SAE INTERNATIONAL

AEROSPACE STANDARD

AS5127/1 REV. C

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Superseding AS5127/1B

Aerospace Standard Test Methods for Aerospace Sealants Two-Component Synthetic Rubber Compounds

RATIONALE

Revision C is a 5-year update that provides updated procedures and many clarifications for the sealing compound/sealant test methods.

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1. SCOPE

This SAE Aerospace Standard (AS) describes test methods to determine the application and performance properties of two-component sealing compounds. It shall be used in conjunction with AS5127 and the applicable material specification. When modifications to these test methods are called out in material specifications, the material specification shall take precedence.

2. REFERENCES

The following publications form a part of this document 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. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2471	Anodic Treatment of Aluminum Alloys Sulfuric Acid Process, Undyed Coating
AMS2629	Fluid, Jet Reference
AMS3167	Solvents, Wipe for Cleaning Prior to Application of Primer and Top Coat Materials, or Sealing Compounds
AMS3333	Sealing Compound, Polysulfide, For Aircraft Windshields and Canopies, For Use up to 250 °F (121°C)
AMS3819	Cloths, Cleaning for Aircraft Primary and Secondary Structural Surfaces
AMS4045	Aluminum Alloy, Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr, 7075: (-T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated
AMS4049	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
AMS4911	Titanium Alloy, Sheet, Strip, and Plate, 6Al - 4V, Annealed
AMS-C-27725	Coating, Corrosion Preventative, for Aircraft Integral Fuel Tanks for Use to 250 °F (121 °C)
AMS-G-25667	Glass, Monolithic, Aircraft Glazing
AMS-P-83310	Plastic Sheet, Polycarbonate, Transparent
AS5127	Aerospace Standard Test Methods for Aerospace Sealants, Methods for Preparing Aerospace Sealant Test Specimens

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D329	Standard Specification for Acetone
ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1193	Standard Specification for Reagent Water
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D5032	Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E1742	Standard Practice for Radiographic Examination
ASTM G85	Standard Practice for Modified Salt Spray (Fog) Testing
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

2.3 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

MIL-PRF-5425	Plastic Sheet, Acrylic, Heat Resistant
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids
MIL-PRF-25690	Plastic, Sheets and Formed Parts, Modified, Acrylic Base, Monolithic, Crack Propagation Resistant
MIL-PRF-85285	Coating: Polyurethane, Aircraft and Support Equipment
MIL-PRF-85582	Primer Coatings: Epoxy, Waterborne

3. CLASSIFICATION

The sealing compound may be of the following designations:

3.1 Classes

3.1.1 Class A

Sealing compound suitable for application by brush.

3.1.2 Class B

Sealing compound suitable for application by extrusion gun, spatula, brush, or roller.

3.1.3 Class C

Sealing compound suitable for application by extrusion gun, spatula, brush, or roller.

3.1.4 Class D

Sealing compound suitable for application by extrusion gun or spatula.

3.1.5 Class E

Sealing compound suitable for application by automatic riveting equipment.

3.2 Application Time or Work life

Dash numbers following the sealing compound classification, e.g., B-2, shall be used to designate the maximum application time in hours for Classes A, B, D, and E. Class C dash numbers represent application time and assembly time in hours, e.g., C-12(48).

4. PREPARATION OF SEALING COMPOUND

The sealing compound must be mixed according to the manufacturer's instructions. The mix ratio of sealant base compound and the curing agent of two-part sealant shall be maintained as specified by the manufacturer.

NOTE: In order to achieve the expected cured sealant properties both curing agent and base compound must be mixed thoroughly to complete uniformity with no visible streaks or swirls of unmixed material. Both curing agent and base compound must be moved physically by the stirring instrument and the container walls. If mixed by hand the mixing blade shall be scraped frequently to ensure a complete blend. To minimize introduction of air into the sealant mixture (see AIR4069), no swirling motion should be used when stirring. To avoid risk of overheating the mixture and compromising application properties the sealant mixture should not be over-mixed or mixed too fast.

4.1 Qualification Testing

Manufacturer's instructions for mixer operation and mixing must be followed. Plastic disposable cartridges, as shown in Figure 1 may be used, or a suitable manufacturer's recommended alternative to hold the mixed sealant, from which it can later be extruded from the cartridges for sealing application and specimen fabrication. If specified in the applicable material specification, sealing compound may be provided in cartridges for multiple component sealants as shown in Figure 2 for Type I and Type II kits, and shall be mixed according to sealant manufacturer's instructions.

4.2 Acceptance Testing

Sealing compound supplied in multi-component (e.g., barrier or injection) kits for acceptance testing may be machine or hand-mixed following the manufacturer's recommended instructions using the appropriate ratio of base compound to curing agent.

4.3 Thawing of Quick-Frozen Sealing Compound

For application time, flow, tack-free time, and curing rate tests, the sealing compound shall be thawed according to the manufacturer's recommendations. Time zero shall begin once the material in the container has completely thawed, has reached a maximum temperature of 50 °F (10 °C), or when condensation does not occur after wiping the container dry with cloth.

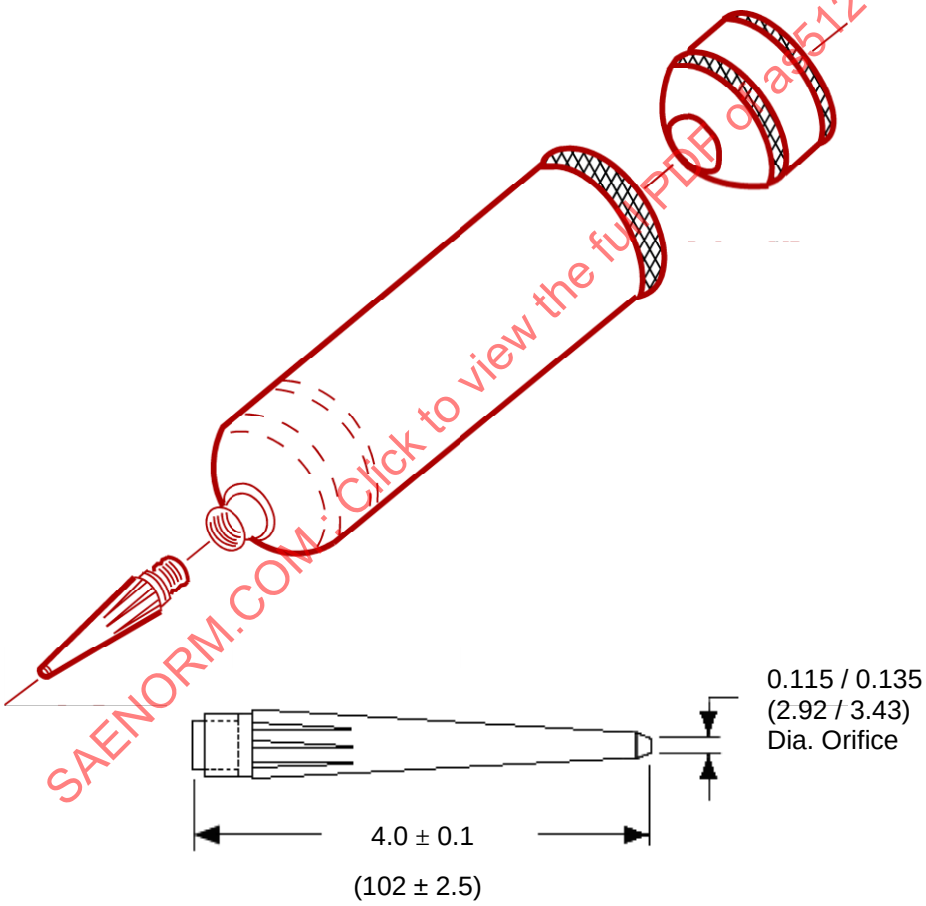
5. APPLICATION PROPERTIES TEST METHODS

5.1 Nonvolatile Content

Three samples of the sealing compound shall be tested. Weigh a cup to the nearest 0.001 g (W_1). Transfer 11 to 12 g of mixed sealing compound to the cup as rapidly as possible within 5 minutes of the completion of mixing, and weigh immediately to the nearest 0.001 g (W_2). Place the sealing compound and uncovered cup in an air circulating or friction oven that has been preheated to 158 °F (70 °C). After heating for seven days or as specified in the applicable material specification, place the sealing compound and cup in a desiccator and cool to room temperature. Weigh to the nearest 0.001 g (W_3). Determine (W_2 - W_1) and (W_3 - W_1). Calculate the percent nonvolatile content as shown in Equation 1:

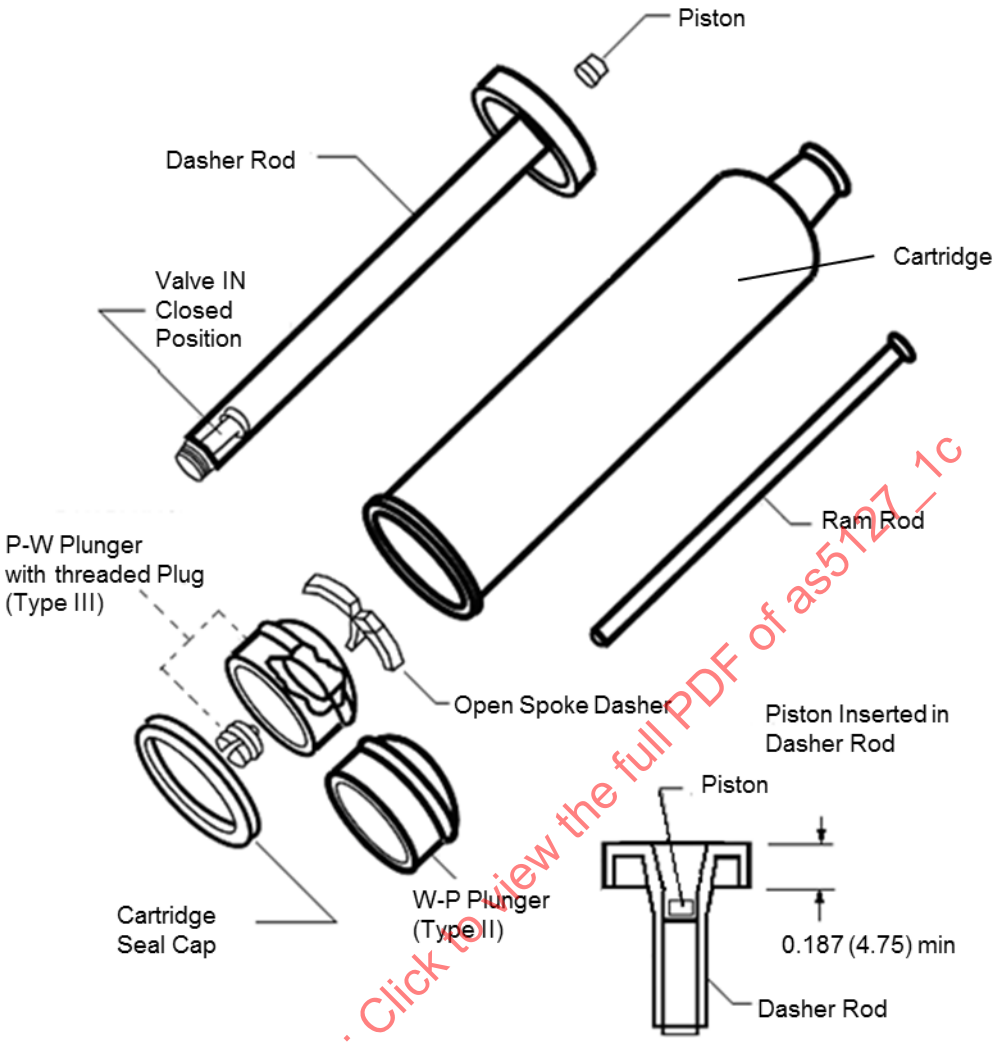
$$\text{Percent nonvolatile} = \frac{(W_3 - W_1)}{W_2 - W_1} \times 100 \qquad \text{(Eq. 1)}$$

