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AEROSPACE MATERIAL SPECIFICATION

SAE AMS3283 REV. B

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Stabilized 2011-09

Superseding AMS3283A

Sealing Compound, Polysulfide Non-Curing, Groove Injection Temperature and Fuel Resistant

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

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1. SCOPE:

1.1 Form:

This specification covers a permanently mastic polysulfide compound in the form of a paste.

1.2 Application:

This product has been used typically for sealing or resealing integral fuel tanks designed for groove-injection type sealing for use from -65 to +250 °F (-54 to +121 °C), with intermittent use to 300 °F (149 °C).

1.3 Classification:

Sealing compounds covered by this specification are classified as follows:

Class 1 - Medium viscosity, permanently mastic, fuel resistant, polysulfide paste compound suitable for sealing applications with structural mismatch of 0.008 inch (0.20 mm) or less.

Class 2 - High viscosity, permanently mastic, fuel resistant, polysulfide paste compound suitable for sealing applications with structural mismatch of 0.015 inch (0.38 mm) or less. Normally contains glass bead filler material.

1.4 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2471	Anodic Treatment, Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
AMS 2629	Jet Reference Fluid
AMS 2825	Material Safety Data Sheets
AMS 3660	Polytetrafluoroethylene Moldings, As Sintered, General Purpose Grade
AMS 3819	Cloths, Cleaning for Aircraft Primary and Secondary Structural Surfaces
AMS 4035	Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024-0), Annealed
AMS 4045	Aluminum Alloy Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075; -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS 5070	Steel Bars and Forgings, 0.18 - 0.23C (SAE 1022)
AMS 5640	Steel Bars, Wire, and Forgings, Corrosion Resistant, 18Cr - 9.0Ni, (SAE 30303, 30303Se, 30303 Mod) Free Machining
AMS 6370	Steel Bars, Forgings, and Rings, 0.95Cr - 0.20Mo - (0.28 - 0.33C) (SAE 4130)
AMS-QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 471 Rubber Property - Effect of Liquids

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

TT-S-735	Standard Test Fluids, Hydrocarbon
MIL-S-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT General Specification for
MIL-C-7742	Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-C-27725	Coating, Corrosion Preventive, for Aircraft Integral Fuel Tanks
MIL-P-38714	Packaging and Packing of Two Component Materials in Semkits
MIL-C-38736	Compound, Solvent; for Use in Integral Fuel Tanks
MIL-STD-2073-1	DOD Materiel, Procedures for Development and Application of Packaging Requirements
AN 3	Bolt and Machine, Aircraft

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Sealing compound shall be a permanently deformable, non-curing polysulfide product which does not contain solvents.

3.1.1 Appearance: Sealing compound shall exhibit no separation of components. Occluded gases shall not be permitted.

3.1.2 Storage Life: The sealing compound shall meet the requirements of 3.2 after storage at 77 °F (25 °C) for 12 months from date of manufacture (date of last acceptance tests conducted by manufacturer).

3.1.2.1 Storage Life Updating: At the expiration of the storage life time, sealing compound meeting the requirements of 3.2.1, 3.2.2, 3.2.4, and 3.2.5 may have its storage life extended 3 months. Up to four extensions will be allowed.

3.2 Properties:

Sealing compound shall conform to the requirements shown in Table 1, determined in accordance with specified test methods.

TABLE 1 - Properties

Paragraph	Property	Requirements	Test Method
3.2.1	Specific Gravity		4.5.2
	Class 1	1.6 max	
	Class 2	1.6 max	
3.2.2	Nonvolatile Content, minimum	97%	4.5.3
3.2.3	Extrusion		4.5.4
	Class 1	200 - 325 pounds force	
	Class 2	250 - 370 pounds force	
3.2.4	Corrosion Resistance	The surface of the panel which was in contact with sealing compound shall have no more corrosion or severe discoloration than the uncoated panel.	4.5.5

TABLE 1 - Properties (Continued)

Paragraph	Property	Requirements	Test Method
3.2.5	Pressure Rupture, minimum		4.5.6
	Class 1	5 inches (127 mm) Hg	
	Class 2	7 inches (178 mm) Hg	
3.2.6	Fuel Resistance		4.5.7
3.2.6.1	Volume Change		
3.2.6.1.1	Jet Reference Fluid (AMS 2629)	+5 to +35%	
3.2.6.1.2	TT-S-735, Type 1, Fluid	0 to +10%	
3.2.6.2	Weight Loss, maximum	6%	
3.2.7	Sealability	No leaks, one re-injection allowed	4.5.8
3.2.8	Reinjection Time, maximum	20 seconds	4.5.8
3.2.9	Adhesion, minimum	Cohesive 85%	4.5.9
3.2.10	Tow Temperature Flexibility	No cracking or loss of adhesion	4.5.10

3.3 Quality:

The compound, as received by purchaser, shall be uniform in quality and consistency and free from foreign materials and from imperfections detrimental to usage of the compound.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of sealing compound shall supply all samples and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the compound conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for nonvolatile content (3.2.2), extrusion (3.2.3), pressure rupture (3.2.5), and fuel resistance (3.2.6) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of compound to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient compound shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A batch shall be all compound run through a mixer at one time.

