven for 10 minutes at $150 \pm 3^{\circ}\text{C}$ ($302 \pm 5^{\circ}\text{F}$).

After cooling to room temperature, the bonded assembly shall be removed from the mandrel by cutting along one edge of the masking tape. A 1-inch (*25-mm*) wide specimen shall be cut from the center of each double thickness (Figure 2). The unbonded ends shall be inserted in a tensile tester operating at 2 inches per minute (Figure 3). Readings of peel strength shall be made at every 1/2 inch (*12.5 mm*) of jaw separation after the 1 inch (*25 mm*) initial separation. Peel strength shall be defined by the average of 5 readings.



TEMPERATURE
Figure 1

4.3.1.6.2 Polyethylene to Steel

A 6-inch (*152-mm*) length of 1-inch (*25-mm*) steel pipe (ASA-B36.10-1939 or equivalent) shall be abraded with No. 320 emery cloth and wiped with a clean cloth or paper towel wet with methyl ethyl ketone. S-1048 tape shall be spiral wrapped on the pipe with a 50% overlap to produce a double thickness of adhesive. A strip of 3/4-inch (*19-mm*) wide masking tape shall be placed lengthwise over the adhesive to hold it in place and to provide unbonded ends for insertion into the tensile tester. (Figure 2)

Three 1-1/2-inch (*38-mm*) lengths of 1-1/2 inch (*38 mm*) diameter RNF-100 shall be abraded, cleaned, recovered on the prepared mandrel and oven-heated as described in 4.3.1.6.1. After cooling to room temperature, the tubing shall be cut into 1 inch (*25 mm*) wide sections. (Figure 2). Each specimen shall be cut along one edge of the masking tape to free the unbonded ends of the tubing.

The specimen shall be placed in a tensile testing machine with the specimen around the positioning mandrel and the free end of the specimen inserted into the tensile testing machine jaw. (Figure 3) The holding fixture shall be constructed so that the yoke is free to rotate during testing. Jaw-separation speed of the tester shall be 2 inches (*50 mm*) per minute. Readings of peel strength shall be taken at every 1/2 inch (*12.5 mm*) of jaw separation after the 1 inch (*25 mm*) initial separation. Peel strength shall be defined by the average of five readings.

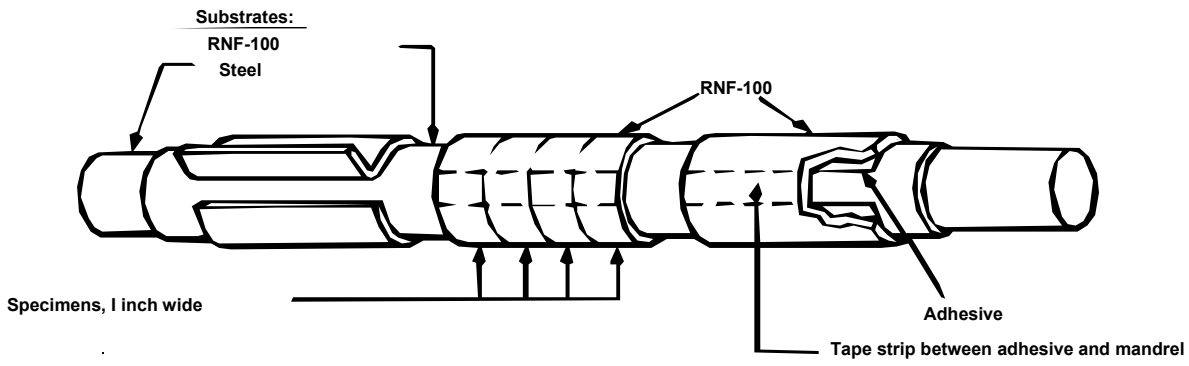
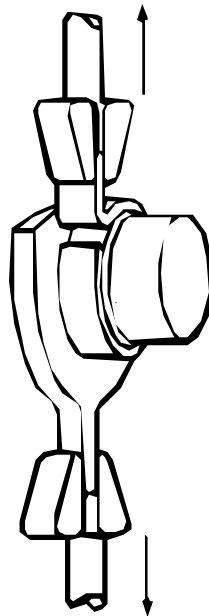


