SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3279

Issued MAR 1997

Submitted for recognition as an American National Standard

SEALING COMPOUND, SPRAYABLE, For Integral Fuel Tanks and Fuel Cell Cavities, Intermittent Use to 350 °F (177 °C)

1. SCOPE:

1.1 Form:

This specification covers one type sprayable fuel resistant polythioether urethane sealing compound supplied as a two-component system.

1.2 Application:

This product has been used typically for sealing metal or composite integral fuel tanks by spray application, but usage is not limited to such applications. It can be used for original fuel tank sealing of seams, joints, fasteners, and fay surface edges or for repair of conventional fillet and fastener seals. As a fuel containment barrier it can also be used on the interior or exterior of auxiliary fuel tanks and fuel cell cavities. It can be cured at ambient temperatures or with mild heat up to 140 °F (60 °C) following an initial 4 to 5 hour ambient cure period after each coating application. A primer, specified by the sealant manufacturer, is required with the sealing compound and must be applied prior to sealing. The sealing compound can be applied in fuel tank and non-fuel tank areas by the use of a spray gun. Sealant can be applied by brush for small touch-up repairs. The sealing compound is useable long term from -65 to 250 °F (-54 to 121 °C), with short term (up to 6 hours) exposures up to 350 °F (177 °C).

1.3 Classification:

The sealing compound shall be suitable for spray application and supplied in the following classes:

Class A - White
Class B - Black

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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 of Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
AMS 2629	Fluid, Jet Reference
AMS 2825	Material Safety Data Sheets
AMS 3023	Fluid, Reference, For Testing Polyol Ester (and Diester) Resistant Material
AMS 3276	Sealing Compound, Integral Fuel Tanks and General Purpose, Intermittent Use to 360 °F (182 °C)
AMS 3277	Sealing Compound, Polythioether, Integral Fuel Tanks and General Purpose, Fast Curing, Intermittent Use to 360 °F (182 °C)
AMS 3819	Cloths, Cleaning, for Aircraft Primary and Secondary Structural Surfaces
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 4049	Aluminum Alloy Sheet and Plate, Alclad, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (Alclad 7075 -T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS 4901	Titanium Sheet, Strip and Plate, Annealed, 70 ksi (485 MPa) Yield Strength
AS7001	National Aerospace and Defense Contractors Accreditation Program (NADCAP) Program Description
AS7002	National Aerospace and Defense Contractors Accreditation Program (NADCAP) Rules for Implementation
AS7003	National Aerospace and Defense Contractors Accreditation Program (NADCAP) Program Operation
AS7201	National Aerospace and Defense Contractors Accreditation Program (NADCAP) Requirements for Accreditation of Pass-Thru Distributors
AS7202	National Aerospace and Defense Contractors Accreditation Program (NADCAP) Requirements for Accreditation of Value Added Distributors
AS7202/1	National Aerospace and Defense Contractors Accreditation Program - Audit and Inspection Checklists for the Sealant Manufacturers Accreditation Program

2.2 ASTM Publications:

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

ASTM D 412	Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 792	Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 2240	Rubber Property - Durometer Hardness
ASTM D 3960	Volatile Organic Compound (VOC) Content of Paints and Related Coatings

2.3 U.S. Government Publications:

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

PPP-B-636	Box, Shipping Fiberboard
PPP-C-96	Can, Metal, 28 Gage and Lighter
PPP-P-704	Pail, Metal (Shipping Steel, 1 through 12 gallon)
MIL-A-9962	Abrasive Mats, Non-woven, Non-metallic
MIL-P-23377	Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant
MIL-C-27725	Coating, Corrosion Preventive, for Aircraft Integral Fuel Tanks
MIL-C-38334	Corrosion Removing Compound, Prepaint, For Aircraft Aluminum Surfaces
MIL-C-38736	Compound, Solvent, for Use in Integral Fuel Tanks
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-H-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft
MIL-C-85285	Coating, Polyurethane, High Solids
MIL-C-87936	Cleaning Compounds, Aircraft Exterior Surfaces, Water Dilutable
MIL-S-8802	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion
MIL-STD-2073-1	DOD Materiel, Procedures for Development and Application of Packaging Requirements
DOL-29 CFR 1910.1200	Occupational Safety and Health Standards - Hazard Communications (Dept. of Labor)

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

The basic ingredient shall be isocyanate terminated polythioether synthetic polymer. The sealing compound shall cure by the addition of a curing agent to the base compound, and shall not depend on solvent evaporation for curing. The compound shall contain no lead compounds. The curing agent shall possess sufficient color contrast to the base compounds to permit easy identification of an unmixed or incompletely mixed sealing compound. Neither the base compound nor the cured sealant shall be red or pink in color. A primer, as recommended by the manufacturer, is required.

3.2 Volatile Content:

The mixed sealant shall have a maximum volatile organic compound content (VOC) of 600 grams/liter (g/l) when tested in accordance with ASTM D 3960.

3.3 Sprayed Film Appearance:

Sprayed films of mixed sealant shall be uniform and free of bubbles and blisters when tested in accordance with 4.5.10.3.

3.4 Properties:

The sealing compound when mixed in accordance with the manufacturer's instructions and cured as in 4.5.2.7 shall conform to the requirements shown in Table 1, determined in accordance with the indicated test methods:

TABLE 1 - Properties

Paragraph	Property	Requirements	Test Methods
3.4.1	Specific Gravity, max	1.25	4.5.4
3.4.2	Hardness, Shore A, min	65	4.5.5
3.4.3	Nonvolatile Content (% by weight), min	50%	4.5.6
3.4.4	Viscosity of Base Compound	100 to 400 poises (10 to 40 Pa·s)	4.5.7
3.4.5	Viscosity of Curing Agent, max	5 poise (0.5 Pa·s)	4.5.8
3.4.6	Flow	No flow over 0.2 inch (5.08 mm)	4.5.9
3.4.7	Application Time	From the beginning of mixing the viscosity shall not exceed 200 poises (20 Pa·s) at two hours. It shall remain suitable for spray application during the two hour period.	4.5.10

TABLE 1 (Continued)