4.3.1.2 An inspection lot shall be not more than 200 gallons (757 L) of compound from one batch.

4.3.1.3 When a statistical sampling plan has been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3 and the report of 4.6 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Preproduction sample compound shall be approved by purchaser before compound for production use is supplied, unless such approval be waived by purchaser. Results of tests on production compound shall be essentially equivalent to those on the approved sample compound.

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production compound which are essentially the same as those used on the approved sample. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample compound. Production compound made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Standard Conditions:

4.5.1.1 Laboratory Test Conditions: Standard laboratory test conditions shall be 77 °F ± 2 (25 °C ± 1) and 50% ± 5 relative humidity. Except as otherwise specified herein, all test specimens shall be prepared and tested under these conditions.

4.5.1.2 Standard Tolerances: Unless otherwise specified herein, standard tolerances shall be as shown in Table 2.

TABLE 2 - Standard Tolerances

Condition	Value
Temperature	±2 °F (1 °C)
Days	±2 hours
Hours	±5 minutes
Minutes	±1
Seconds	±1
Pressure	±1 psi (7 kPa)
Inches (mm)	±0.01 inch (0.25 mm)

4.5.1.3 Standard Cleaning: Unless otherwise specified herein, all test panels and jigs shall be cleaned using MIL-C-38736 solvent and AMS 3819, Grade A, cleaning cloths.

4.5.2 Specific Gravity: The specific gravity shall be determined in triplicate during the fuel resistance test. The weights W_1 through W_4, of 4.5 shall be used as follows in Equation 1:

$$\text{Specific Gravity} = \frac{W_3 - W_1}{(W_2 + W_3) - (W_1 + w_4)} \quad \text{(Eq.1)}$$

where:

W_1 = Weight of panel in air
W_2 = Weight of panel in water
W_3 = Weight of panel and sealing compound in air
W_4 = Weight of panel and sealing compound in water

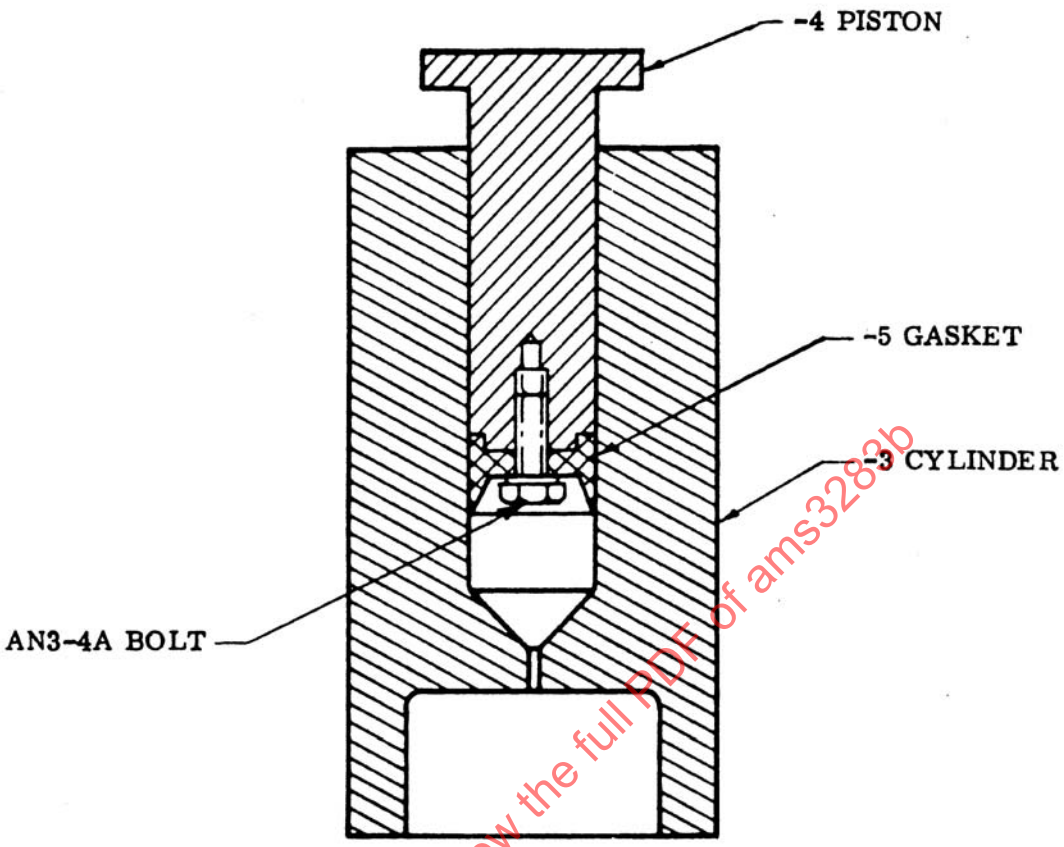
4.5.3 Nonvolatile Content: Five to ten grams of sealing compound shall be transferred to a tared covered cup approximately 3 inches (76 mm) in diameter and 0.75 inch (19 mm) in depth. The specimen shall be weighed to the nearest milligram and the weight of the sealing compound calculated. The cover shall be removed and the sealing compound heated for 168 hours at 160 °F (71 °C). Compound shall be cooled in a desiccator at standard conditions, the cover replaced, and the specimen reweighed. The test shall be run in duplicate and the average of the results reported. The total nonvolatile content percentage shall be calculated as shown in Equation 2:

$$\text{Percent Nonvolatile Content} = \frac{\text{Final Weight}}{\text{Initial Weight}} \times 100 \quad \text{(Eq.1)}$$