The measured value shall be checked for conformance to the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 1 - PLASTIC DISPOSABLE CARTRIDGE, PLUNGER AND NOZZLE



Note: Dimensions in inches (millimeters)

FIGURE 2 - SEALANT CARTRIDGE FOR TWO-COMPONENT MATERIALS (ACCEPTABLE, TYPE I & II KITS)

5.2 Air Content (Class B Sealant Base Compound Only)

NOTE: The AMS Committee G-9 is removing this requirement from the AMS sealing compound specifications based on historically high variability within the test method and inaccurate measurements obtained with new light-weight fillers.

The equipment used for the air content test shall be:

a. Sealant Cartridge, as shown in Figure 1.

b. Nozzle, 4.0 inches (102 mm) with 0.125 inch (3.18 mm) orifice shown in Figure 1.

c. Dasher rod with valve assembly and separate plug and ramrod from a 6-fluid ounce (177 mL) sectional cartridge as shown in Figures 2 and 3.

NOTE: This test is not considered valid for low density (specific gravity <1.35) sealing compounds, since these compounds may contain compressible filler materials.

The test method shall conform to the following steps and shall refer to Figure 3 for the various steps:

1. Test shall be performed at standard conditions in accordance with AS5127 (4).

2. Sealant base compound to be tested shall be stabilized at standard conditions in accordance with AS5127 (4) for at least 8 hours prior to the test. The test sample shall not be taken from the top of the sealant base container or drum.

3. Fill the cartridge with sealant base compound, being careful not to introduce air. Attach the nozzle with 0.125 inch (3.18 mm) orifice to the cartridge. Cut off the tip of the nozzle and extrude a minimum of 2 inches (51 mm) of sealing compound to remove entrapped air.

4. Prior to starting the test, the dasher rod should have the piston in contact with the dasher end and the valve should not be closed.

5. Insert the nozzle of the filled cartridge firmly into the handle of the dasher rod as shown in Figure 3, and deliver sealing compound slowly until dasher is about 3/4 full. The sealing compound, however, should be filled completely into the handle end of the dasher.

6. Fill the wider flange side of the plug with sealing compound and place the plug in the dasher rod behind the sealing compound with the wide flange side of the plug toward the sealing compound, taking care not to entrap air. Clean off excess sealing compound.

7. Measure the length of the sealing compound in the dasher rod in millimeters. The plug should be pushed forward until the whole plug clears the dasher rod handle. Measurements shall be between the interior bottom of the plug and the middle of the curved sealing compound bead at the other end of the dasher rod (length "X", as shown in Figure 3).

8. Insert the ramrod into the dasher rod and push until the valve is in full open position as shown in Figure 3.

9. Remove ramrod and clean off any remaining excess sealing compound at the handle end of the dasher ramrod.

10. Slowly push the valve body into the dasher, finally forcing a seal.

11. Lightly insert the ramrod again into the dasher until it just touches the top of the plug. Make a mark "B" on the ramrod at the handle end of the dasher.

12. Put firm hand pressure on the ramrod while the valve end of the dasher is held against a table edge. Make a second mark "C".

13. Measure the distance between the two marks on the ramrod.

14. Calculate the percent air present in the sealing compound using Equation 2.

$$\%\ \text{Air Present} = \frac{\text{Distance between marks B and C on the ram rod}}{\text{Original length of the sealant in dasher rod}} \times 100 \qquad \text{(Eq. 2)}$$

15. The test shall be performed a total of three times, and the results shall be averaged. Use new dasher rod and piston for each repetition.

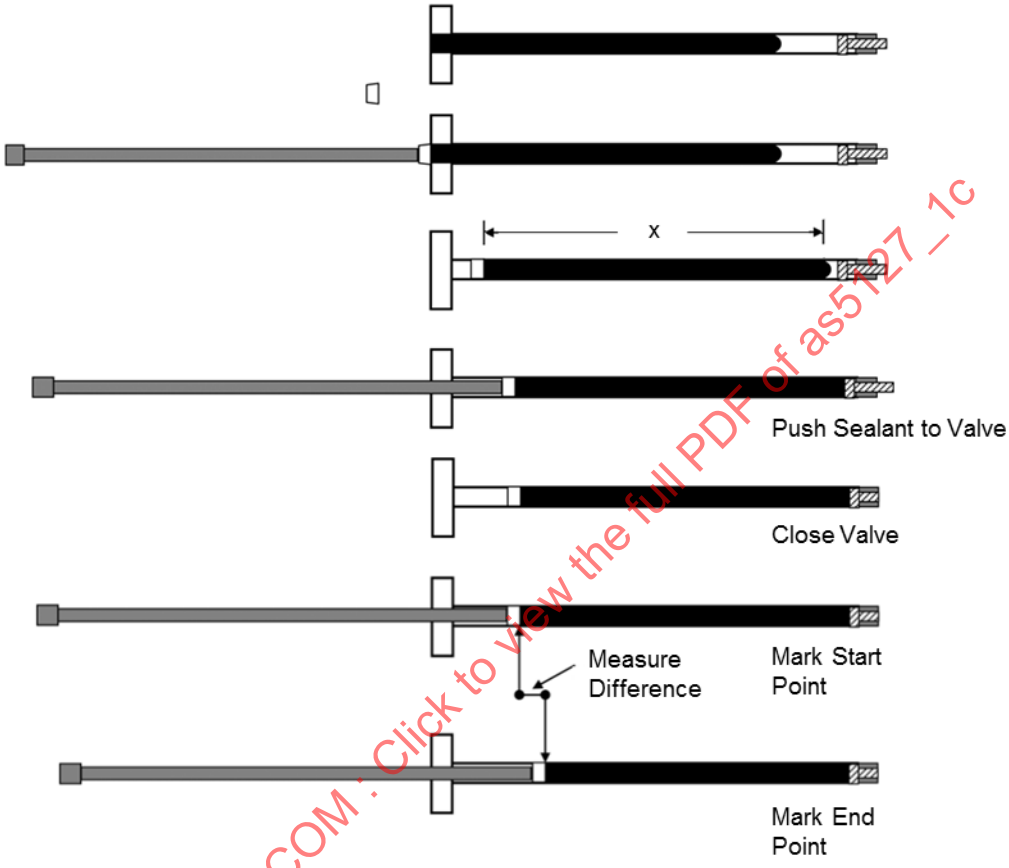


FIGURE 3 - DIAGRAM OF STAGES IN FILLING DASDHER ROD

5.3 Viscosity of Base Compound

A 1-pint (473 mL) or larger container shall be filled with the base compound such that the notch above the spindle is covered and the spindle does not come in contact with the bottom of the container. The base compound shall be covered and stored at 77 °F (25 °C) for not less than 8 hours. The base compound shall be thoroughly mixed by stirring slowly for not less than 3 minutes after which the container shall be closed and the base compound shall be allowed to stand for not less than 1 hour, and no more than 2 hours.

The Brookfield Model RVF viscometer, or equivalent, shall be used. The torque value of the spring of the viscometer and the viscometer's speeds shall be calibrated by the OEM (Brookfield), by an ISO 17025 lab with the proper scope of accreditation, or by the user's lab using fluid standards. The spindles should be checked to ensure they are not damaged. It is not necessary to calibrate in the range of use. It is recommended to verify the viscometer in the range of use for less viscous sealing compounds (e.g., Class A). The readings obtained shall be converted to poise (Pa·s). Viscometer spindle size and speed of rotation to be used are defined in the applicable material specification for the class and application time of sealing compound under test, according to sealing compound class. The highest reading shall be taken after the instrument has run in the base compound for 60 to 70 seconds. The measured value shall be checked for conformance to the applicable material specification.

5.4 Viscosity of the Curing Agent

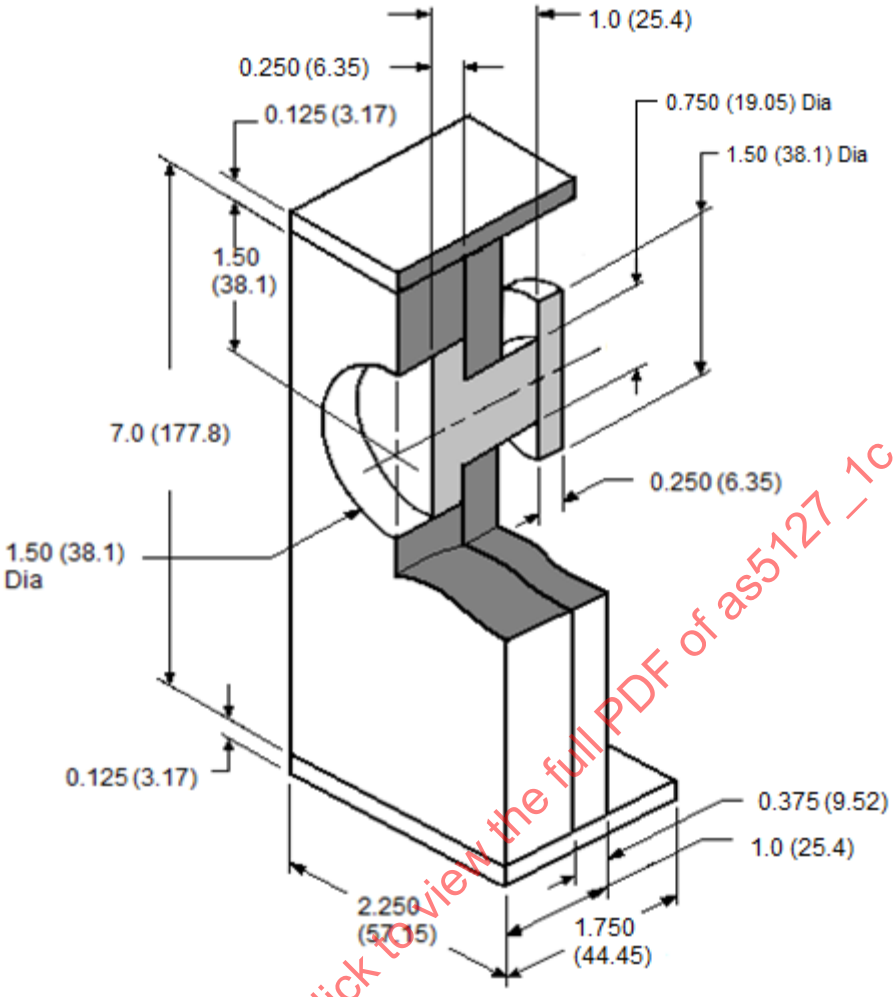
The viscosity of the curing agent shall be determined using the same procedure as AS5127/1 (5.3). Spindle size and speed of rotation to be used are defined in the applicable material specification for the class and application time of the sealing compound under test. The measured value shall be checked for conformance to the applicable material specification.