Paragraph	Property	Requirements	Test Methods
3.4.8	Tack-Free Time (from the beginning of mixing), max	6 hours	4.5.11
3.4.9	Standard Cure Rate Shore A 30, min	24 hours max	4.5.12
3.4.10	Fluid Immersed Cure Rate, Shore A min at 48 hours	40	4.5.13
3.4.11	Resistance to Thermal Rupture	No blistering or sponging 5/32 inch (4 mm) deformation, max	4.5.14
3.4.12	Low Temperature Flexibility	No visual evidence of cracking checking or loss of adhesion	4.5.15
3.4.13	Hydrolytic Stability, Tensile Strength and Elongation, min	800 psi (5516 kPa) 700% elongation	4.5.16
3.4.14	Corrosion	No corrosion or signs of sealant deterioration	4.5.17
3.4.15	Peel Strength, min	20 pounds force per inch (3503 N/m) with 100% cohesive failure	4.5.18
3.4.16	Chalking	None	4.5.19
3.4.17	Tensile Strength and Elongation, min		4.5.20
	Standard Cure as in 4.5.2.7	1300 psi (8963 kPa) 700% elongation	
	14 days at 140 °F (60 °C) in JRF	900 psi (6205 kPa) 700% elongation	
	8 hours at 350 °F (177 °C)	150 psi (1034 kPa) 100% elongation	

TABLE 1 - (Continued)

Paragraph	Property	Requirements	Test Methods
	3 days at 140 °F (60 °C) in JRF +3 days air dry at 120 °F (49 °C) +7 days air dry at 250 °F (121 °C)	700 psi (4826 kPa) 350% elongation	
	Standard Heat Cycle as in 4.5.1.3 +7 days in JRF at 140 °F (60 °C)	150 psi (1034 kPa) 120% elongation	
3.4.18	Weight Loss (max), Flexibility and Swell	5% No cracking or checking 5 to 30% swell	4.5.21
3.4.19	Repairability, min	5 pounds force per inch (876 N/m), 100% cohesive failure	4.5.22
3.4.20	Accelerated Storage Cure Rate at Standard Temperature Application Time Viscosity of Base Compound Peel Strength, min	 Same as 3.4.9 Same as 3.4.7 Same as 3.4.4 Same as 3.4.15	4.5.23.1
3.4.21	Long Term Storage	Sealant shall meet requirements of 3.4.20	4.5.23.2

3.5 Performance and Application Requirements:

Properties are divided up into two classifications, performance requirements and application requirements. Performance requirements define those properties of the cured sealant and its performance in service. Application requirements define those properties of the uncured sealant and affect the application parameters of the sealant, but have little or no effect on the performance properties of the cured sealant. Minor variation in the application requirements during acceptance testing may not be cause for rejection if approved by the procuring agency. Application requirements are listed below, all other requirements are performance requirements.

Viscosity of Base Compound
Viscosity of Curing Agent
Flow
Application Time
Tack-Free Time
Standard Cure Rate

3.6 Shelf Life:

The sealing compound shall have a minimum shelf life of six months from the date of packaging.

3.6.1 Date of Packaging: The date of packaging is defined as the date the finished material is assembled from its components, base compound and curing compound, into a packaged and labelled kit or unit by the sealant manufacturer or re-packager. Date of packaging shall be no more than 90 days from the last day of full acceptance testing in accordance with 4.2.1. Material may be retested by the sealant manufacturer at any time to determine conformance to full acceptance testing in accordance with 4.2.1.

3.7 Quality:

The base compound and the curing agent (accelerator), as received by purchaser, shall each be of uniform blend and shall be free of excessive air, skins, lumps, and gelled or coarse particles. There shall be no separation of ingredients which cannot be readily dispersed.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

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

4.1.1 Source Inspection: Material procured by the U.S. Military under this specification shall be third party approved prior to shipment, to ensure that the material meets the acceptance tests (4.2.1). Third party approval shall be by a third party accreditation process in accordance with AS7001, AS7002, AS7003, and AS7202/1. Sealant shall be from a manufacturer that current holds a third party accreditation and shall be from a batch of material that has been third party source inspected in accordance with AS7202/1. Distributors supplying sealant shall supply material from an accredited manufacturer and from a batch of material that has been third party source inspected. Distributors shall also be third party accredited in accordance with AS7201 or AS7202, whichever is applicable.

4.1.2 Shelf-life Surveillance and Updating:

4.1.2.1 Sampling: The minimum number of samples to be tested during shelf-life surveillance and updating is shown in Table 2.

TABLE 2 - Shelf-Life Surveillance Samples

Items in Stock	Samples to be Tested
Up to 100, excl	3
100 to 500, incl	5
over 500	7

4.1.2.2 Testing: The following inspections are to be conducted for shelf-life surveillance and updating.

a. Condition of Container
b. Application Time
c. Tack-Free Time
d. Standard Cure Rate
e. Viscosity of Base Compound
f. Viscosity of Curing Agent
g. Peel Strength - two aluminum panels sulfuric acid anodized in accordance with AMS 2471, coated with material conforming to MIL-C-27725 cured at standard conditions (4.5.1.1) for seven days. After sealant is applied and cured, age in JRF for seven days at 140 °F (60 °C).

Tests are to be conducted in accordance with the test methods outlined herein for acceptance tests. If the tests are being performed at the end of the stated shelf-life to update the shelf-life of the sealing compound, and all tests are passed, the shelf-life will be extended an additional three months.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Requirements shown in Table 3 are acceptance tests and shall be performed on each batch. A batch shall be the quantity of material run through a mill or mixer at one time.

TABLE 3 - Acceptance Tests

Requirement	Paragraph Reference
Hardness	3.4.2
Nonvolatile Content	3.4.3
Viscosity of the Base Compound	3.4.4
Viscosity of the Curing Compound	3.4.5
Flow	3.4.6
Application Time	3.4.7
Tack-Free Time	3.4.8
Standard Cure Rate	3.4.9
Resistance to Thermal Rupture	3.4.11
Peel Strength	3.4.15
Weight Loss, Flexibility and Swell	3.4.18

4.2.2 Qualification Tests: All technical requirements are qualification tests and shall be performed prior to the initial shipment of sealing compound by the manufacturer, 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, and for procurement on U.S. Military contracts, the sealant shall be a product that has been tested, has passed the qualification tests of 4.2.2 and has been listed or approved for listing on applicable U.S. Military qualified products list.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient sealing compound shall be taken at random from each lot or batch to perform all the 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. Multiple testing is not required for viscosity, application time, flow, tack-free time and hardness. Materials for testing shall be mixed, as much as possible, in the same containers in which the sealing compounds were procured.