4.5.4 Extrusion: The extrusion plastometer shown in Figures 1 and 2 shall be packed with a hand rolled, cylindrically shaped mass of sealing compound about 0.75 inch (19 mm) in diameter and 2.25 to 2.50 inch (57.2 to 63.5 mm) long. Special precaution should be taken to avoid forming air pockets in the slug of sealing compound. Sufficient fingertip pressure shall be used to force the sealing compound into intimate contact with the cylinder walls. The packed apparatus shall be stabilized for 24 hours at standard conditions. At the end of the stabilization period, insert the plastometer piston, center the assembly on the fixed base of a tensile machine, and load in compression at the constant rate of 0.100 inch ± 0.002 (2.54 mm ± 0.05) per minute. When the top of the piston is approximately 1.25 inches (31.8 mm) from the top of the plastometer cylinder, the maximum scale load which occurs during the ensuing 0.25 inch (6.4 mm) of piston travel shall be recorded. Clean the plastometer completely after each trial. Make a blank determination on the empty plastometer and subtract the scale load obtained from the maximum scale loads obtained when the sealant was tested. The test shall be run in duplicate and the average of the results reported. Individual test results shall not deviate by more than 10% of the average value.

4.5.5 Corrosion Resistance: Two AMS 4045 panels approximately 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm) in size shall be cleaned. Two parallel fillets of sealing compound 0.06 inch (1.5 mm) thick by 0.75 inch (19 mm) wide by 5 inches (127 mm) long shall be applied to one of the panels. That panel shall be set aside under standard conditions, lying horizontally with the sealing compound face up, for at least 24 hours. Both panels shall be immersed vertically for 20 days in a covered glass vessel containing a 2-layer liquid consisting of a 3% aqueous sodium chloride solution and AMS 2629, Type I, jet reference fluid, so that 1.6 inches (41 mm) of the panels are exposed to the salt water, 1.6 inches (41 mm) exposed to jet reference fluid, and the remainder exposed to air-vapor mixture. The temperature during the exposure shall be maintained at 140 °F (60 °C). Immediately upon removal from the liquid, the sealant shall be removed using a plastic scraper and the panels examined for evidence of corrosion.

4.5.6 Pressure Rupture: Specimens constructed in accordance with Figure 3 and finished as listed in Table 3 shall be used. Pack the sealing compound into the specimens, taking care to eliminate air bubbles, and stabilize the specimens at standard conditions for not less than 24 hours. The specimens shall be cooled to below -20 °F (-29 °C) and the excess material trimmed from the surfaces with a razor blade. One of the specimens shall be mounted in the pressure rupture jig (Figure 3). One air hose bib of the apparatus shall be connected to a manometer, the other to a variable pressure source. The assembly shall be immersed in a water bath at 77 °F (25 °C) and stabilized for five minutes. Starting at atmospheric pressure, the pressure on the apparatus shall be uniformly increased at the rate of 1 inch (25 mm) of mercury per 15 seconds until failure occurs. A continuous stream of air bubbles observed to come from the specimen shall constitute a failure. The pressure applied at the time of failure shall be recorded. Test the other two specimens in the same manner. The average failure pressure of the three specimens shall be reported to the nearest 0.5 inch (13 mm) of mercury (Hg).



NOTES:

1. Material of -3 Cylinder; AMS 6370 Steel Bar, Heat Treat 180 to 200 ksi (1241 to 1379 MPa)

2. Material of -4 Piston; AMS 5070 Steel Bar,
   Case Harden 0.032 inch (0.81 mm) Deep
   Case 55 HRA, minimum
   Core Strength 55.0 ksi (379 MPa), minimum