Figure 2 Peel Specimen Preparation



Figures 3 Peel Specimen in Tensile Tester

4.3.2 Electrical

4.3.2.1 Dielectric Strength

The dielectric strength shall be determined in accordance with ASTM D 149. Measurements shall be made under oil using 1-inch (25-mm) electrodes on a 6 x 6 x .050-inch (152 x 152 x 1.3-mm) sheet specimen prepared according to paragraph 4.2.1.1. The rate of rise shall be 500 volts per second. Thickness measurements shall be made at the point of breakdown for the purpose of calculating dielectric strength. Five readings shall be determined for dielectric strength.

4.3.2.2 Volume Resistivity

The volume resistivity shall be determined on sheet specimens referenced in Section 4.2.1.1 in accordance with ASTM D 257. The specimens shall be prepared using silver paint electrodes.

4.3.3 Chemical

4.3.3.1 Corrosive Effect

The corrosive effect shall be determined in accordance with ASTM D 2671, Procedure A. The specimens shall be 1/4 x 1-inch (6.3 x 25-mm) strips, and shall be exposed for 16 hours at $121 \pm 3^{\circ}\text{C}$ ($250 \pm 5^{\circ}\text{F}$).

4.3.3.2 Solvent and Fluid Resistance

Seven test assemblies, one for each of the fluids listed in Table 1, shall be prepared and tested in accordance with Figures 4 and 5 and the following:

4.3.3.2.1 Test Assembly Preparation

For each test assembly, fourteen 15-inch (381-mm) lengths of 44A0111-20-9 wire in accordance with Raychem Specification 44, shall be stripped back 1/2 inch (12.5 mm) at each end. A 1-inch (25-mm) length of S-1048 adhesive in tube form (SAS-090) shall be mounted on each wire, 2 inches (50 mm) from the lower end (Figure 4). An approximate 10-inch (250 mm) length of size 1" Thermofit RNF-100, Type 2 in accordance with Raychem RT-350 shall be recovered over the wires such that an end bell is created at the top (Figure 5). The heat source shall be a hot air gun (Raychem Model 500B or equivalent). Additional heat shall be applied in the area of the adhesive bundle for 5 minutes at approximately 200°C (392°F) forming a solid, continuous mass of adhesive to provide a barrier against fluid leakage (Figure 5). The lower end of the tubing shall be sealed by applying a strip of S-1048 tape, heating and crimping while the assembly is still warm.