4.3.1.1 If the material is being procured in cans, pails, or drums, the batch shall be tested on the material placed in 1-quart (1-L) cans.

4.3.1.2 A statistical sampling plan, acceptable to the purchaser, may be used in lieu of sampling as in 4.3.2.

4.3.2 U.S. Government Procurement: Each batch shall be subjected to both initial and final acceptance testing. Sufficient material for initial acceptance testing shall be packaged in the same type containers that are being procured. Initial acceptance tests are those listed in 4.2.1. Final acceptance testing shall be conducted on the final packaged product and consists of application time, tack-free time, and standard cure time. After successful completion of the initial acceptance tests, the batch shall be released for final packaging. During packaging, test kits shall be picked at random to perform final acceptance tests as shown in Table 4.

TABLE 4 - Final Acceptance Tests

Property	Value
Application Time	3.4.7
Tack-Free Time	3.4.8
Standard Cure Rate	3.4.9

4.3.2.1 If the batch is being packaged in different type and/or different size containers, the final acceptance tests shall be conducted on each type and/or each size containers. If the material is being procured under different purchase orders, but the purchase orders call for the same type and size containers, it is only necessary to conduct the final acceptance tests once.

4.3.3 For Qualification Tests: Samples shall consist of 30 1-pint (473-mL) two-component kits with the appropriate amount of primer plus two 1-quart (1-L) cans. Samples shall be identified as follows and forwarded to the activity responsible for testing as designated in the letter of authorization from that activity.

SEALING COMPOUND, POLYTHIOETHER, INTEGRAL FUEL TANKS AND FUEL CELL CAVITIES, INTERMITTENT USE TO 350 °F (177 °C)

Specification AMS 3279
Manufacturer's Identification
Name of Manufacturer*
Lot Number
Date of Manufacture
Submitted by (name) (date) for qualification tests in accordance with AMS 3279 under authorization (reference authorizing letter)

*Date the quality conformance tests are completed by the sealant manufacturer.

4.4 Approval:

4.4.1 Sealing compound shall be approved by purchaser before sealing compound for production use is supplied, unless such approval be waived by purchaser. For direct Military procurement and for procurement for use on U.S. Military contracts, the sealing compound shall be listed, or approved for listing, on the applicable U.S. Military qualified products list. Results of the tests on the production sealing compound shall be essentially equivalent to those on the approved sample.

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production sealing 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 the manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, a sample of sealing compound. Production sealing compound made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

Shall be as follows:

4.5.1 Standard Conditions:

4.5.1.1 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 cured under these conditions. Test specimens shall be prepared at 77 °F ± 5 (25 °C ± 3) and immediately upon completion of preparation, shall be placed into standard conditions for cure. Except as otherwise specified herein, tests shall be performed at 77 °F ± 5 (25 °C ± 3).

4.5.1.2 Standard Tolerances: Unless otherwise specified, the standard tolerances shown in Table 5 shall apply.

TABLE 5 - Standard Tolerances

Unit	Tolerance
Temperatures	±2 °F (1 °C)
Days	± 2 hours
Hours	± 5 minutes
Minutes	± 10 seconds
Inches	± 0.010 inch (0.25 mm)

4.5.1.3 Standard Heat Cycle: Standard heat cycle shall consist of the cure cycle of 4.5.2.7 and the following cycle which shall be repeated six times.

Four hours at 260 °F (127 °C)
40 minutes at 320 °F (160 °C)
One hour at 350 °F (177 °C)
Cool to under 100 °F (38 °C)

4.5.2 Preparation of Test Specimens:

4.5.2.1 Chemical Conversion Coating Application on Aluminum Alloy Panels:

4.5.2.1.1 Coating Preparation: A chemical conversion coating conforming to MIL-C-81706, Class IA, Form II, Method C shall be used. It shall be prepared according to the manufacturer's instructions.

4.5.2.1.2 Panel Preparation: Remove oil or grease using a suitable solvent followed by alkaline detergent cleaning using MIL-C-87936, Type I, compound or an equivalent commercially available alkaline cleaner. The cleaning may be accomplished by brushing, swabbing or soaking the panels in the detergent solution or by a combination of the following techniques. Rinse the cleaned panels in warm flowing tap water 60 to 100 °F (16 to 38 °C), and check for cleanliness by observing for a water break free surface. If a water break occurs on the panel surfaces, return them to the detergent solution and repeat the cleaning procedure until a water break free surface is obtained. Immediately transfer the cleaned panels to a deoxidizing solution consisting of the following:

Butyl alcohol - 35% by weight
Distilled or deionized water - 22% by weight
Isopropyl alcohol - 25% by weight
H_3PO_4 (85% by weight) - 18% by weight

Acid deoxidizer conforming to MIL-C-38334 may also be used. Allow the panels to remain in the above solution for three to five minutes. Rinse the panels thoroughly under flowing tap water.

4.5.2.1.3 Coating Application (Immersion): Transfer the deoxidized panels immediately to the chemical conversion coating solution conforming to MIL-C-81706. Immerse the panels in the solution at standard temperature for three to five minutes or until a light straw color develops. (Color development time will vary with the aluminum alloy being conversion coated.) After removal from the conversion coating solution, immediately rinse thoroughly in flowing distilled or deionized water. Arrange the panels in an upright position to permit them to drain dry. Apply the test materials to the conversion coated surfaces within 48 hours.

4.5.2.1.3.1 Mix the conversion coating solution in either 18-8 stainless steel, polyethylene or other compatible plastic containers. DO NOT MIX IN GLASS CONTAINERS.

4.5.2.2 Preparation of Composite Panels:

4.5.2.2.1 Graphite Epoxy: AS4/3501-6 test panels shall be fabricated using eight plies of unidirectional tape laid (0°, 45°, 90°, 135°) symmetrical. Size of the test panels shall be 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm). Cure as in 4.5.2.2.2.1.

4.5.2.2.2 Graphite Bismaleimide (BMI): IM7/5250-4 BMI test panels shall be fabricated using eight plies of unidirectional tape laid (+45°, 90°, -45°, 0°) symmetrical. Size of the test panels shall be 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm). Cure as in 4.5.2.2.2.1.