3. Material of -5 Gasket; AMS 3660 Plastic Rod

4. Machine finish all surfaces 250 microinches (6.35 mm) except as noted

5. Tolerances to be ± 0.005 inch (± 0.13 mm), except as noted.

FIGURE 1 - Extrusion Plastometer

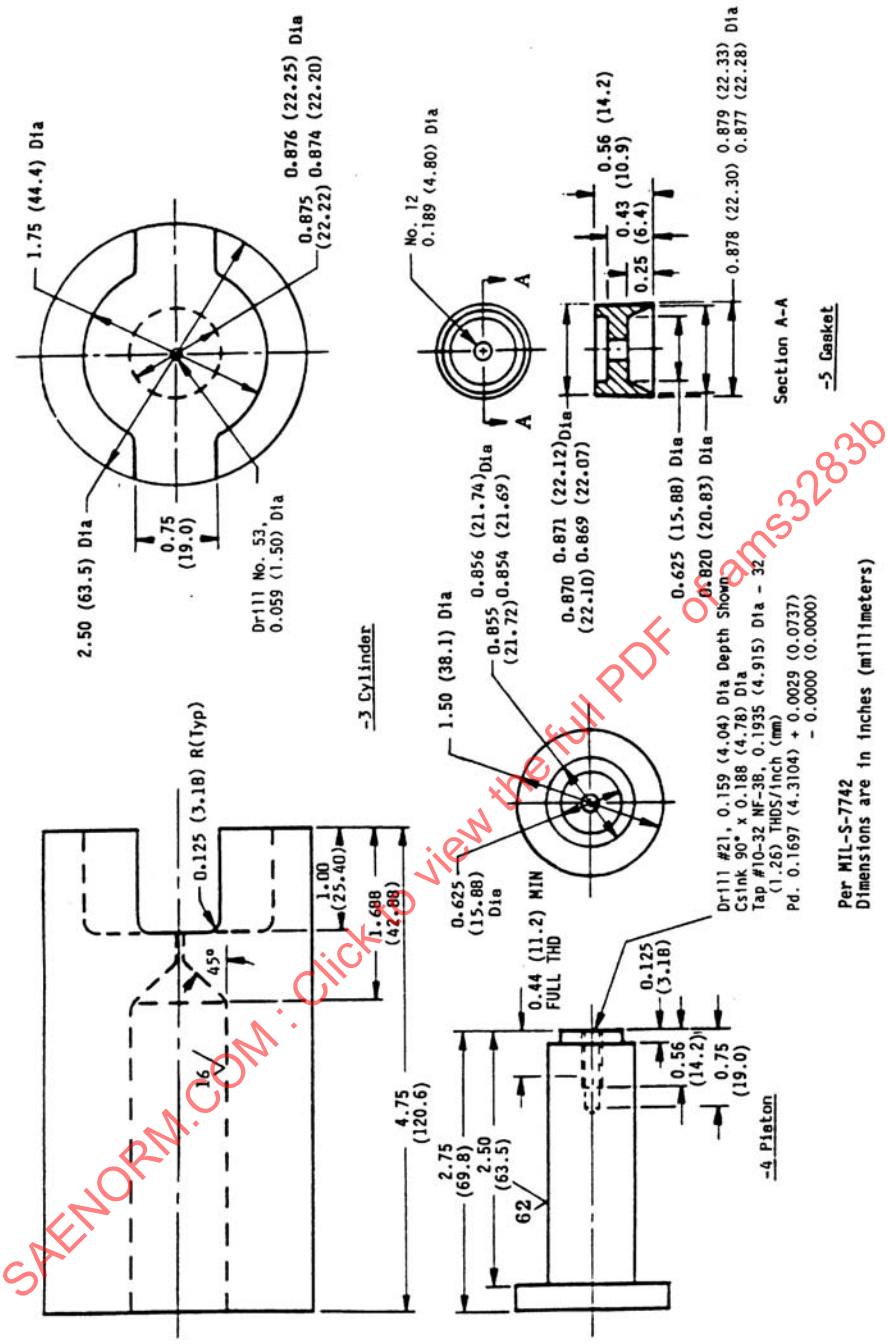
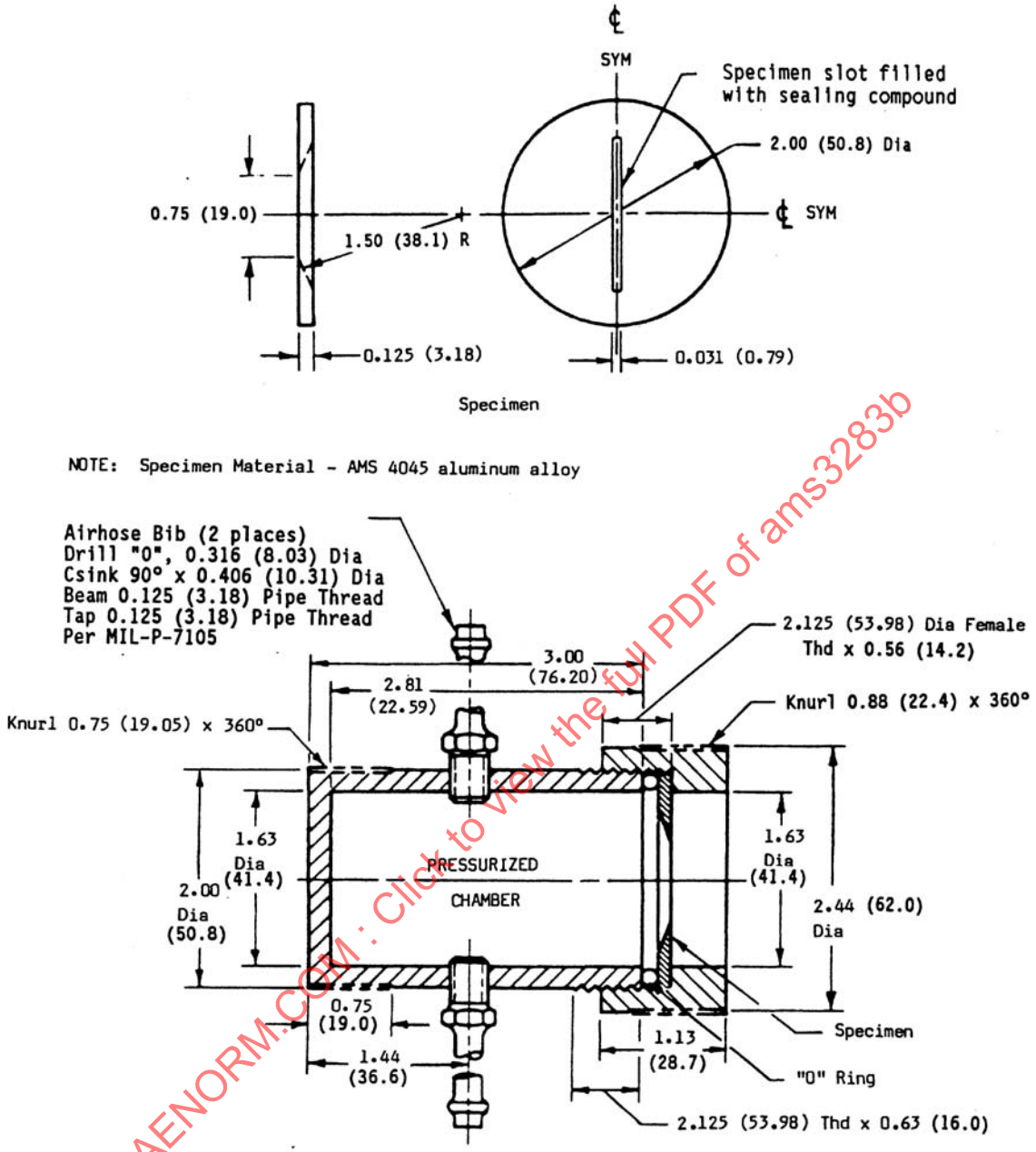