5.5 Flow (Classes B, C, and D)

5.5.1 Flow for Classes B and D

A standard sealing compound gun cartridge, fitted with a 0.125 inch (3.18 mm) orifice nozzle per Figure 1 shall be filled with freshly mixed sealing compound. The sealing compound gun, cartridge and enough sealing compound to complete all required flow determinations shall be maintained at standard conditions in accordance with AS5127 (4). The test shall be conducted using a clean flow test jig as shown in Figure 4. The Diameter and depth of the fixture plunger, the volume of the cavity, and the flushness of the plunger to the front face (±0.010 inch (±0.25 mm)) are critical and shall be controlled within the tolerance specified in Figure 4 during all flow testing. Other dimensions of the flow jig are for reference only. The flow jig shall be placed on a table with the front face upward and the plunger depressed to the limit of its travel. Within 15 minutes of the beginning of sealing compound mixing (5 minutes for B-1/6 and 10 minutes for B-1/4), enough of the mixed sealing compound shall be extruded using the application gun to fill the cavity created by the depressed plunger. On the flow jig's back, the sealing compound shall be leveled with the front surface of the flow jig. 10 seconds after the leveling operation, the jig shall be placed upright on its base and the plunger immediately advanced to the limit of its forward travel. The flow measurement shall be taken at 30 minutes after the sealing compound has been applied to the flow test fixture. The test at this time interval will be considered the initial flow of the sealing compound. The flow shall be measured from the lower edge of the plunger to the furthest point to which flow has advanced. The measured flow distance shall be within the required limits of the applicable material specification.

If additional flow determinations are required according to the applicable material specification, the flow fixture shall be cleaned then refilled at the specified time with sealing compound from the same mix used in the determination of initial flow. The flow measurement shall be taken at 30 minutes after the sealing compound has been applied to the flow test fixture. For example, for 50 minute flow, the fixture shall be refilled at 50 minutes after mixing of the sealing compound, and the flow measurement shall be taken 30 minutes subsequent to filling of the fixture. Typical flow test requirements, according to application rates, are shown in Table 1. All time intervals, other than initial flow, are measured from the end of the mixing period.



Notes: Dimensions in inches (millimeters)

FIGURE 4 - FLOW TEST JIG

TABLE 1 - TYPICAL FLOW TEST REQUIREMENTS

Flow Requirement	Flow Fixture Fill Time	Sealing Compound Class and Application Time							
		Flow Measurement Time[1]							
		B 1/6	B 1/4	B 1/2	B-1	B-2	B-4	B-6	B-12
Initial	Within 15 minutes of start of mix	10 minutes	15 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes
30 minutes	30 minutes after mixing				60 minutes				
50 minutes	50 minutes after mixing					80 minutes			
90 minutes	90 minutes after mixing					120 minutes			
2 hours	2 hours after mixing						2.5 hours		
3 hours	3 hours after mixing							3.5 hours	
3.5 hours	3.5 hours after mixing						4 hours		
5.5 hours	5.5 hours after mixing							6 hours	
6 hours	6 hours after mixing								6.5 hours
11.5 hours	11.5 hours after mixing								12 hours

[1] All Flow measurements shall be made 30 minutes after flow fixture is filled except for B-1/6 and B-1/4 materials.

5.5.2 Flow for Class C

One AMS4049 aluminum alloy panel measuring 0.040 x 2.75 x 6 inches (1.02 x 69.9 x 152 mm) shall be solvent cleaned in accordance with AS5127 (6.1). A 0.015 to 0.020 inch (0.38 to 0.51 mm) layer of freshly mixed sealing compound shall be applied to the panel after which the panel shall be immediately placed in a vertical position and allowed to stand for a period equivalent to the rated tack-free time defined in the applicable material specification for the sealing compound under test. At the end of the tack-free time, the thickness of the remaining sealing compound on the upper one-third of the test panel shall be measured. The measured thickness shall be checked for conformance to the minimum thickness requirement of the applicable material specification.

5.6 Application Time

5.6.1 Class A and E Material

The base compound and curing agent shall be stabilized at standard conditions in accordance with AS5127 (4) before a sample of the base compound is mixed with the proper amount of curing agent sufficient to fill a standard 1 pint (473 mL) or larger can. This can shall be tightly covered except when testing for the viscosity.

At the end of the rated sealing compound application time, e.g., 0.25 hour for A-1/4, measured from the beginning of the mixing period, the sealing compound shall be tested for viscosity using a Brookfield Model RVF viscometer or equivalent. Stir sample slowly with a metal spatula for 25 to 30 seconds before measuring viscosity. Spindle size and speed of rotation shall be defined in the applicable material specification. The highest reading shall be taken after the instrument has run in the sealing compound for 60 to 70 seconds. The measured viscosity shall be within the limits defined in the applicable material specification.

5.6.2 Class B, C, and D Material

The base compound, curing agent, and application gun shall be stabilized at standard conditions in accordance with AS5127 (4) before mix. Sufficient base compound to provide 6 fluid ounces (177 mL) shall be mixed with the proper amount of curing agent.

The mixed sealing compound shall be used to fill a sealing gun cartridge, having a nozzle with an orifice of 0.125 inch ± 0.010 inch (3.18 mm ± 0.25 mm) and a length of 4.0 inches ± 0.1 inch (102 mm ± 2.5 mm) as shown in Figure 1. The gun and sealing compound shall be maintained at standard conditions in accordance with AS5127 (4) throughout the test.

The gun shall be attached to a constant air supply of 90 psi ± 5 psi (621 kPa ± 34 kPa). From 2 to 3 inches (51 to 76 mm) of sealing compound shall be extruded initially to clear any entrapped air. At the end of the rated sealing compound application time, measured from the beginning of the mixing period, the sealing compound shall be extruded onto a previously weighed suitable receptacle for 60 seconds ± 1 second and the weight of extruded sealing compound determined within ±0.1 g. The weight or volume of sealing compound extruded per minute shall be within the limits of the applicable material specification for the sealing compound under test.

If the extrusion rate is anticipated to exceed 100 g per minute, it is permissible to extrude material for 30 seconds ± 1 second, per the above method and multiply the recorded weight of sealant by 2 to determine its actual extrusion rate per minute. If extrusion rate is anticipated to exceed 200 g per minute, it is permissible to extrude material for 12 seconds ± 1 second per the above method and multiply the recorded weight of sealant by 5 to determine the actual extrusion rate per minute.

If the sealing compound is extruded before the time required is reached, record the weight extruded (in grams) and the extrusion time (in seconds). Calculate the extrusion rate ((weight extruded / extrusion time) x 60) to determine the actual extrusion rate per minute.

5.7 Assembly Time (Class C only)

Six panels 0.125 x 1.5 x 4 inches (3.18 x 38 x 102 mm) in size shall be prepared using AMS4045 aluminum alloy, or equivalent. Drill two holes using a number 11 drill, 0.50 inch (13 mm) from one end with centers 0.75 inch (19 mm) apart and 0.375 inch (9.5 mm) from each side. The panels are depicted in Figure 5. Deburr the holes and clean the panels according to AS5127 (6.1). Accurately determine the thickness of the panels around the holes. Apply approximately 0.015 inch (0.38 mm) of freshly mixed sealant to the drilled end of three panels. Use of tape or metal shims to achieve this bond line is acceptable. Allow the sealant to flash-off for 0.5 hour prior to further assembly. Place the remaining three cleaned panels on those with sealant so that the holes line up and result in a 1.0 inch (25.4 mm) overlap (see Figure 5). Sealant shall cover the entire 1.0 inch (25.4 mm) faying surface overlap area. Insert two size 10-32 steel bolts that have been heat treated to at least 160 ksi (1103 MPa) into the holes. Install and tighten (NAS 679-A3) nuts only until sealant starts to squeeze out. The thickness of each assembly shall be measured at this time and the thickness of the sealant shall be 0.010 to 0.015 inch (0.25 to 0.38 mm). Allow the specimens to cure at standard conditions in accordance with AS5127 (4) for the rated assembly time defined in the applicable material specification, then tighten the nuts to a torque value of 40 inch-pound ± 2 inch-pound (4.5 N·m ± 0.11 N·m). Measure the thickness of the assembly between the bolts using a micrometer and from this thickness subtract the original thickness of the panels. The sealant must squeeze out to a thickness of 0.005 inch (0.13 mm) or less at the bolts, in accordance with the applicable material specification for the sealing compound under test.

5.8 Tack-Free Time

A metal or plastic substrate shall be cleaned in accordance with AS5127 (6.1). Sealing compound, applied at a minimum thickness of 0.125 inch (3.18 mm) thick in accordance with applicable material specification requirements for the sealing compound under test, shall be cured at standard conditions in accordance with AS5127 (4), for the tack-free time defined in the applicable material specification for the sealing compound under test.