4.5.2.2.2.1 Install peel ply to bag surface of laminate. Nylon peel ply is acceptable. Apply a vacuum of not less than 28 inches (711 mm) of mercury and 85 psi (586 kPa) pressure. Heat to 375 °F ± 10 (190 °C ± 5) at a rate of 1 to 4 F (0.5 to 2 C) degrees per minute. From 320 °F (160 °C) to 375 °F (190 °C) heat at a rate of less than 1 F (0.5 C) degrees per minute. Keep free air temperature at or below 390 °F (199 °C). Hold laminate at 375 °F (190 °C) for 360 minutes ± 20. Cool laminate to 150 °F (65 °C) or below at an average rate less than or equal to 5 F (3 C) degrees per minute while maintaining a minimum of 25 psi pressure. Remove peel ply.

4.5.2.3 Preparation of Sealing Compound:

4.5.2.3.1 Qualification and Acceptance Tests: The quantity of sealing compound required for the tests shall be hand mixed as thoroughly as possible according to manufacturer's instructions.

4.5.2.4 Cleaning of Test Panels: All test panels shall be cleaned by scrubbing and rinsing using MIL-C-38736 solvent and clean AMS 3819 Grade A cloths. The panels shall be wiped dry immediately with clean AMS 3819 Grade A cloths. Titanium, BMI and epoxy graphite panels shall be scrubbed with abrasive mats and MIL-C-38736 solvent. After scrubbing, the panels shall be rinsed using MIL-C-38736 solvent and clean cloth and then wiped dry. The abrasive mats shall conform to MIL-A-9962, Type I, Class 1, Grade A for the epoxy and BMI graphite and MIL-A-9962, Type III, Class 1, Grade A for the titanium.

4.5.2.4.1 When organic coatings are specified for the test panels, the coating shall be fully cured as defined by the applicable coating specification before cleaning. The applied coatings shall be at least 14 days old and a maximum of six months old when stored at ambient indoor temperatures.

4.5.2.5 Application of Primer: The panel surface shall always be treated with the sealant manufacturer's recommended primer. This shall be done immediately after the panels are solvent cleaned by wetting a clean AMS 3819 Grade A cloth and wiping the surface. Apply the primer in accordance with the manufacturer's application and curing instructions.

4.5.2.6 Application of Sealing Compound: Unless otherwise specified herein, test panels shall be given an application of sealing compound to produce the specified dry sealant thickness. The dry sealant thickness will be approximately 50% of the applied wet thickness. Sealant specimen preparation shall be by spray method for qualification testing. Either spray or casting methods may be used for acceptance test specimen preparation. Do not apply wet sealant more than 0.125 inch (3.18 mm) thick. If additional sealant is needed to obtain a specific dry thickness, allow the wet coating to dry eight hours minimum and twenty four hours maximum at standard conditions (4.5.1.1) before adding additional sealant.

4.5.2.7 Cure of Sealing Compound: The sealing compound shall be cured for 14 days at standard conditions (4.5.1.1) for wet sealant thickness up to 0.125 inch (3.18 mm). For test specimens requiring higher wet sealant thickness, the sealing compound shall be cured for 21 days at standard conditions (4.5.1.1). An accelerated cure of 48 hours at standard conditions (4.5.1.1) plus 48 hours at 140 °F (60 °C) may be used for acceptance tests. Tests on the cured sealing compound shall commence not more than two days after the completion of the specified cure.

4.5.3 Jet Reference Test Fluid: The jet reference fluid (JRF) shall conform to AMS 2629. Type I fluid shall be used for conducting all tests requiring fluid except Type II shall be used for the chalking test (4.5.19).

4.5.4 Specific Gravity: Three test specimens approximately 0.060 x 1 x 1 inch (1.5 x 25 x 25 mm) in size shall be cut out with a sharp razor blade from a sheet of the sealing compound that has been cured in accordance with 4.5.2.7. Determine the specific gravity of each sample in accordance with ASTM D 792, Method A and report the average value.

4.5.5 Hardness: The instantaneous hardness shall be determined in accordance with ASTM D 2240 after the sealing compound is cured in accordance with 4.5.2.7. The reading shall be taken on a quadrupled back-to-back 0.062 inch (1.57 mm) thick specimen making the total 0.25 inch (6.4 mm).

4.5.6 Nonvolatile Content: Within five minutes after mixing, 11 to 12 grams of mixed sealing compound shall be transferred as rapidly as possible to a previous weighed (W1) aluminum dish approximately two inches (51 mm) in diameter. The initial weight (W2) shall be determined using an analytical balance accurate within ±1 milligram. Immediately following the weighing the sample and dish shall be placed in a circulating air oven preheated to 160 °F (71 °C), and allowed to dwell for three days. Following this, the sample and dish shall be removed from the oven and allowed to cool in a desiccator to room temperature. Final weight (W3) shall be determined on the same balanced used for the initial weights. All weights shall be recorded to the nearest milligram.

Percent nonvolatile content shall be determined from the average of three samples and calculated in accordance with Equation 1.

$$\text{Percent nonvolatile} = \frac{W3 - W1}{W2 - W1} \times 100 \qquad \text{(Eq.1)}$$

4.5.7 Viscosity of Base Compound:

4.5.7.1 Shall be determined with the base compound placed in a 1-pint (1/2-L) can. The can shall be filled with the base compound to within 0.5 inch (13 mm) of the top, covered, and stored at 77 °F (25 °C) for not less than eight hours. The base compound shall be thoroughly mixed by stirring slowly for not less than three minutes after which the can shall be closed and the base compound shall be allowed to stand for one hour.

4.5.7.2 The Brookfield Model RVF viscosimeter, or equivalent, shall be used. The reading obtained shall be converted to poises (Pa·s). The No. 6 spindle, at 10 rpm, shall be used. The reading shall be taken after the instrument has run in the base compound for one minute.

4.5.8 Viscosity of the Curing Agent: The viscosity of the curing agent shall be determined in accordance with 4.5.7 except a No. 2 spindle at 10 rpm shall be used.