FIGURE 2 - Extrusion Plastometer



1. Dimensions are in inches (millimeters)

FIGURE 3 - Pressure Rupture Jig

TABLE 3 - Pressure Rupture Specimens (3 each required)

1. Anodized in accordance with AMS 2471.
2. Sulfuric acid anodized in accordance with AMS 2471 and coated with MIL-C-27725 corrosion preventive coating. Application, coating thickness, and curing shall be in accordance with manufacturer's recommendations. Care shall be taken to ensure a thin, even coat in the slot.

4.5.7 Fuel Resistance: Six AMS 4045 aluminum panels, approximately 0.040 x 1 x 2.50 inches (1.02 x 25 x 63.5 mm), shall be weighed accurately to the nearest milligram in air (W_1), and in water (W_2). A pad of sealing compound 0.06 x 1 x 2 inches (1.5 x 25 x 51 mm) shall be applied to each panel. One-half inch (12.7 mm) at one end of each panel shall not be coated for handling purposes. The sealant coated panels shall then be weighed in air (W_3) and in water (W_4). The panels shall be conditioned at standard conditions for 24 hours. The panel shall then be exposed for 14 days at 160 °F (71 °C) with three of the panels immersed in AMS 2629, Type I, fluid and the other three in TT-S-735, Type I, fluid. The panels shall be weighed immediately upon removal from the fluid in air (W_5) and in water (W_6). The procedures in accordance with ASTM D 471 shall be used. The percent change in volume shall be determined by the formula, Equation 3. The reported value shall be determined by averaging the three values obtained for each exposure. The average value shall be determined to the nearest 0.1%.

$$\text{Percent Volume Change} = \frac{(W_5 - W_6) - (W_3 - W_4)}{(W_3 - W_4) - (W_1 - W_2)} \times 100 \qquad \text{(Eq.1)}$$

4.5.7.1 Each specimen shall then be placed in an oven at 200 °F (93 °C) for 24 hours, cooled to standard conditions for at least 2 hours, and weighed in air (W_7). The percentage weight loss shall be determined by the formula, Equation 4.

$$\text{Percentage Weight Loss} = \frac{W_3 - W_7}{W_3 - W_1} \times 100 \qquad \text{(Eq.1)}$$

4.5.7.1.1 The average of the three values obtained for each exposure shall be determined to the nearest 0.1%.

4.5.8 Sealability and Reinjection:

4.5.8.1 Jig Assembly: Washer and shim thicknesses required for jig assembly are shown in Table 4.

TABLE 4 - Jig Assembly

Sealant Class	Washer and Shim Thickness Inch	Washer and Shim Thickness Millimeter
Class 1	0.008 inch ± 0.0002	0.20 mm ± 0.005
Class 2	0.015 inch ± 0.0002	0.38 mm ± 0.005

4.5.8.2 A groove injection pressure test jig conforming to Figures 4 and 5 shall be cleaned. Metal washers 0.008 inch (0.20 mm) thick for Class 1 sealant and 0.015 inch (0.38 mm) thick for Class 2 sealant shall be installed on each bolt between the plates of the assembly. The washers shall have an I.D. of 0.26 inch (6.6 mm) and an O.D. of 0.50 inch (12.7 mm). The washers on the outer circle of bolts shall be squared so as not to extend into the groove. During assembly, the head and nut area of the inner circle of bolts shall be sealed with additional sealant to prevent spurious leakage. The bolts shall be torqued to 60-inch pounds (6.8 N·m) and sealant injected into the groove through the three injection ports I, II, and III. A suitable sealing compound injection gun with a 70 to 1 injection pressure to air line pressure ratio shall be used for sealant injection. The line air pressure shall be maintained, so, that the maximum pressure developed at the injection tip (See Figure 4) is 2800 psi ± 70 (19.3 MPa ± 0.5). The sealing compound shall be injected into the jig as follows:

a. With all ports unplugged, inject into I until a .50 inch (12.7 mm) sealant worm emerges from ports II and III.
b. Insert a plug screw into I and inject into II until a .50 inch (12.7 mm) sealant worm emerges from III.
c. Plug II, then unplug I and inject into III until a .50 inch (12.7 mm) sealant worm emerges from I.
d. Block all injection ports with plug screws.