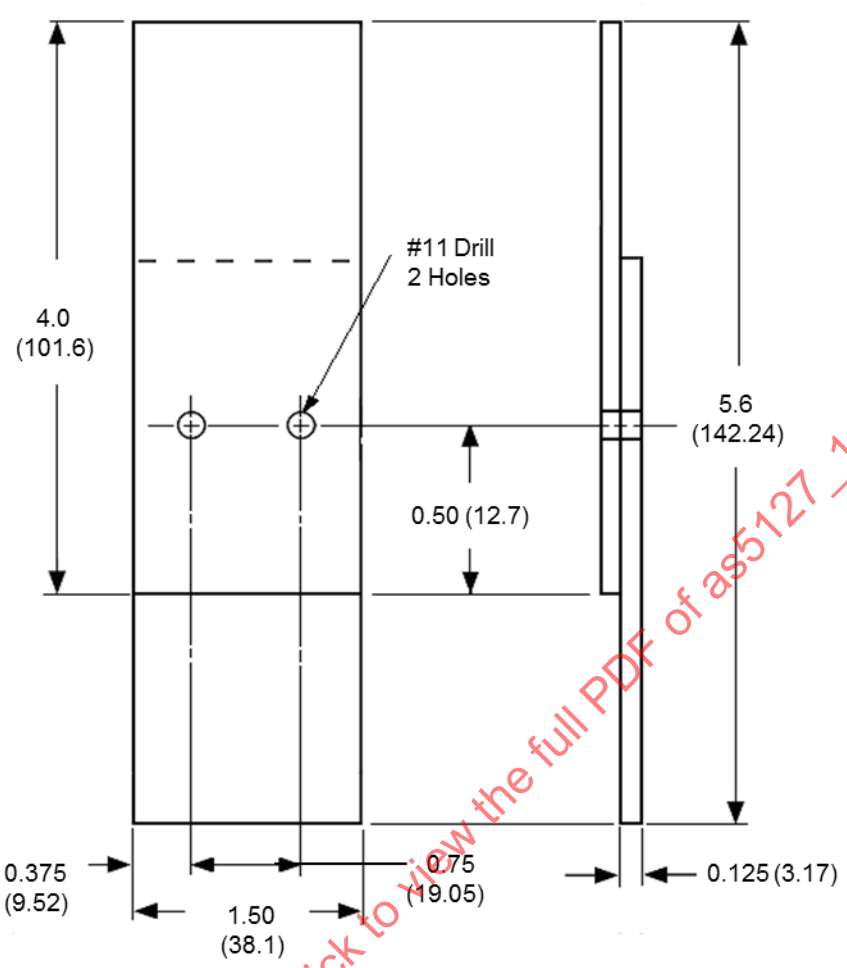
At the end of the specified tack-free time, one 1 x 7 inch (25 x 178 mm) strip of low density polyethylene film 0.005 inch ± 0.002 inch (0.13 mm ± 0.05 mm) thick, cleaned with AMS3819 cloth wipes and clean solvent conforming to AMS3167, shall be applied to the sealing compound so that the plastic has intimate contact with the sealing compound, and held in place at a pressure of a minimum of 0.5 ounce per square inch (0.0002 N/mm^2) for 2 minutes ± 10 seconds. 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.

5.9 Standard Curing

The instantaneous hardness shall be determined in accordance with ASTM D2240 using a Type A Durometer after the sealing compound is allowed to cure at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. The reading shall be taken on two 0.125 inch (3.18 mm) thick specimens, stacked back to back to make a total thickness of 0.25 inch (6.35 mm). If the thickness is less than 0.125 inch (3.18 mm) thick, multiple pieces may be stacked to obtain a total thickness of at least 0.25 inch (6.35 mm). The measured hardness shall be checked for conformance to the applicable material specification for the sealing compound under test.

5.10 Low-Temperature Cure Time (Classes A and B only)

The instantaneous hardness shall be determined in accordance with ASTM D2240 using a Type A Durometer after the sealing compound is applied at standard conditions in accordance with AS5127 (4) according to the sealing compound applicable material specification and allowed to cure at the temperature and time defined in the applicable material specification. The specimen shall be allowed to stabilize at standard conditions in accordance with AS5127 (4) for a minimum of 10 minutes before reading the Type A Durometer. The reading shall be taken on two 0.125 inch (3.18 mm) thick specimens, stacked back to back to make a total thickness of 0.25 inch (6.35 mm). If the thickness is less than 0.125 inch (3.18 mm) thick, multiple pieces may be stacked to obtain a total thickness of at least 0.25 inch (6.35 mm). The measured hardness shall be checked for conformance to the applicable material specification for the sealing compound under test.



Note: Dimensions in inches (millimeters)

FIGURE 5 - ASSEMBLY TIME TEST SPECIMEN

5.11 Fluid Immersion Cure Time (Classes A-1/4, A-1/2, B-1/4, and B-1/2 only)

An AMS4049 aluminum alloy test panel measuring 0.040 x 2.75 x 6 inches (1.02 x 69.9 x 152 mm) shall be cleaned in accordance with AS5127 (6.2), and covered with sealing compound to a depth of 0.25 inch (6.4 mm) in one application. After curing for 6 hours at standard conditions in accordance with AS5127 (4), the test panel shall be immersed in AMS2629, Type 1 jet reference fluid at 77 °F (25 °C). The instantaneous hardness of the sealant shall be determined in accordance with ASTM D2240 using a Type A Durometer after a total of 48 hours (42 hours in fluid) and after a total of 120 hours (114 hours in fluid). The measured hardness shall be checked for conformance to the applicable material specification.

5.12 Soluble Chromate Level

5.12.1 Extraction

Sealants used for this test must be fully cured in accordance with the applicable material specification. Use a suitable grinding device to get the cured sealant into small fines. The fines shall pass through an ASTM E11 No. 40 sieve (0.0165 inch (0.419 mm) nominal sieve opening) or equivalent. Weigh 1 g ± 0.01 g of the fines into a 500 mL beaker and add 300 mL ± 10 mL reagent water conforming to ASTM D1193 Type IV. Boil for 2 hours. Decant and filter. Add 100 mL ± 10 mL reagent water conforming to ASTM D1193 Type IV to the sealing compound in the beaker and boil for 30 minutes. Repeat until the last extraction is colorless; the total volume of fluid may be up to 500 mL.

5.12.2 Titration

Transfer 200 mL ± 10 mL of the extracted solution to a 600 mL beaker, cover with a watch glass, and gently boil for 10 minutes. Add 10 mL ± 0.5 mL of a 0.25% silver nitrate solution (2.5 g ± 0.01 g of silver nitrate in 1000 mL ± 10 mL of reagent water conforming to ASTM D1193 Type IV). Cautiously add 1.5 g ± 0.01 g of ammonium persulfate. Boil gently for an additional 10 minute. Allow to cool, add 5 mL ± 0.5 mL of 1:1 sulfuric acid for each 100 mL of solution, then titrate with 0.1 N ferrous ammonium sulfate solution. Use a platinum and Ag/AgCl electrode combination in a potentiometric titration to maximum deflection.

5.12.3 Calculation

$$\frac{A \times B \times C \times D \times 100}{E} = \%MgCrCo_4.5H_2O \qquad \text{(Eq. 3)}$$

where:

A = mL ferrous ammonium sulfate

B = dilution factor (2 if 200 mL of a 400 mL extract was used in the titration)

C = normality of ferrous ammonium sulfate

D = 0.0768 (milliequivalent weight of $MgCrO_4 \cdot 5H_2O$)

E = weight of sample in grams

The calculated value shall be checked for conformance to the requirements of the applicable material specification.

5.12.4 Alternate Tests for Soluble Chromate

Soluble chromate level may also be determined using either of the following test methods:

a. Lachat Quik-Chem® 10-124-13-1-A for Hexavalent Chromium

b. Optical Emission Spectroscopy

6. PERFORMANCE PROPERTIES TEST METHODS

6.1 Specific Gravity

Three test specimens approximately 0.125 x 1 x 1 inch (3.18 x 25 x 25 mm) in size shall be cut out with a sharp blade from a sheet of the sealing compound that has been cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. Determine the specific gravity of each sample in accordance with ASTM D792, Method A. The averaged value shall be checked for conformance to the applicable material specification for the sealing compound under test.

6.2 14-Day Hardness

The instantaneous Type A Durometer hardness shall be determined in accordance with ASTM D2240 after the sealing compound has been cured for 14 days at standard conditions in accordance with AS5127 (4). The reading shall be taken using two 0.125 inch (3.18 mm) thick specimens, stacked back to back to make a total thickness of 0.25 inch (6.4 mm). The measured hardness shall be checked for conformance to the applicable material specification.

For quality acceptance testing only, the above hardness can be measured prior to 14 days duration at standard conditions in accordance with AS5127 (4). If the recorded hardness exceeds the minimum requirements of the applicable material specification, then the result is acceptable.

6.3 Radiographic Density

NOTE: The AMS Committee G-9 is removing this requirement from the AMS sealing compound specifications based on its value in detecting sealing compound failures and the development of NDI equipment for inspection.

6.3.1 Preparation of Test Panels

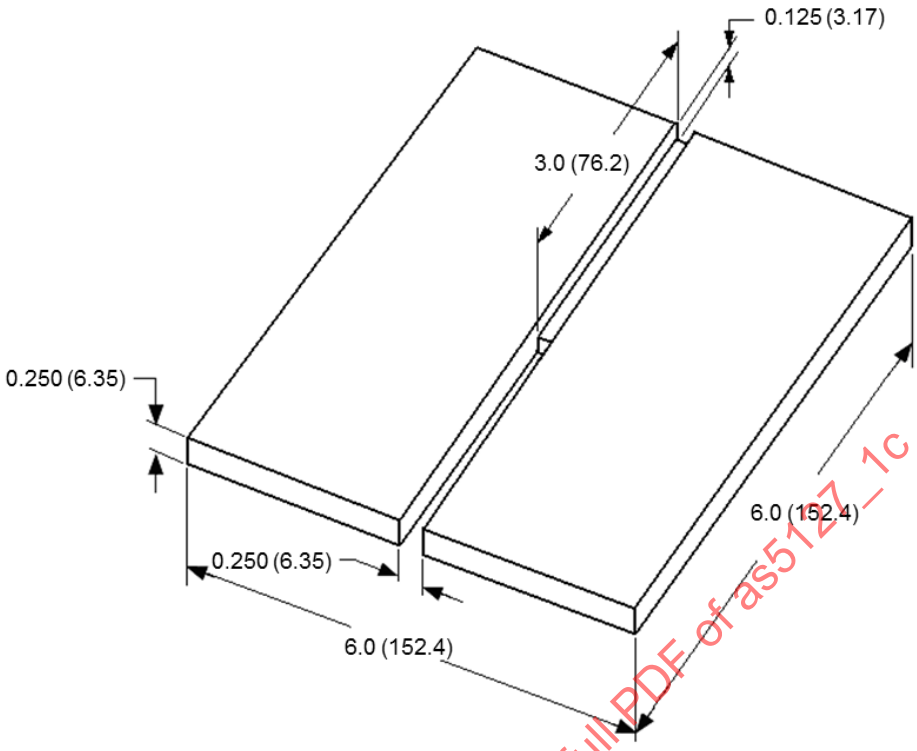
A 6 inch (152 mm) square plate, 0.25 inch (6.4 mm) thick shown in Figure 6, shall be prepared from AMS4049 aluminum alloy. A notch 0.25 inch (6.4 mm) wide shall be milled to a depth of 0.125 inch (3.18 mm) half way across the plate. A continuation of this notch shall be milled completely through the remaining half to form a slot in the plate.

6.3.2 Application of Sealant

After cleaning the test panel according to AS5127 (6.1), a sample of the sealant to be tested shall be mixed according to the manufacturer's recommended procedure, after which a strip 1 inch (25 mm) wide and 0.125 inch (3.18 mm) thick shall be applied over the entire length of the notched portion and slot in the test plate, ensuring that the notch and slot are also filled. A mold shall be used during application of the sealant to the plate to maintain uniform thickness of the sealant. Allow the sealant to cure at standard conditions in accordance with AS5127 (4), for the time specified in the applicable material specification for the sealing compound under test.