4.5.9 Flow:

4.5.9.1 Prepare a 0.040 x 2.75 x 6 inch (1.02 x 69.8 x 152 mm) AMS 4049 aluminum alloy panel having a horizontal scribed line across the panel width at the panel midpoint and a second scribed parallel line 0.2 inch (5.08 mm) distance from the first line. Clean the panel in accordance with 4.5.2.5. Apply the edge of a strip of one-inch wide masking tape on the midpoint line also covering the second 0.2 inch (5.08 mm) distant scribed line.

4.5.9.2 Within 10 minutes from the beginning of mixing spray a 0.50 inch (1.27 mm) thick wet sealant coating in one application to cover one-half the panel surface and extending at least one-inch over the midpoint line.

4.5.9.3 Within two minutes after sealant application score a line through the coating with a sharp edged blade at the panel midpoint line, remove the masking tape and place the panel on the 2.75 inch (69.8 mm) uncoated end at a 90° vertical position and condition at standard conditions (4.5.1.1).

4.5.9.4 Thirty minutes after completion of the sealant application inspect the panel for sealant flow below the midpoint line.

4.5.10 Application Time:

4.5.10.1 The base compound and curing agent shall be stabilized at standard conditions (4.5.1.1) for not less than eight hours before a sample of the base compound is mixed with the proper amount of curing agent sufficient to fill a standard 0.5 pint (1/4 L) can, 2.875 inches (73.02 mm) in diameter by 2.875 inches (73.02 mm) high, to within 0.5 inches (13 mm) of the top. This can shall be tightly covered except when testing for viscosity.

4.5.10.2 At the end of two hours, measured from the beginning of the mixing period, the sealing compound shall be tested for viscosity using a Brookfield Model RVF viscometer, or equivalent. The No. 5 spindle at 10 rpm shall be used. The highest reading shall be taken after the instrument has run in the sealing compound for one minute.

4.5.10.3 Mixed sealant shall be sprayed to a wet thickness of 0.050 inches (1.27 mm) on individual cleaned 0.040 x 2.75 x 6 inch (1.02 x 69.8 x 152 mm) AMS 4049 aluminum alloy panels at intervals of 15 minutes and two hours after the beginning of mixing, respectively. Cure the panels at standard conditions, in accordance with 4.5.1.1, for six hours. Inspect the sealant film appearance for conformance to paragraph 3.3.

4.5.11 Tack-Free Time:

4.5.11.1 A 0.040 x 2.75 x 6 inch (1.02 x 69.8 x 152 mm) AMS 4049 aluminum alloy panel shall be cleaned in accordance with 4.5.2.5 and 0.050 inch (1.27 mm) thick wet sealing compound applied. The sealant shall be placed at standard conditions (See 4.5.1.1).

4.5.11.2 At the end of the tack-free time (See 3.4.8) two 1 x 7 inch (25 x 178 mm) strips of polyethylene 0.005 inch ± 0.002 (0.13 mm ± 0.05) thick shall be applied to the sealing compound and held in place at a pressure of approximately 0.5 ounces per square inch (0.0002 N/mm^2) for two minutes.

4.5.11.3 The strips shall then be slowly and evenly peeled back at right angles to the sealing compound surface. The polyethylene shall come away clean and free of sealing compound.

4.5.12 Standard Cure Rate: The instantaneous hardness shall be determined in accordance with ASTM D 2240 (instantaneous) using a Type A Durometer after the sealing compound is allowed to cure at standard conditions (4.5.1.1) for the time specified in 3.4.9. The reading shall be taken on a 0.062 inch (1.57 mm) thick dry film which has been quadrupled to obtain a total minimum film thickness of 0.25 inch (6.4 mm).

4.5.13 Fluid Immersed Cure Rate: AMS 4049 aluminum alloy test panel measuring 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm) shall be coated with a suitable release agent and covered with sealing compound to a wet thickness of 0.050 inch (1.27 mm) in one application. After curing at standard conditions (4.5.1.1) for six hours, the test panel shall be immersed in JRF at 77 °F (25 °C). The hardness shall be determined after a total of 48 hours (42 hours in fluid) in accordance with ASTM D 2240 (instantaneous) using a Type A Durometer. The sample for the durometer reading shall be prepared by removing the film from the panel and layering the film to obtain a minimum thickness of 0.25 inch (6.4 mm).

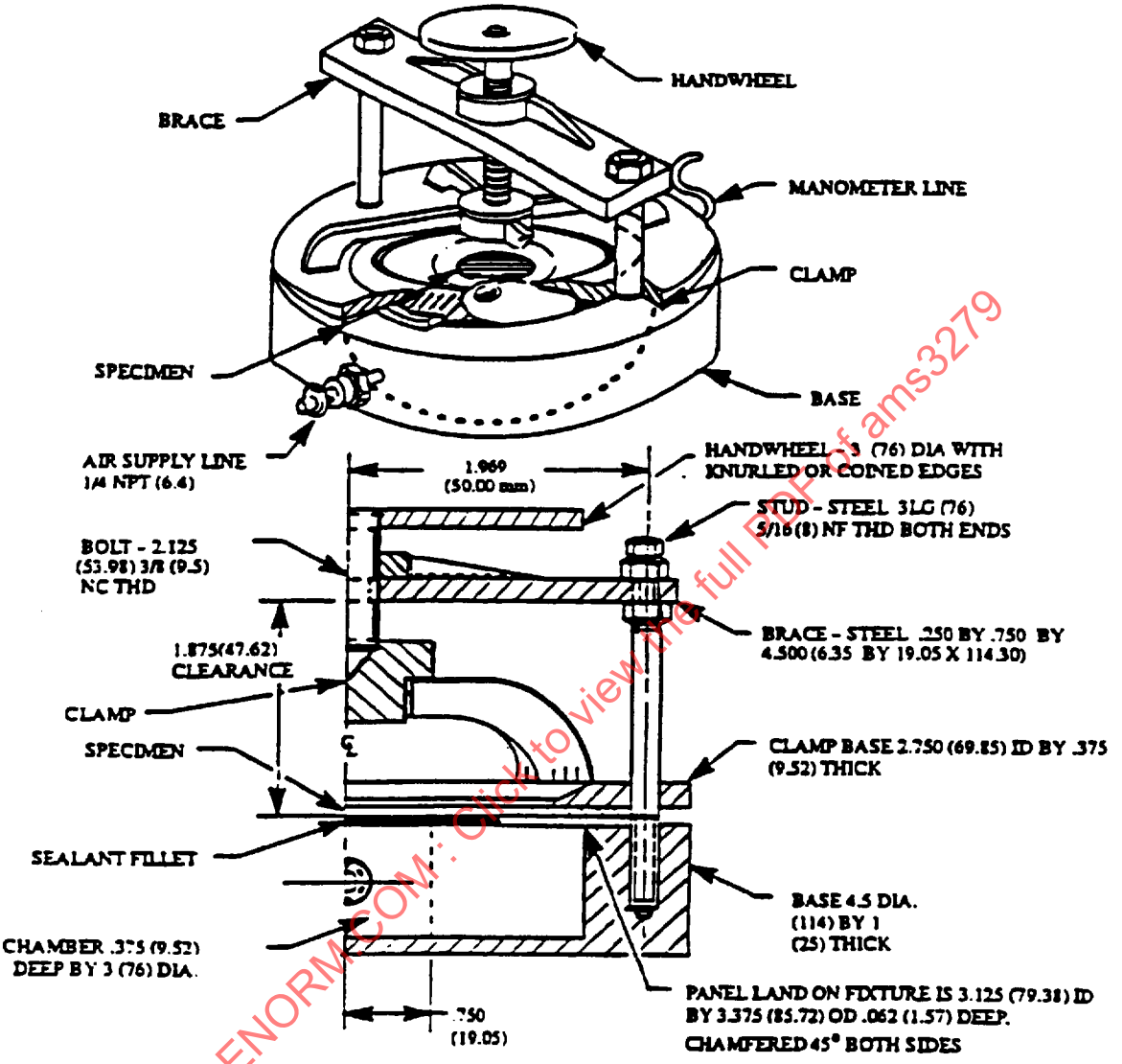
4.5.14 Resistance to Thermal Rupture:

4.5.14.1 Two specimens shall be prepared, each having a fillet approximately 0.125 inch (3.18 mm) thick by two inches (51 mm) in diameter, applied to a test panel of AMS 4045 aluminum alloy. The test panels shall be 0.40 x 3.5 x 3.5 inches (1.02 x 89 x 89 mm) in size, with a hole 0.25 inch (6.4 mm) in diameter in the center of the panel. The hole in the test panel shall be filled with sealant.

4.5.14.2 The sealing compound fillets shall be applied in accordance with 4.5.2.6 and cured in accordance with 4.5.2.7 and tests shall begin not more than two hours after cure cycle.

4.5.14.3 One of the panels shall then be placed in JRF for 120 hours ± 4 at 140 °F (60 °C), followed by 60 hours ± 4 at 160 °F (71 °C), and followed by 6 hours ± 1 at 180 °F (82 °C).

4.5.14.4 The panel shall then be removed from the fluid and immediately applied to the fixture, shown in Figure 1, using a suitable gasket. The panel shall then be positioned on the fixture such that the sealant is within the fixture chamber.



DIMENSIONS ARE IN INCHES (MILLIMETERS). UNLESS OTHERWISE SPECIFIED.
TOLERANCES: DECIMALS ± 0.016 INCH (± 0.41MM) DEGREES ± 1.

(NOT TO SCALE)

FIGURE 1 - Thermal Rupture Fixture

4.5.14.5 The fixture shall be placed in an oven at 350 °F (177 °C). Ten psi (69 kPa) air pressure shall be applied using an air regulator. The clamp fixture shall be maintained in an oven for one hour after the pressure is applied.

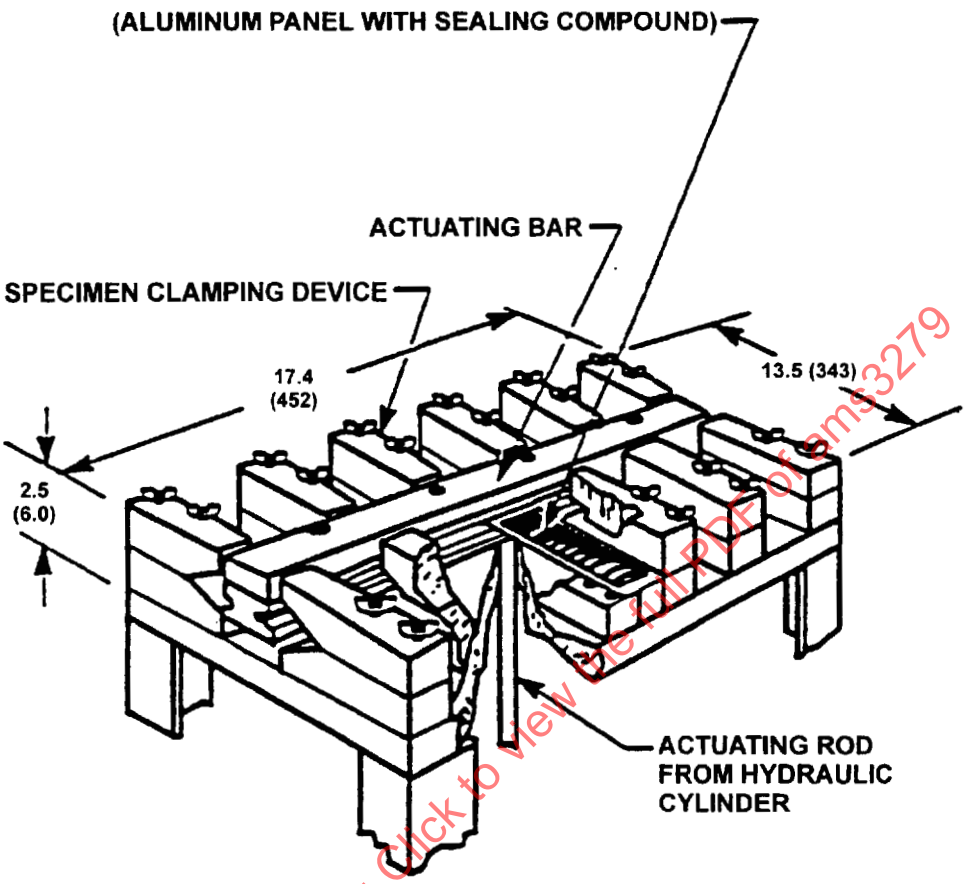
4.5.14.6 Deformation shall be measured from the surface of the test panel not exposed to pressure, to the point of maximum deformation of the sealant compound.