4.5.8.3 Pressure Test: To ensure that the jig is initially sealed, the following shall be done:

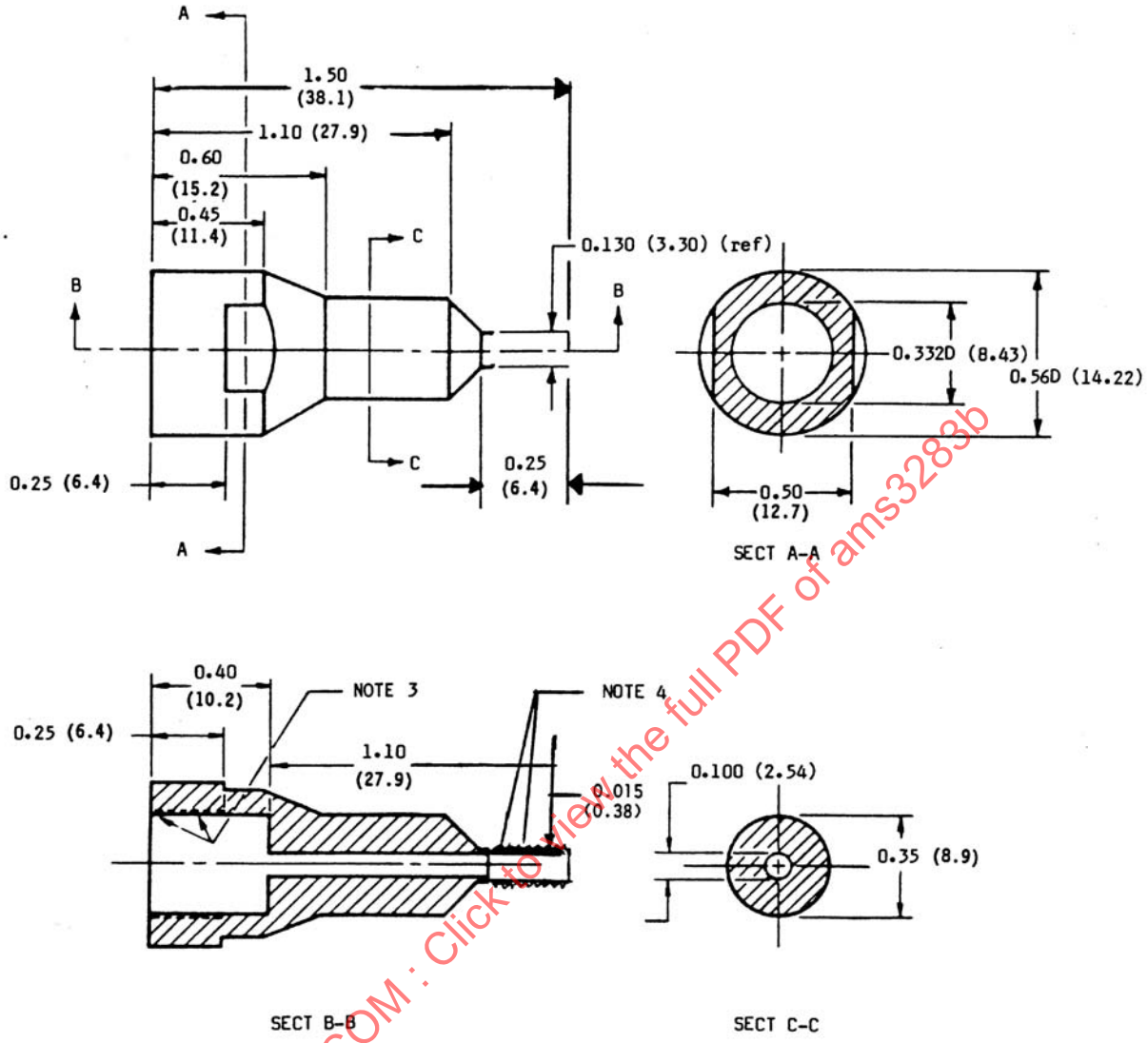
4.5.8.3.1 Immerse the jig in water.