6.3.3 Test Procedure

The prepared test panel shall be radiographed in accordance with ASTM E1742 to obtain 2% sensitivity through the plate at an H & D density of 2.5 ± 0.2, using DuPont 510 or Kodak M film, or equivalent. All density measurements shall be measured with an Ansco-Sweet densitometer, or equivalent. Density measurements shall be checked for conformance to the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 6 - RADIOGRAPHIC DENSITY

6.4 Resistance to Thermal Expansion

The thermal expansion block shown in Figure 7 shall be sulfuric acid anodized per AMS2471 and coated on all sides with MIL-PRF-23377 primer in accordance with the applicable coating specification. After cleaning the thermal expansion block according to AS5127 (6.4.1.2), the groove in the block shall be filled with sealing compound. (Care shall be taken to prevent air entrapment during filling.) The sealing compound shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. After cure, the sealing compound surface shall be trimmed flush with the block, if necessary. Expose the specimen to the standard heat cycle specified in the applicable material specification. Remove the block from the oven and allow the block to cool to standard conditions in accordance with AS5127 (4). Measure the amount of sealant that has expanded or shrunk from the block at locations of 2 inches (51 mm) from each end of the block. The measured values shall be checked for conformance to the applicable material specification for the class and application time of the sealing compound under test.

6.5 Heat Reversion Resistance (Classes B and C only)

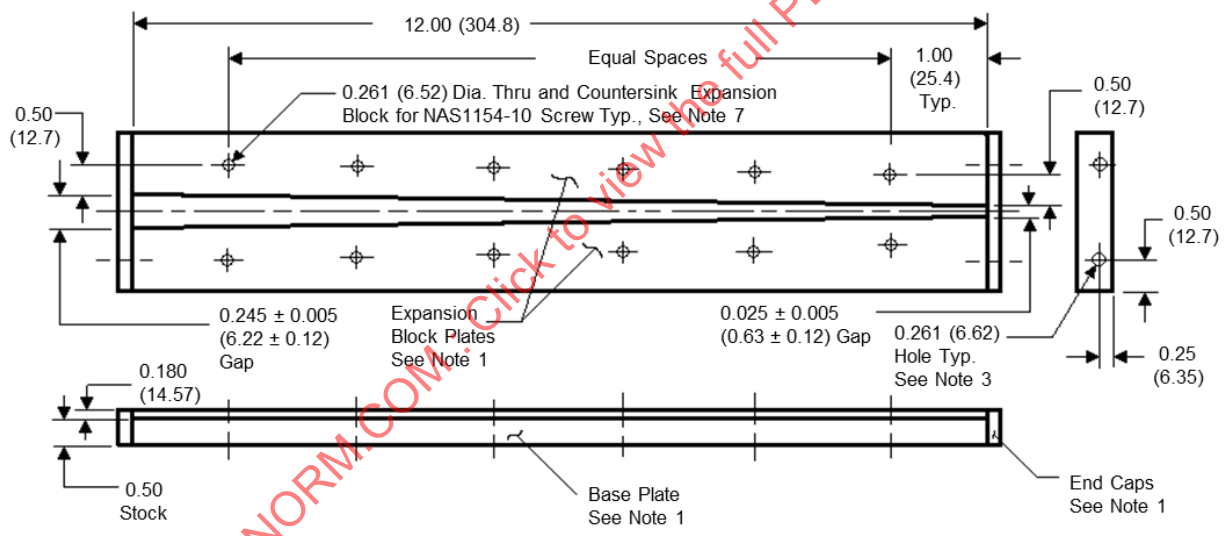
Two AMS4045 aluminum panels, measuring 0.040 x 3 x 12 inches (1.02 x 76.2 x 305 mm), anodized per AMS2471 and coated with 0.001 inch (0.025 mm) of AMS-C-27725, shall be cleaned in accordance with AS5127 (6.4.1.2). Using Mylar tape or equivalent, tape approximately 3 x 3 inches (76.2 x 76.2 mm) of one end of each panel. Freshly mixed sealing compound shall be applied over the remaining 9 inches (228 mm) of each surface of each panel. Placing the uncoated sections at one end, position the sealant coated surface of the second panel over the sealant coated surface of the first panel to form a sandwich with a layer of sealing compound approximately 0.010 inch (0.25 mm) thick. The panels shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, and then shall be exposed to the heat cycle defined in the applicable material specification. After the heat cycle has been completed, the panels shall be cooled to standard conditions in accordance with AS5127 (4). Using the uncoated portions of the panels as tabs, the sandwich construction shall be peeled apart at 90 degrees to the panel in a tensile testing machine at a jaw separation rate of 2 inches (51 mm) per minute. The observations and, if required, measured values shall be checked for conformance to the applicable material specification for the sealing compound under test.

6.6 Hydrolytic Stability

A sealing compound specimen measuring 0.50 inch (13 mm) thick x 3 inches (76 mm) in diameter shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, after which it shall be exposed for 120 days in an environment of 160 °F (70 °C) and 95% ± 5% relative humidity cabinet or by use of an aqueous glycerin solution in accordance with ASTM D5032. If aqueous glycerin solutions are used, it shall be changed every 30 days or when it becomes cloudy and the container shall be removed from the oven and cooled to standard conditions in accordance with AS5127 (4) by frequently opening and closing the vent. After cooling, remove the specimen from the humidity cabinet or container and hold it for 14 days at standard conditions in accordance with AS5127 (4). The instantaneous Type A Durometer hardness shall be determined according to ASTM D2240. The measured hardness shall be checked for conformance to the applicable material specification for the sealing compound under test.

6.7 Shaving and Sanding (Class B only)

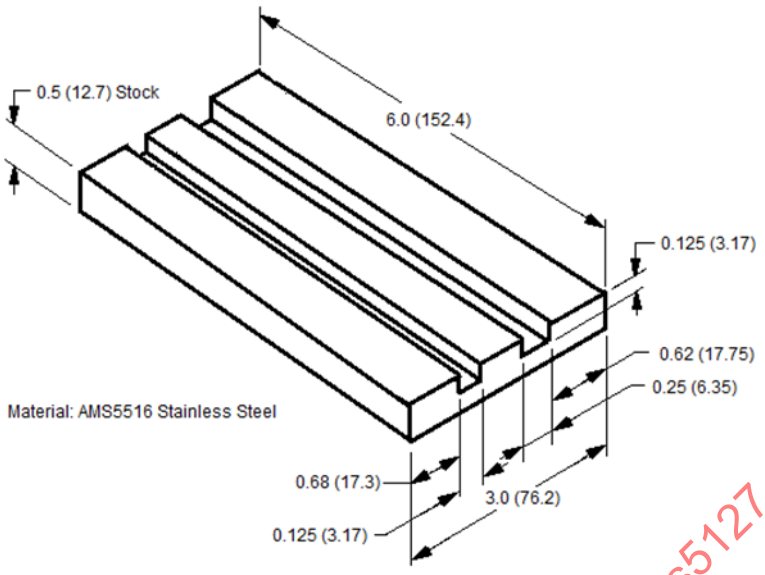
The groove and screw heads of a thermal expansion block (Figure 7), coated with MIL-PRF-23377, shall be filled with sealant allowing for excess material for shaving and sanding. If the thermal expansion test is not required by the applicable material specification, sealing compound may be applied to a grooved metallic block (Figure 7A) that is sulfuric acid anodized per AMS2471 and coated with MIL-PRF-23377 primer in accordance with the applicable coating specification. After being cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, the excess sealant from the thermal expansion block shall be shaved off using a non-metallic scraper or the sealing material on the surface of the coated metallic panel shall be sanded with 400 grit abrasive paper on a sanding block. The sanded surface shall be visually inspected. There shall be no rolling or tearing of the sealing compound.



Notes:
1. Material: Aluminum Alloy, AMS-QQ-A-250/4, T81
   Base Plate: 12.00 x 2.25 (304.8 x 57.15) by 0.50 (12.7) stock aluminum sheet
   End Caps: 2.25 x 0.688 (57.15 x 17.47) by 0.063 (1.60) stock aluminum sheet
   Expansion Block: fabricate as shown in figure
2. Tolerances: 0.XX = 0.003 (0.076), 0.XXX = 0.010 (0.254)
3. Drill/tap for 1/4 (6.35) bolt, typical 2-places in line thru End Cap holes into Base Plate
4. Establish 0.025 (0.63) and 0.245 ((6.22) gaps on ends of Expansion Block Plates before drilling 0.261 ((6.52) dia. Holes.
5. Install Expansion Block Plates with NAS1154-10 screws and NAS21042.12 nuts, twelve places maintaining 0.025 and 0.245 gaps.
6. Install End Caps with 1/4 ((6.35) bolts
7. NAS1154-10 screws to be 0.005 to 0.020 (0.12 to 0.50) sub-flush on Expansion Block Plate surfaces

Note: Dimensions in inches (millimeters)

FIGURE 7 - THERMAL EXPANSION BLOCK



Note: Dimensions in inches (millimeters)

FIGURE 7A - SHAVING AND SANDING BLOCK

6.8 Paintability

Two 0.040 x 2.75 x 6 inch (1.02 x 69.9 x 152 mm) AMS4045 aluminum alloy panels shall be sulfuric acid anodized per AMS2471 and coated with fuel tank coating in accordance with AMS-C-27725. After cleaning according to AS5127 (6.4.1.2), a thin layer of sealant, approximately 0.031 inch (0.79 mm) thick, shall be applied to one surface and allowed to cure at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. After curing, the sealant coated surface of one panel shall be painted with MIL-PRF-23377 primer. The sealant coated surface of the other panel shall be coated with MIL-PRF-23377 primer followed by overcoating with MIL-PRF-85285 polyurethane coating in accordance with the applicable coating specifications. When the coatings have been cured according to the applicable coating specification, they shall be tested for adhesion by immersing the panel for 24 hours in reagent water conforming to ASTM D1193 Type IV at room temperature and adhesion tested in accordance with ASTM D3359 Method A. The painted surface shall be evaluated per the applicable material specification. A rating of ASTM D3359 4A or higher shall be considered “no separating from sealant”.