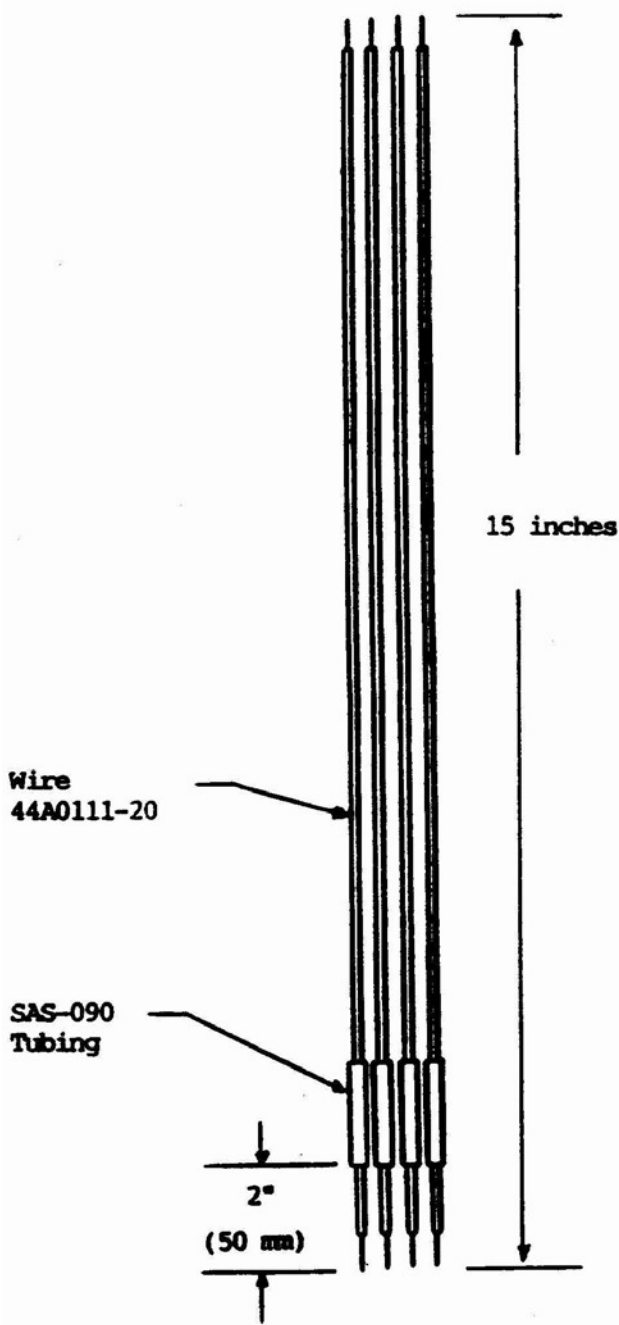


Figure 4

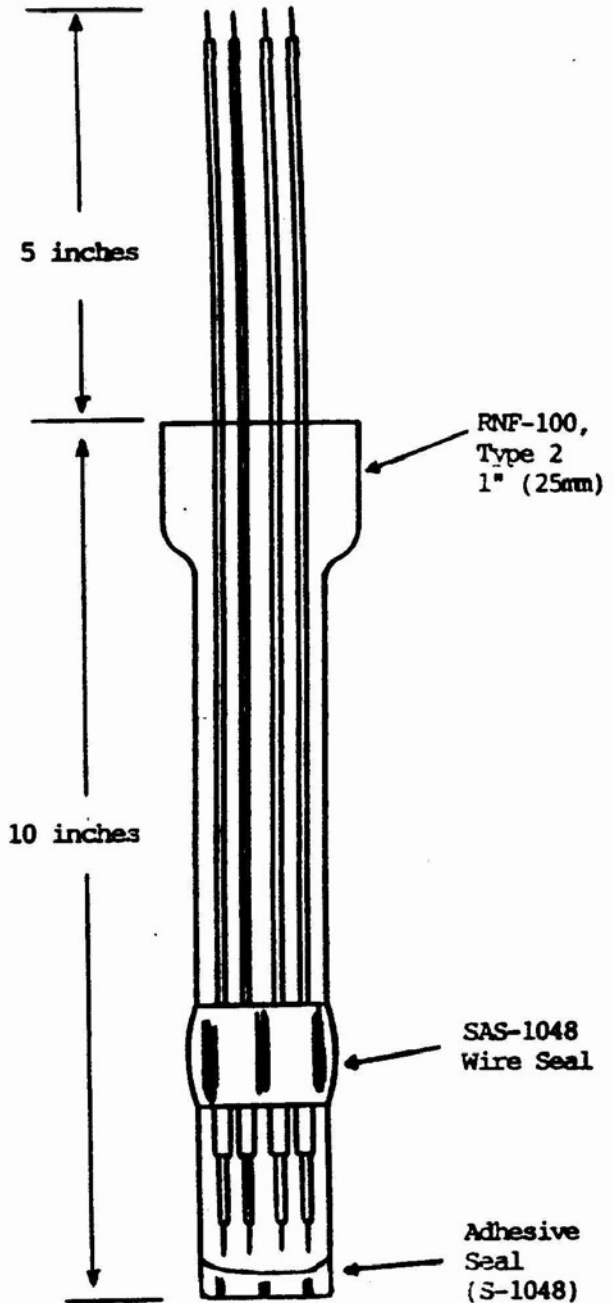


Figure 5

4.3.3.2.2 Testing

The end bell reservoir of each specimen shall be filled with a 5% salt solution for 4 hours and the insulation resistance between the solution and the wire ends shall be measured using a 500-volt potential. The salt solution shall be removed, the reservoir rinsed with distilled water and dried. After drying, each end bell reservoir shall be filled with one of the fluids from Table 1. Each specimen with the fluid shall then be conditioned for 30 days at the temperature specified in Table 1. The fluid level shall be maintained during the period of conditioning.

After conditioning, the specimens shall be visually examined for fluid leakage or material degradation. Leakage of fluid through the wire seal area or degradation of the adhesive shall be cause for rejection.

After examination, the test fluid shall be emptied from the reservoir, the reservoir rinsed with distilled water and re-filled with 5% salt solution for 4 hours. The insulation resistance shall then be measured between a ground wire in the solution above the wire seal and the wire end.

4.3.4 Rejection and Retest

Failure of any adhesive to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Material which has been rejected may be replaced or reworked and resubmitted for acceptance. Before resubmitting, full particulars concerning previous action taken to correct the defects shall be furnished to the inspector.

5. PREPARATION FOR DELIVERY

5.1 PACKAGING

Unless otherwise specified, the adhesive shall be in packages containing a measured quantity of material, in conformance with good commercial practice.