4.5.8.3.2 Pressurize the jig to 5 psi (34.5 kPa).

4.5.8.3.3 Close the needle valve.

4.5.8.3.4 Watch for bubbles in the water.

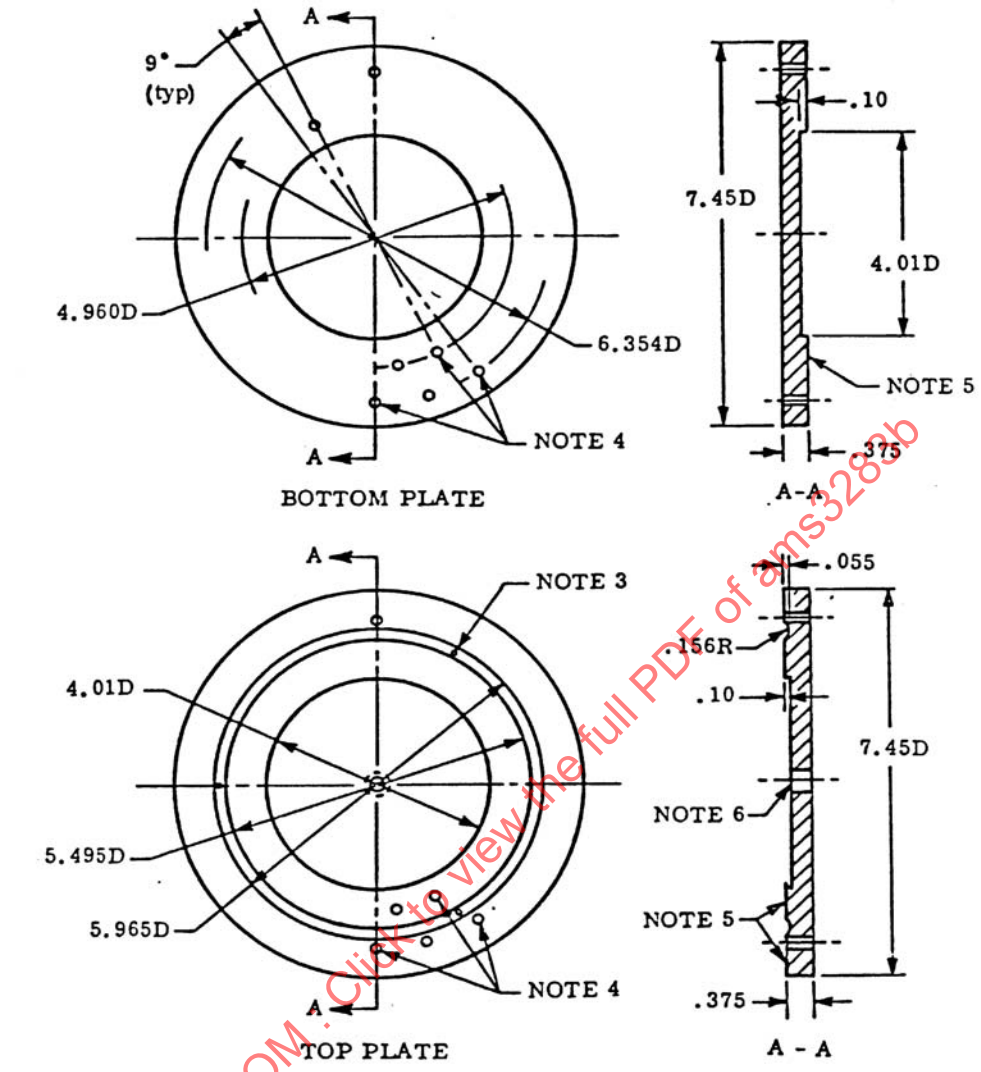
4.5.8.3.5 Reinject the proper portion of compound into the groove to stop the leak and pressure test again in water.



NOTES:

1. Material - AMS 5640 Steel Rod
2. Tolerances: .XX ± 0.010 (0.25), .XXX ± 0.002 (0.05)
3. Tap 3/8-24 UNF-3B 0.375 (9.52) Dia - 24 (0.9) THDS/inch (mm) per MIL-S-7742. Countersink 100° by 0.375 (9.52) diameter.
4. Tap 8-32 0.199 (5.05) Dia - 32 (1.26) THDS/inch (mm) (optional)
5. All dimensions are in inches (millimeters)

FIGURE 4 - Injection Tip



NOTES:

1. Material - .375 aluminum plate, 2024-T851 per AMS-QQ-A-250/4.
2. Tolerances: .XX ± .010, .XXX ± .005, hole diam. ±.002, angles ± 0°15'
3. Hole centered on groove 3 places thru top plate at 120° intervals. (Csink 100° x .164 diam. on side opposite groove. Tap 8-32 UNC-3B thru per MIL-S-7742. Install appropriate size set screw.)
4. .25 diam. hole (40 places thru each plate to match)
5. Surface indicated shall be flat within .001 max.
6. Drill and tap for 1/4 NPT.
7. Dimensions are in inches.