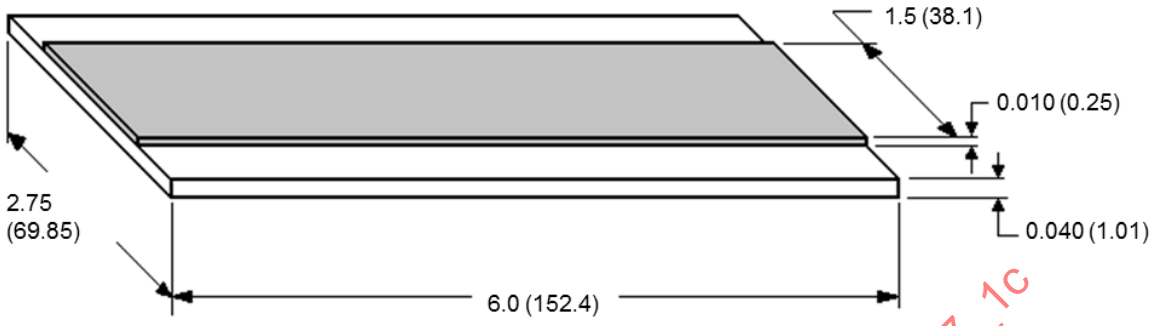
6.9 Weathering

Two AMS4045 aluminum panels, 0.040 x 2.75 x 6.0 inches (1.0 x 69.9 x 150 mm) shall be sulfuric acid anodized according to AMS2471 and primed and cured in accordance with MIL-PRF-23377. After cleaning in accordance with AS5127 (6.4.1.2), a coating of sealing compound approximately 0.010 x 1.5 x 6 inches (0.25 x 38.1 x 152 mm) shall be applied in the center of each panel as shown in Figure 8. After curing at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, the test specimens shall be exposed in accordance with ASTM G155 using a Xenon-arc accelerated weathering chamber that cycles between 102 minutes of light and 18 minutes of light and water spray for a minimum of 220 hours. Table 2 outlines the applicable test conditions.

TABLE 2 - WEATHERING CHAMBER SETTINGS

Controls	Light Cycle
Automatic Irradiance	0.35 W/m^2 @ 340 nm
Cabinet Temperature	108 °F (42 °C)
Cabinet Humidity	50% ± 5%
Black Panel Temperature	145 °F (63 °C)

Following exposure, the sealing compound shall be evaluated for chalking in accordance with ASTM D4214 Method B (Wet Finger Method). If any visible powder material rubs off the sealing compound following the test method, it shall be considered chalking. In accordance with the applicable material specification requirements, other deterioration such as cracking, sponging, blistering, or loss of adhesion shall also be evaluated. Chalking and other inspection results shall be checked for conformance to the applicable material specification for the sealing compound under test.



Note: Dimensions in inches (millimeters)

FIGURE 8 - WEATHERING TEST SPECIMEN

7. RESISTANCE TO HYDROCARBONS

7.1 Chalking

Four 0.125 x 0.125 x 5 inch (3.18 x 3.18 x 127 mm) specimens shall be cut from a sheet of the sealing compound that has been cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. The specimens shall be immersed in a closed glass container with AMS2629 Type 2 jet reference fluid. To prevent evaporation, aluminum foil may be used to seal the lids of the containers. No metal (other than the metal ions in solution in AMS2629 Type 2) shall be allowed to be in contact with the fluid or sealant specimens during the immersion period. The specimens shall not touch each other, so that all sides are exposed to the fluid. The immersion temperature shall be 77 °F (25 °C). The AMS2629 Type 2 fluid shall be replaced after 48 hours and the sealant specimens shall be immersed for an additional 72 hours. Remove the specimens from the fluid and allow the fluid to evaporate. The specimens are not to be blotted or wiped. Inspect strips in a well-lighted area, using an original, unexposed specimen for comparison with the specimens under test to detect chalking. The rating criteria for sealant chalking are:

a. Slight Chalk - Initial observation of white or light gray formation, usually at the edges of the sealant.

b. Moderate Chalk - The white or light gray formation has spread between 25% and 50% of the surface area.

c. Heavy Chalk - The white or light gray formation has spread to more than 50% of the surface area.

7.2 Resistance to Thermal Rupture

Two AMS4045 panels, 0.040 x 3.5 x 3.5 inches (1.02 x 89 x 89 mm) in size, with a hole that is 0.25 inch (6.4 mm) in diameter in the center of the panel shall be prepared. After cleaning according to AS5127 (6.2), a fillet of sealing compound, approximately 0.125 inch (3.18 mm) thick by 2 inches (51 mm) in diameter, shall be applied to the center of the test panel, filling the hole with sealant. Great care must be taken when preparing the specimens to avoid entraining air or creating air voids.

The sealing compound fillets shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. One specimen shall be tested within two days after the cure has been completed per the next paragraph. The other specimen shall be placed in AMS2629 Type 1 jet reference fluid for 120 hours ± 4 hours at 140 °F (60 °C), followed by 60 hours ± 4 hours at 160 °F (71 °C), and followed by 6 hours ± 1 hour at 180 °F (82 °C).The panel shall be removed from the fluid and immediately applied to the fixture, shown in Figure 9, using a suitable gasket. A 0.188 inch (4.78 mm) thick silicone O-ring is recommended for the gasket. The fixture shall be at room temperature. The panel shall be positioned on the fixture such that the sealant is within the fixture chamber.

The fixture and test specimen shall be placed in an air circulating oven that has been preset to the temperature defined in the applicable material specification. Using a regulated air supply, air pressure at a value defined in the applicable material specification, shall be applied to the fixture. There shall be no air leaks when air pressure is applied. After the pressure is applied, the clamp fixture shall be maintained in the oven for 30 minutes or for the time designated in the applicable material specification.

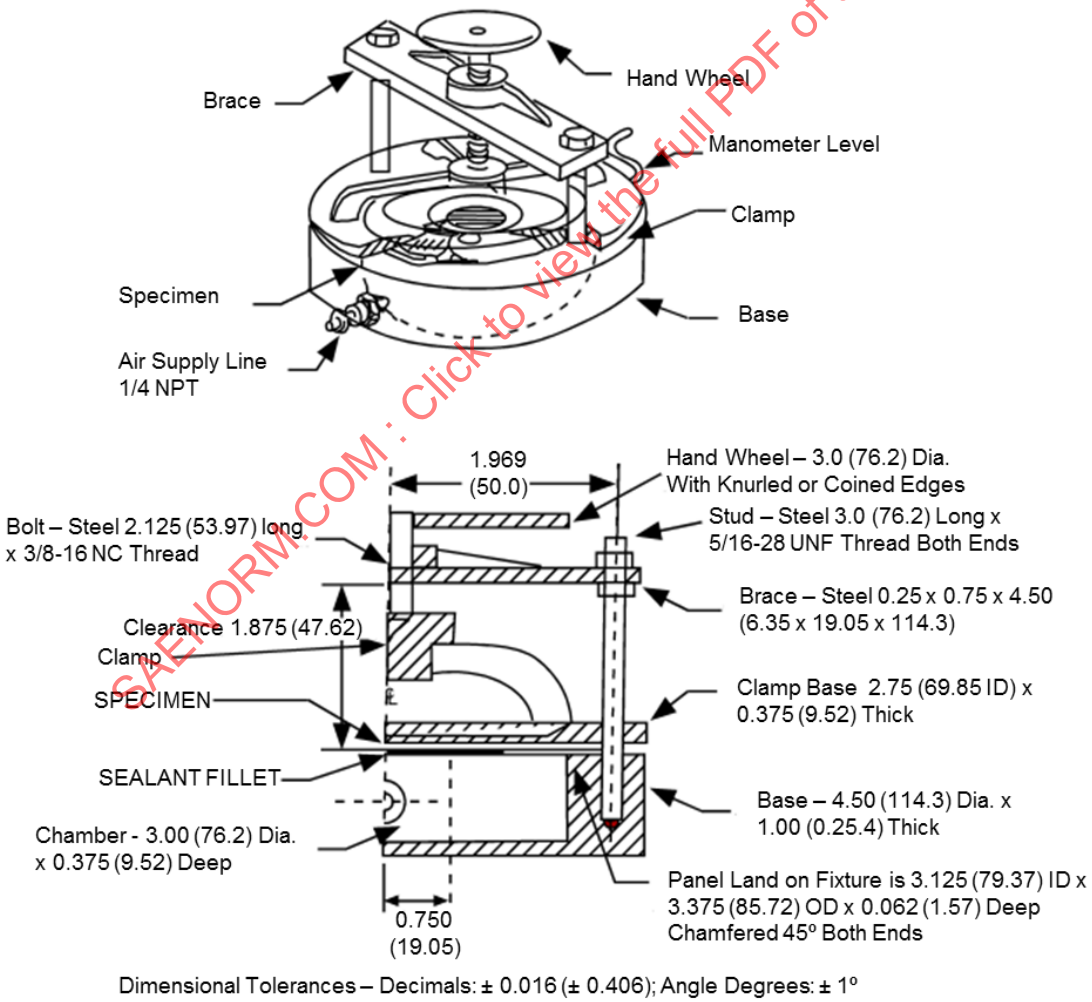
The test specimen shall be removed from the fixture and cooled to standard conditions in accordance with AS5127 (4) and inspected for conformance. Failure of the thermal rupture test is defined as the occurrence of one or more of the following:

a. Sealant deformation greater than that allowed by the applicable material specification.

b. A rupture, blowout or perforation of the specimen during the test while under pressure.

c. Swelling of the specimen resulting from the development of a sponging (a sponge-like texture) beneath the surface.

If bubbles or voids are observed on the surface of the specimen, then it shall be cut and sectioned as required to assure no sponging has occurred. 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. Deformation shall be checked for conformance to the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 9 - THERMAL RUPTURE FIXTURE

7.3 Fluid Rupture Resistance (B-1/6, B-1/4, and B-1/2 only)

A 0.125 inch (3.18 mm) hole shall be drilled in the center of a 0.040 x 3.5 x 3.5 inch (1.02 x 89 x 89 mm) AMS4045 aluminum alloy test panel. After cleaning according to AS5127 (6.2), a fillet of sealant 0.125 inch (3.18 mm) thick and 0.50 inch (13 mm) in diameter shall be applied to the center of the panel covering the hole. Curing shall be at standard conditions in accordance with AS5127 (4) for the Tack Free Time specified in the applicable material specification in accordance with AS5127 (4), after which a 0.50 inch (13 mm) cork borer shall be used to trim excess sealant and the panel shall be installed in the apparatus shown in Figure 10. The apparatus consists of a glass bulb fitted with a Buna-N O-ring. After installation of the panel in the fixture, 100 mL ± 1 mL of AMS2629 Type 1 jet reference fluid shall be added to the apparatus. Plastic tubing shall be attached, and the apparatus shall be pressurized to 10 psi +1/-0 psi (69 +6.9/-0 kPa) pressure using a regulated air supply. This pressure shall be maintained for 24 hours at standard conditions in accordance with AS5127 (4). The test apparatus shall be checked for loss of AMS2629 Type 1 fluid or loss of pressure according to the requirements of the applicable material specification for the sealing compound under test.

7.4 Weight Loss and Flexibility

Five 0.125 x 1 x 5 inch (3.18 x 25 x 127 mm) specimens shall be cut from a sheet of the sealing compound that has been cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification.