5.2 MARKING

Unless otherwise specified, each package of adhesive shall be marked with the product designation, the batch number or lot number, date of manufacture and manufacturing data.

TABLE 1
Requirements

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
PHYSICAL			
Visual	Pass		Section 4.3.1.1
Dimensions	inches	In accordance with applicable drawing	ASTM D 2671
Specific Gravity	--	1.00 ± 0.05	Section 4.3.1.2 ASTM D 792
Flow 30 minutes at 200 ± 3°C (392 ± 5°F)	inches	.125 max.	Section 4.3.1.3
Softening Point	°C	90 ± 10	Section 4.3.1.4
Low Temperature Flexibility -55 ± 2°C (-67 ± 4°F)	--	No cracking	Section 4.3.1.5
Adhesive Peel Polyethylene to Polyethylene Polyethylene to Steel	lbs/in. width	15 min. 15 min.	Section 4.3.1.6 Section 4.3.1.6.1 Section 4.3.1.6.2
ELECTRICAL			
Dielectric Strength	volts/mil	500 min.	Section 4.3.2.1 ASTM D 149
Volume Resistivity	ohm-cm	1 x 10 ¹⁰ min.	Section 4.3.2.2
CHEMICAL			
Water Absorption 24 hours at 23 ± 3°C (73 ± 5°F)	percent	2.0 max.	ASTM D 570
Corrosive Effect 16 hours at 121 ± 3°C (250 ± 5°F)	--	Non-Corrosive	Section 4.3.3.1 ASTM D 2671 Procedure A
Fungus Resistance	--	Rating of 1 or less	ASTM G 21
Solvent and Fluid Resistance Insulation Resistance (before and after exposure) 30 days at 50 ± 2°C (122 ± 4°F) in: Hydraulic Fluid (MIL-H-5606) Lubricating Oil (MIL-L-23699) Anti-Icing Fluid (MIL-A-8243) Cleaning Compound (pH 10 max.) (MIL-C-87936) Cleaning Compound (pH 10 max.) (MIL-C-43616) Cleaning Compound (pH 10 max.) (P-C-444, Type I) Cleaning Compound (pH 10 max.) (P-C-444, Type II)	-- ohms	-- 1 x 10 ¹⁰ min.	Section 4.3.3.2 ASTM D 257