4.5.14.7 The test shall be repeated on the panel not immersed in the JRF.

4.5.14.8 Inspect.

4.5.15 Low Temperature Flexibility: Four AMS 4049 aluminum alloy test panels 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm) in size shall be prepared. A coating of the sealing compound 0.1 x 1.5 x 4 inches (2.5 x 38 x 102 mm) shall be applied to the center of each of the four panels. Care shall be taken to maintain an accurate sample thickness of 0.1 inch (2.5 mm), apply sealant in accordance with 4.5.2.6. At the end of a standard cure, as specified in 4.5.2.7 the specimens shall be immersed in 900 mL of JRF for 120 hours ± 4 at 140 °F (60 °C). At the completion of the fluid exposure, the specimens shall be removed from the fluid and given a standard heat cycle in accordance with 4.5.1.2. All four panels shall then be immediately placed in a low-temperature flexibility fixture (See Figure 2) consisting of a clamp support that will grip both sides of both six inch (152 mm) edges of the panels for a distance of three inches (76 mm) from one end without touching the sealant. The jig shall be capable of flexing the panel through a 30-degree arch (15 degrees each side of the center) at a constant speed of one cycle per five seconds. The temperature shall be reduced to -65 °F (-54 °C), stabilized at this temperature for at least two hours, and the panels flexed through 130 consecutive cycles.

4.5.16 Hydrolytic Stability: Mixed sealing compound 0.060 inch ± 0.005 (152 mm ± 0.13) dry thickness shall be prepared and cured in accordance with 4.5.2.7. Five tensile specimens shall be cut from the sheets using die C, as specified in ASTM D 412. The cured specimens shall be exposed for 120 days in an environment of 160 °F (71 °C) and 95% ± 5 relative humidity. To do this, pour a 22% by weight glycerin in distilled water solution into a desiccator until the liquid level is 1 inch (25 mm) below the desiccator plate. Suspend the sealant specimens in the desiccator so that the flat surfaces are full exposed. Apply vacuum grease to the lid and slide the lid in place. Loosely stopper the hole to prevent vacuum build up. Place the desiccator in a circulating air oven set at 160 °F (71 °C). When the temperature inside the desiccator reaches 160 °F (71 °C) tightly stopper the hole to prevent water evaporation. Change the glycerin solution every 30 days or when it becomes cloudy. After 120 days remove the desiccator from the oven and allow it to cool, frequently loosening the stopper. Remove the specimens from the desiccator and hold them at standard conditions (4.5.1.1) for 14 days. The tensile and elongation tests shall be conducted at standard conditions (4.5.1.1) in accordance with ASTM D 412 at a jaw separation rate of 20 inches ± 1 (508 mm ± 25) per minute.



DIMENSIONS IN INCHES (MILLIMETERS)

FIGURE 2 - Low-Temperature Flexibility Fixture

4.5.17 Corrosion: Two AMS 4045 aluminum alloy panels measuring 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm) shall be prepared as follows. A controlled test area one inch (25 mm) wide by five inches (127 mm) long shall be masked in the center on one side of each panel and the remainder of the panel shall be chemical film in accordance with 4.5.2.1 and overcoated with MIL-C-27725. After the coating has cured, the manufacturer's recommended primer and a 0.062 inch (1.57 mm) thick layer of sealing compound shall be applied to the area, overlapping a minimum of 0.25 inch (6.4 mm) onto the MIL-C-27725 coated portion. The sealant shall be given a standard cure per 4.5.2.7 and the panels conditioned as follows: The panels shall be immersed vertically in a covered glass vessel containing a two-layer liquid consisting of a 3% aqueous sodium chloride solution and JRF so that two inches (51 mm) of the panel is exposed to the salt solution, two inches (51 mm) is exposed to the JRF, and the remainder of the panel is exposed to the air-vapor mixture. The temperature of the fluid shall be 140 °F (60 °C) for 12 days and followed by 60 hours at 160 °F (71 °C) and six hours at 180 °F (82 °C). Immediately upon removal from the liquid, the sealant shall be removed by mechanical means using a nonmetallic scraper and the panel shall be examined for evidence of corrosion.

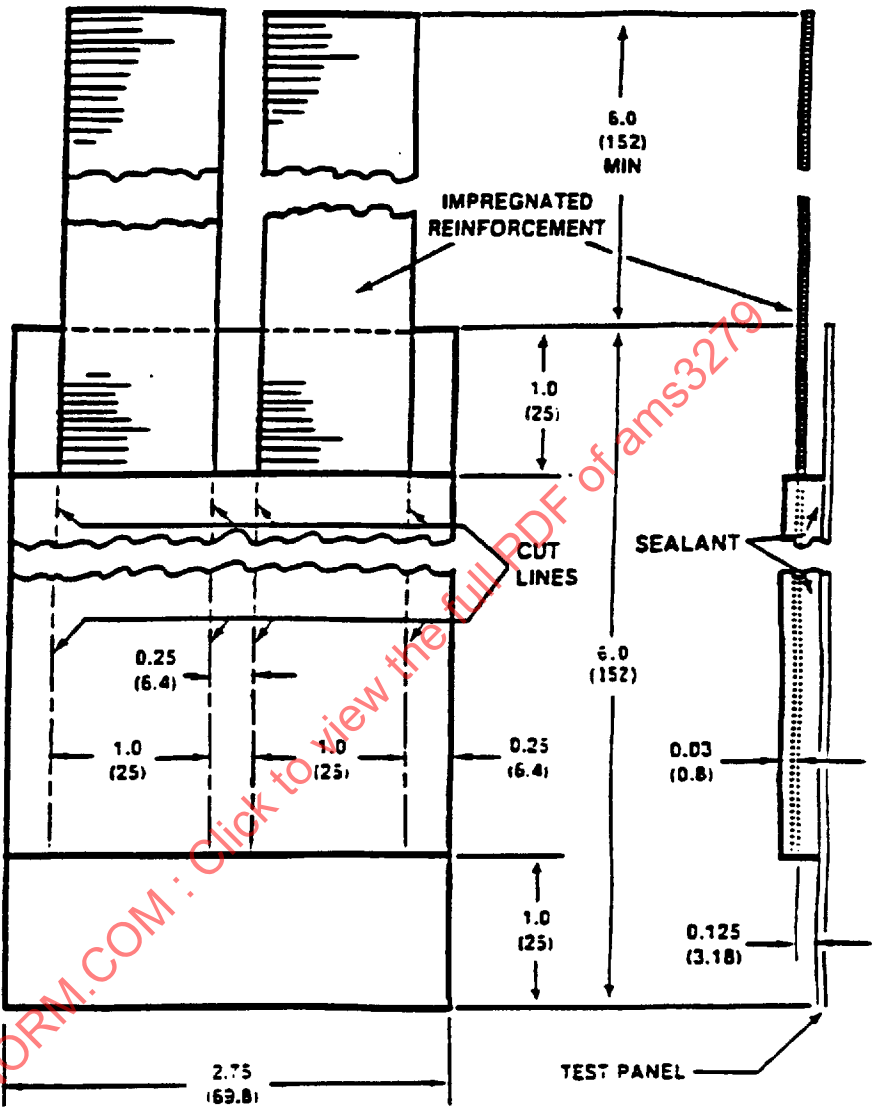
4.5.18 Peel Strength:

4.5.18.1 The type and quantity of panels listed in Table 6 shall be used for evaluation of peel strength. All panels shall be as described in Figure 3. The manufacturer's recommended primer shall be applied in accordance with 4.5.2.5. The center four inches (102 mm) of the panel shall be coated on one face with a 0.125 inch (3.18 mm) wet thickness of sealing compound. An optional configuration consists of coating the bottom approximate five inches (127 mm) of the panel with sealant (Figure 3). A 2.75 x 12 inch (69.8 x 305 mm) strip of stainless steel wire screen (20 to 40) mesh, milling grade, Type 304, shall be impregnated with the sealing compound, so that approximately five inches (127 mm) at one end is completely covered on both sides. The sealant coated end of the fabric shall be placed on the sealant coated panel, and smoothed down on the layer of sealing compound, taking care not to trap air beneath the fabric. An additional coating of sealing compound shall be applied over the screen to approximately 0.032 inch (0.81 mm) dry thickness. The sealant shall be given a standard cure in accordance with 4.5.2.7.

TABLE 6 - Peel Strength Panels

Quantity	Panel Material	Panel Thickness
6	AMS 4045 aluminum alloy anodized in accordance with AMS 2471	0.040 inch (1.02 mm)
*10	AMS 4901 titanium	0.025 to 0.040 inch (0.64 to 1.02 mm)
*10	AMS 4045 aluminum alloy anodized in accordance with AMS 2471, coated with MIL-C-27725	0.040 inch (1.02 mm)
*10	Epoxy graphite composite in accordance with 4.5.2.2.1. Test both ply side and tool side. Do not test both sides of the same panel.	0.040 inch (1.02 mm)
*10	BMI graphite composite in accordance with 4.5.2.2.2	0.040 inch (1.02 mm)
*10	AMS 4045 aluminum alloy anodized in accordance with AMS 2471, coated with MMS-425 epoxy primer (compound - 519X303/910X357, Courtaulds Aerospace) and cured one hour at 150 °F (66 °C)	0.040 inch (1.02 mm)
#6	AMS 4045 aluminum alloy anodized in accordance with AMS 2471 primed with MIL-P-23377, and coated with MIL-C-85285 urethane top coat	0.040 inch (1.02 mm)

NOTE: Items with symbols (*) and (#), see 4.5.18.2.



NOTES:

1. Dimensions are in inches (millimeters).
2. Unless otherwise specified, dimensions shown shall be nominal.
3. Sealant and fabric covers lower 1 inch (25 mm) of panel in the optional specimen.

FIGURE 3 - Peel Specimen Configuration

4.5.18.2 At the end of the sealing compound cure, two panels of each substrate listed in Table 6, except those coated with MIL-C-85285, shall be subjected to each of the test conditions listed below.

a. Seven days at 140 °F (60 °C) in JRF.
b. Seven days at 140 °F (60 °C) in equal parts JRF and 3% aqueous sodium chloride solution.
c. 100 hours at 140 °F (60 °C), 10 hours at 160 °F (71 °C), one hour at 180 °F (82 °C) in equal parts JRF and 3% aqueous sodium chloride solution. Repeat cycle five times (six cycles total) using new fluid each time.

In addition, two panels of each of the substrates marked with a symbol (*) in Table 6 shall be subjected to each of the following test conditions:

a. 70 days at 140 °F (60 °C) in JRF with fluid change every 14 days.
b. 70 days at 140 °F (60 °C) in equal parts JRF and 3% aqueous sodium chloride solution with fluid change every 14 days.

In addition, two panels of each of the substrates marked with a symbol (#) in Table 6 shall be subjected to each of the following test conditions:

a. 72 hours at 140 °F (60 °C) in MIL-H-83282 fluid.
b. 72 hours at 140 °F (60 °C) in AMS 3023 fluid.
c. Seven days at 140 °F (60 °C) in JRF.

After specified exposure at 140 °F (60 °C) the panels shall be in the fluid for one day at standard conditions (4.5.1.1). The peel strength must be measured within five minutes after removal from the test fluid.

4.5.18.3 Two 1-inch (25-mm) wide strips shall be cut through the sealing compound and wire screen to the metal and extended the full length of the wire screen.

4.5.18.4 The specimens shall be stripped back at an angle of 180 degrees to the metal panel in a suitable tensile testing machine having a jaw separation rate of two inches (51 mm) per minute. During the peel strength testing, three cuts shall be made through the sealing compound to the panel in an attempt to promote adhesive failure. The cuts shall be at approximately 1-inch (25-mm) intervals. The results shall be the numerical average of the peak loads during cohesive failure. Failure of the sealant compound to the fabric shall not be included in the peel strength values.

4.5.18.5 Acceptance Tests: Prepare four AMS 4045 aluminum alloy panels measuring 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm), sulfuric acid anodize in accordance with AMS 2471 and coat with MIL-C-27725. Prepare sealant peel panels in accordance with 4.5.18.1. Soak two panels in JRF and two panels in JRF/salt water for seven days at 140 °F (60 °C). Test the panels in accordance with 4.5.18.3 and 4.5.18.4.