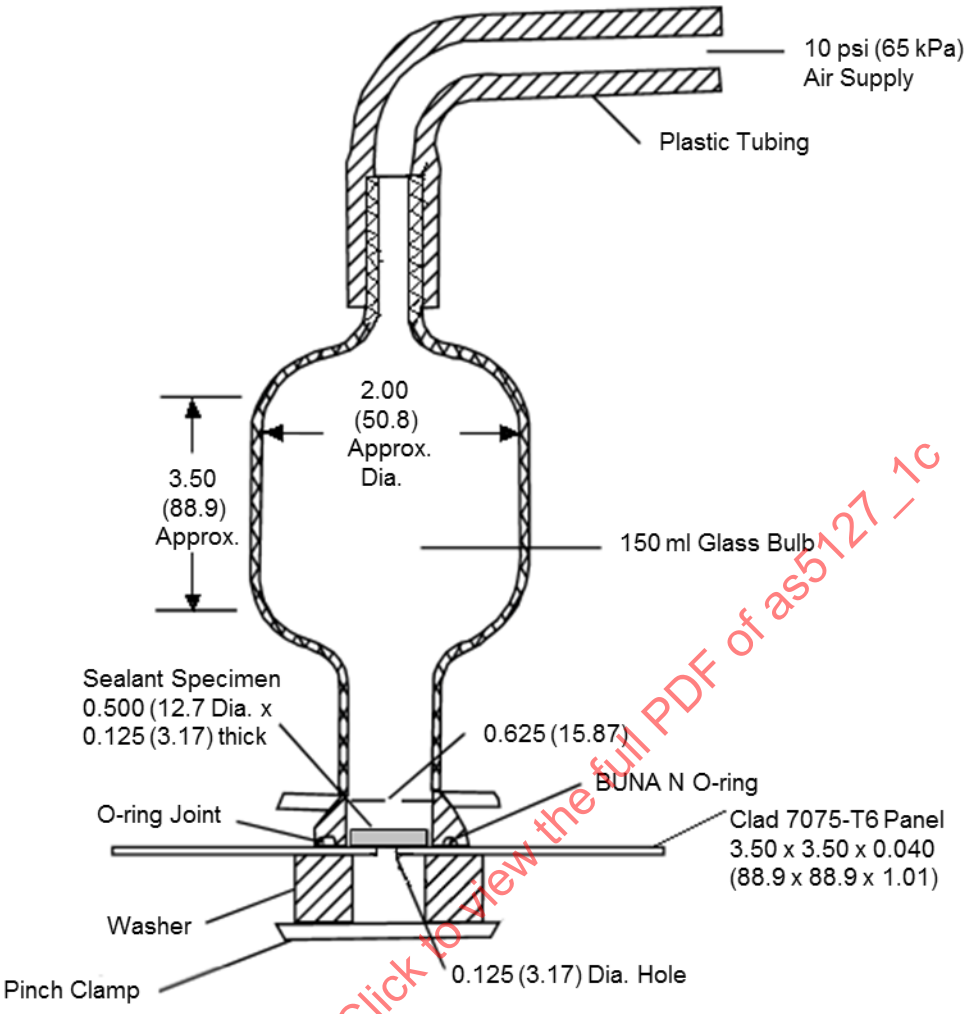
The specimens shall be weighed in air (W_1) and in water (W_2) and then shall be dried. The specimens shall be immersed in a minimum of 900 mL of AMS2629 Type 1 jet reference fluid for a period of seven days at 140 °F (60 °C) in a closed container. At the end of the exposure period, the closed container shall be cooled to standard conditions in accordance with AS5127 (4) and the specimens shall be removed from the fluid, dipped momentarily in methyl alcohol and reweighed in air (W_3) and in water (W_4). They shall then be dried for 24 hours at 120 °F (49 °C). The specimens shall be cooled in a desiccator to standard conditions according to AS5127 (4) and then reweighed (W_5). The percent volume swell shall be calculated using Equation 4.

$$\text{Percent Swell} = \frac{(W_2 + W_3) - (W_1 + W_4)}{W_1 - W_2} \times 100 \quad \text{(Eq. 4)}$$

Percent weight loss shall be calculated using Equation 5.

$$\text{Percent Weight Loss} = \frac{(W_1 - W_5)}{W_1} \times 100 \quad \text{(Eq. 5)}$$

After all weighing has been completed, the specimens shall be bent 180 degrees over a 0.125 inch (3.18 mm) mandrel to determine flexibility of the sealing compound. The specimens shall be visually examined for evidence of cracking or checking. The percent weight loss, percent volume swell and visual appearance of the sealant shall be checked for conformance to the applicable material specification for the sealing compound under test.



Note: Dimensions in inches (millimeters)

FIGURE 10 - FLUID RUPTURE APPARATUS

7.5 Volume Swell

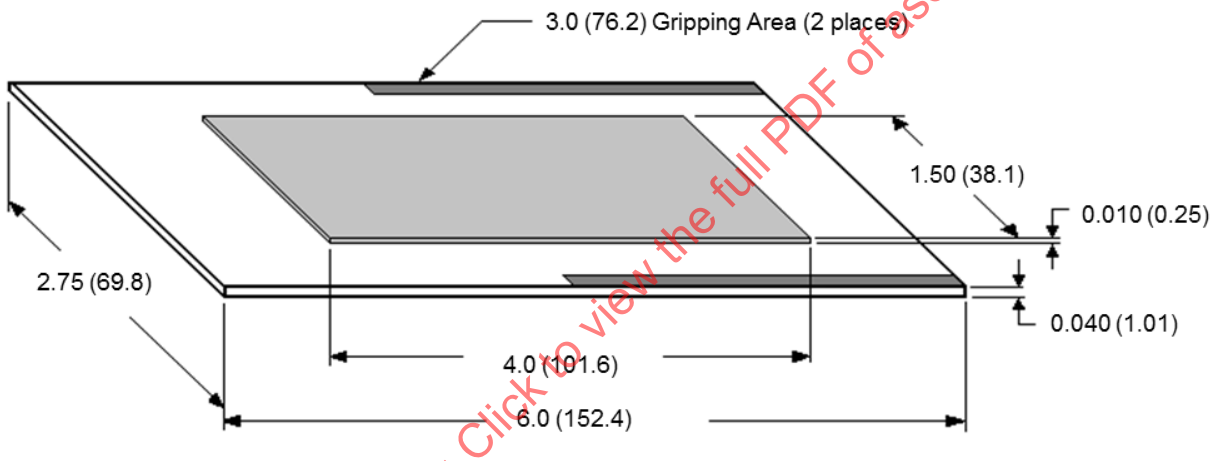
When volume swell is listed as a separate requirement of the applicable material specification, the following procedure shall be used. Five 0.125 x 1 x 3 inch (3.18 x 25.4 x 76.2 mm) or 0.125 x 1 x 5 inch (3.18 x 25.4 x 127 mm) specimens shall be cut from a sheet of the sealing compound that has been cured for 14 days in accordance with AS5127 (4).

The specimens shall be weighed in air (W_1) and in water (W_2) and then shall be dried. The specimens shall be immersed in a minimum of 900 mL of AMS2629 Type 1 jet reference fluid for a period of seven days at 140 °F (60 °C) in a closed container. At the end of the exposure period, the closed container shall be cooled to standard conditions in accordance with AS5127 (4) and the specimens shall be removed from the fluid, dipped momentarily in methyl alcohol and reweighed in air (W_3) and in water (W_4). The percent volume swell shall be calculated using Equation 4 of AS5127/1 (7.4). The percent volume swell shall be checked for conformance to the applicable material specification.

7.6 Low-Temperature Flexibility

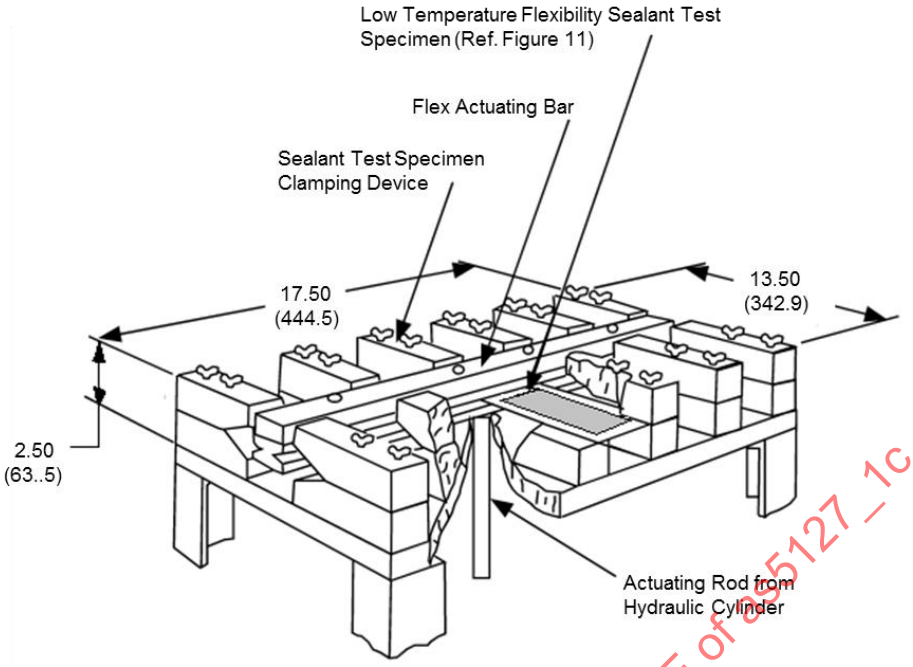
Four AMS4049 aluminum alloy test panels 0.040 x 2.75 x 6 inches (1.02 x 69.9 x 152 mm) shall be conversion coated in accordance with AS5127 (6.2). After conversion coating, sealing compound 0.1 x 1.5 x 4 inches (2.5 x 38 x 102 mm) shall be applied to the center of each of the four panels as shown in Figure 11. Care shall be taken to maintain an accurate sample thickness of 0.1 inch ± 0.02 inch (2.5 mm ± 0.5 mm). After curing at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, the specimens shall be environmentally exposed according to the requirements of the applicable material specification. At the completion of the environmental exposure, all four panels shall then be immediately placed in a low-temperature cabinet containing a low temperature flexibility fixture (see Figure 12) consisting of a clamp support that will grip both sides of both 6 inch (152 mm) edges of the panel for a distance of 3 inches (76 mm) from one end without touching the sealant. The fixture shall be capable of flexing the panel through a 30 degree arc (15 degrees each side of the center) at a constant speed of 1 cycle per 5 seconds. The cabinet temperature shall be reduced to -65 °F (-54 °C), then stabilized at this temperature for at least 2 hours, after which the panels shall be flexed through 130 consecutive cycles. At the completion of testing, the panels shall be visually examined for cracking, checking or loss of adhesion according to requirements of the applicable material specification.