FIGURE 5 - Seal Efficiency Test Fixture

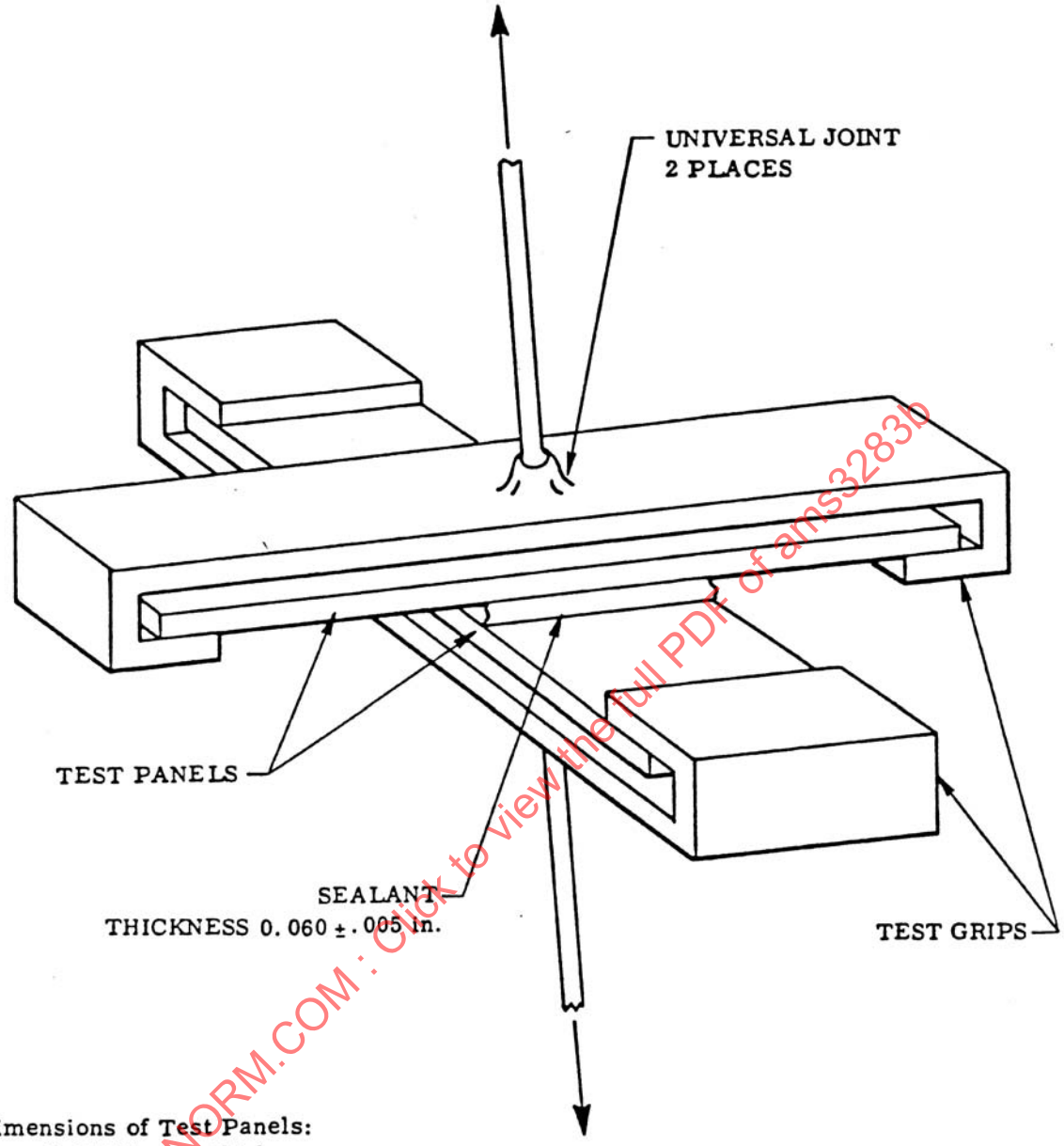
4.5.8.4 Exposure Conditions for Seal Efficiency: The exposure conditions shall be as shown in Table 5 using JP-8 as the fuel.

TABLE 5 - Exposure Conditions

Phase	Exposure Conditions
Liquid Fuel (JP-8) (maintain 7 psi (49 kPa) pressure in fixture)	24 hours @ 77 °F (25 °C) 72 hours @ 100 °F (38 °C) 5 hours @ 120 °F (49 °C) 1 hour @ 160 °F (71 °C), followed by immediate pressurization to 15 psi (105 kPa), hold for 2 minutes. Depressurize to atmospheric pressure. 16 hours @ 77 °F (25 °C) measure fuel.
Fuel vapor (Approximately 10% liquid fuel)	Drain fuel. Do not allow the fixture to dry. Add 5 ml of test fluid. Pressurize to 7 psi (49 kPa) (maintain 7 psi (49 kPa) in fixture) 20 hours @ 100 °F (38 °C) 3 hours @ 120 °F (49 °C) 1 hour @ 160 °F (71 °C), followed by pressure increase to 15 psi (105 kPa), hold for 2 minutes. Depressurize to atmospheric pressure. 16 hours @ 77 °F (25 °C)

4.5.8.5 Repeat 4.5.8.4 five times for a total of six cycles.

4.5.9 Adhesion: Twenty four 0.040 thick x 1 x 4-inch (1 x 25 x 100 mm) aluminum panels conforming to AMS-QQ-A-250/4 shall be prepared; twelve with chemical film conforming to MIL-C-5541 and twelve with coating conforming to MIL-C-27725 applied and cured in accordance with 4.5.2.1. Place a ball of sealing compound in the center one-square inch (25 mm square) section of twelve panels. Place another panel crosswise 90 degrees in relation to the lower panel and compress evenly to leave a 0.060 ± .005-inch (1.5 ± 0.1 mm) thickness of sealant separating the faying surfaces and forming a crosslap specimen. Remove excess sealing compound to leave a one-inch square sealant area (25 mm square) and condition the specimens for 24 hours at standard conditions (4.5.1). Place six of the specimens in an autographic tension testing machine using self-aligning grips similar to Figure 6. The machine jaw separation rate shall be 2.0 inches (50.8 mm) per minute with the force applied vertical to the crosslap faying surface until total separation occurs. The panel surfaces shall be examined and the average cohesive value reported for conformance to Table 1. The remaining six specimens shall be placed in a refrigerated box at -51 °C ± 1 °C (-60 °F ± 2 °F) and held for 2 hours. The specimens shall then be tested for adhesion at -51 °C and examined for conformance to Table 1.



Dimensions of Test Panels:
0.040 inches thick
1 inch wide
4 inches long
Tolerances for all dimensions ±0.005 inches
Aluminum conforming to AMS-QQ-A-250/4

FIGURE 6 - Adhesion Test Fixture