See 7.6.1 and Figures 13 and 14 for an alternate method of low-temperature flexibility testing. This alternate method is only used when specified by the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 11 - LOW TEMPERATURE FLEXIBILITY TEST SPECIMEN

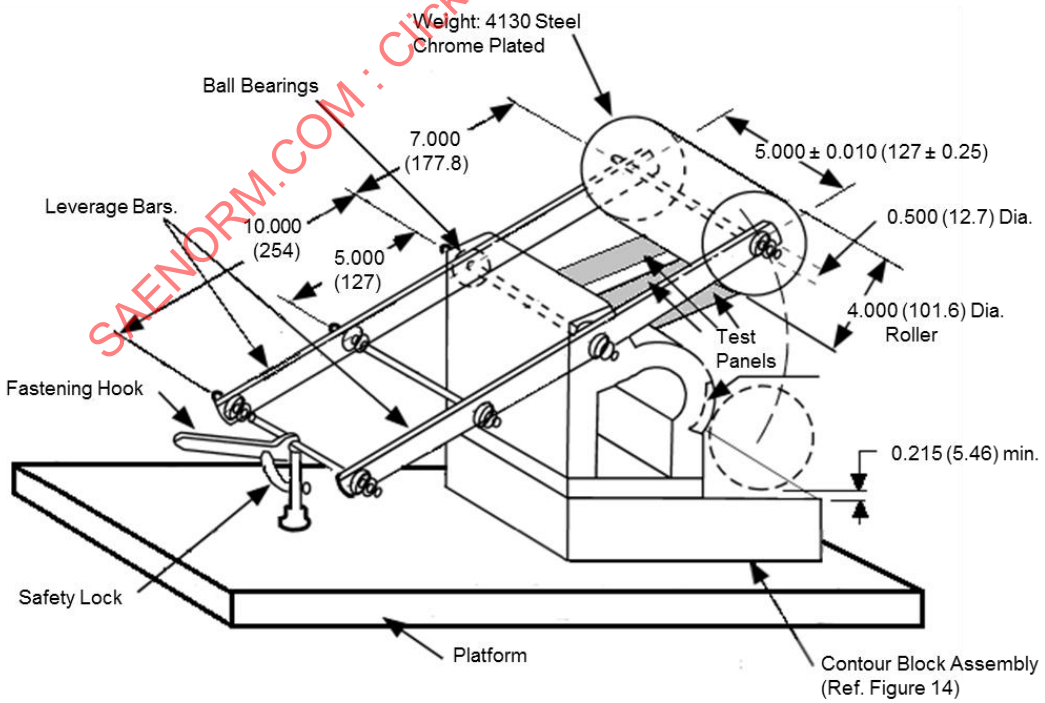


Note: Dimensions in inches (millimeters)

FIGURE 12 - LOW TEMPERATURE FLEXIBILITY JIG

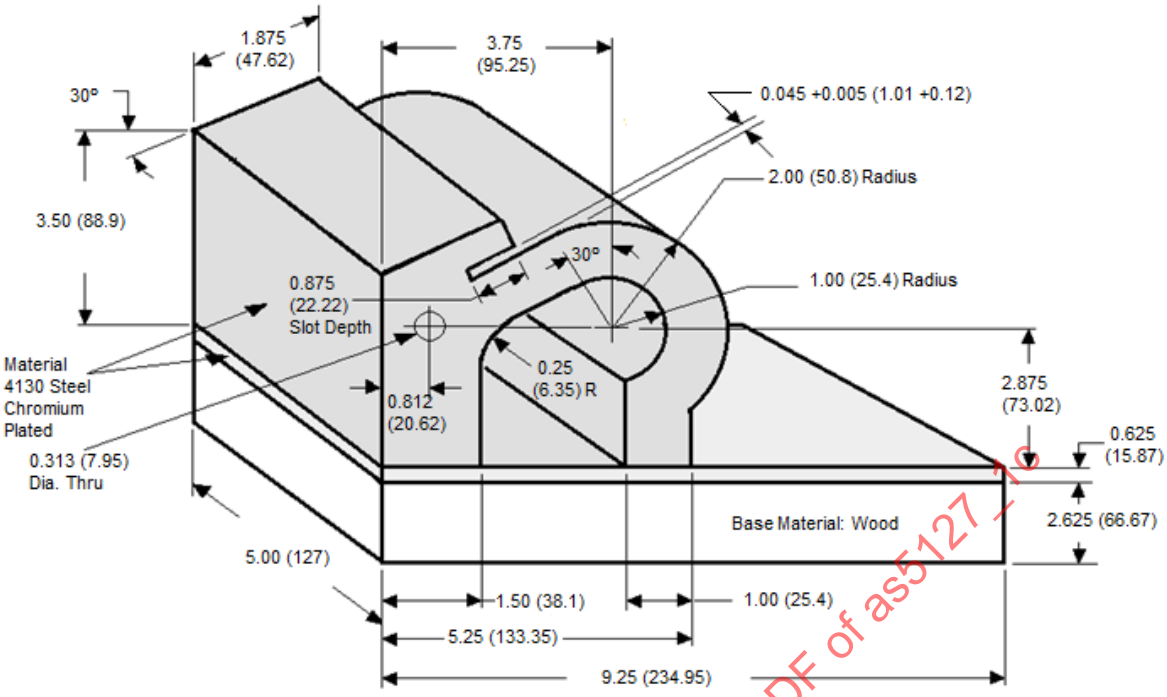
7.6.1 Alternate Low Temperature Flexibility Testing

When applicable material specifications require alternate methods to determine low temperature flexibility, the test fixture shown in Figures 13 and 14 may be employed. At the completion of testing, the panels shall be visually examined for cracking, checking or loss of adhesion according to requirements of the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 13 - LOW TEMPERATURE FLEXIBILITY APPARATUS

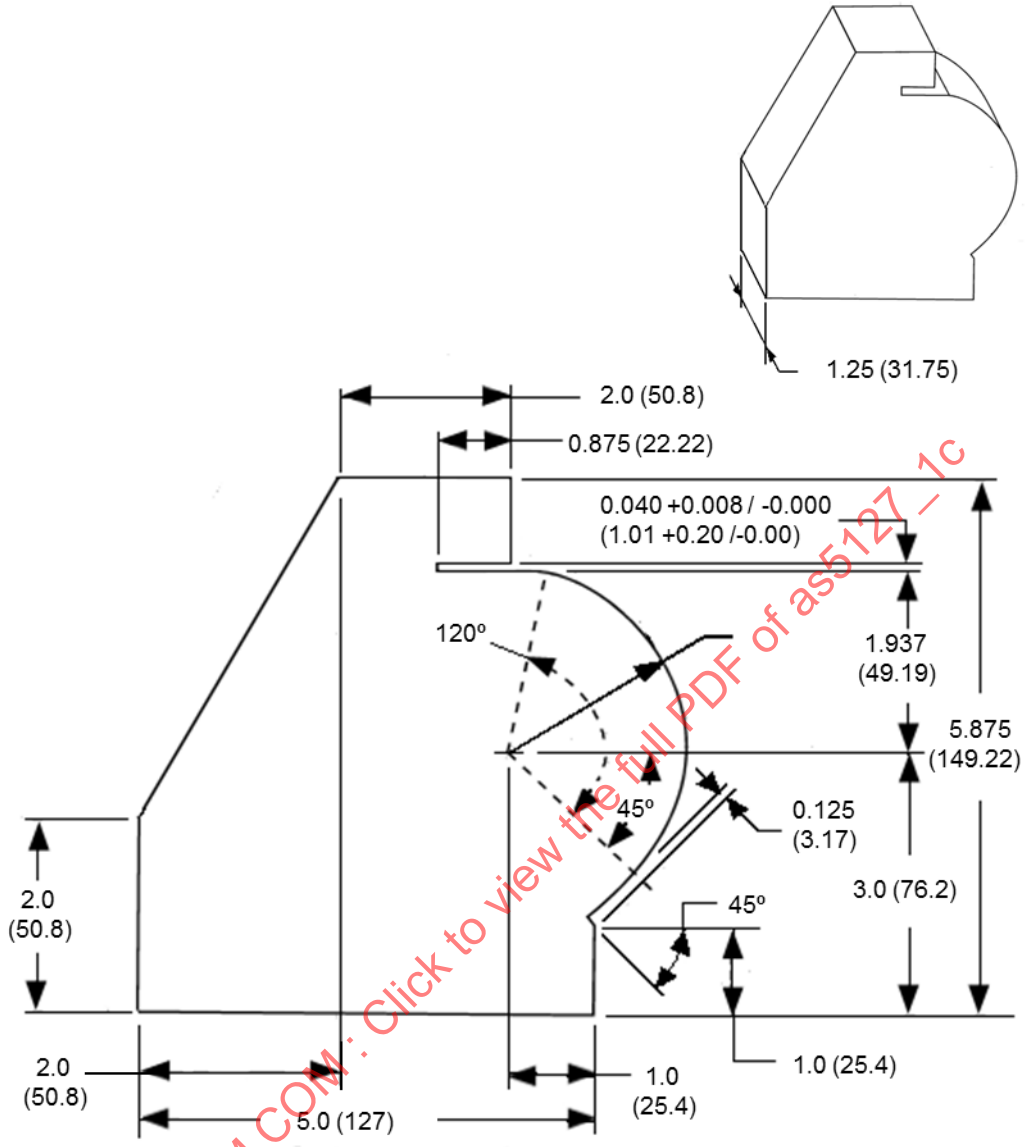


Note: Dimensions in inches (millimeters)

FIGURE 14 - CONTOUR BLOCK

7.6.2 Low-Temperature Flexibility (Windshield Sealant)

Four each 0.040 x 2.75 x 6 inch (1.02 x 69.9 x 152 mm) AMS4049 aluminum alloy panels shall be conversion coated in accordance with AS5127 (6.2). Sealing compound shall cover one side of the panels so that a 1.5 x 4 inch (38 x 102 mm) coating is centered on the panels to a depth of 0.125 inch ± 0.016 inch (3.18 mm ± 0.4 mm). After curing at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification, two of the panels shall be conditioned at 248 °F ± 2 °F (120 °C ± 1 °C) for an additional seven days. The panels and test jig shown in Figure 15 shall be stabilized at -65 °F (-54 °C) for 2 hours. (Note: AMS3333 does not require elevated temperature conditioning.) While at that temperature, each panel shall be tested by placing the panel in the slot (with the sealant coated side facing up) and rapidly bending it once around the curved portion of the jig. Each panel shall then be examined for evidence of cracking, checking or loss of adhesion according to requirements of the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 15 - LOW TEMPERAUTRE FLEXIBILITY TEST JIG

7.7 Tensile Strength and Elongation

A 0.125 inch ± 0.015 inch (3.18 mm ± 0.4 mm) thick sheet of sealing compound shall be prepared by pressing freshly mixed sealing compound between two release sheets or plates (e.g., low density polyethylene, Teflon, release paper, or metal panels), by injecting into a closed mold, or by an alternate method as specified in the applicable material specification. Critical to any method is avoiding air entrapment or voids which later compromise specimen integrity. The sealing compound shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification.

Sufficient tensile specimens shall be cut from the sheet, using Die C as specified in ASTM D412. Three specimens shall be exposed to each of the environmental conditions defined in the applicable material specification.

Where fluid immersion is specified, the specimens shall be immersed in at least 900 mL of fluid. Specimens to be tested after the fluid immersion shall be cooled to standard conditions in accordance with AS5127 (4) and tested within 5 minutes after removal from the fluid.

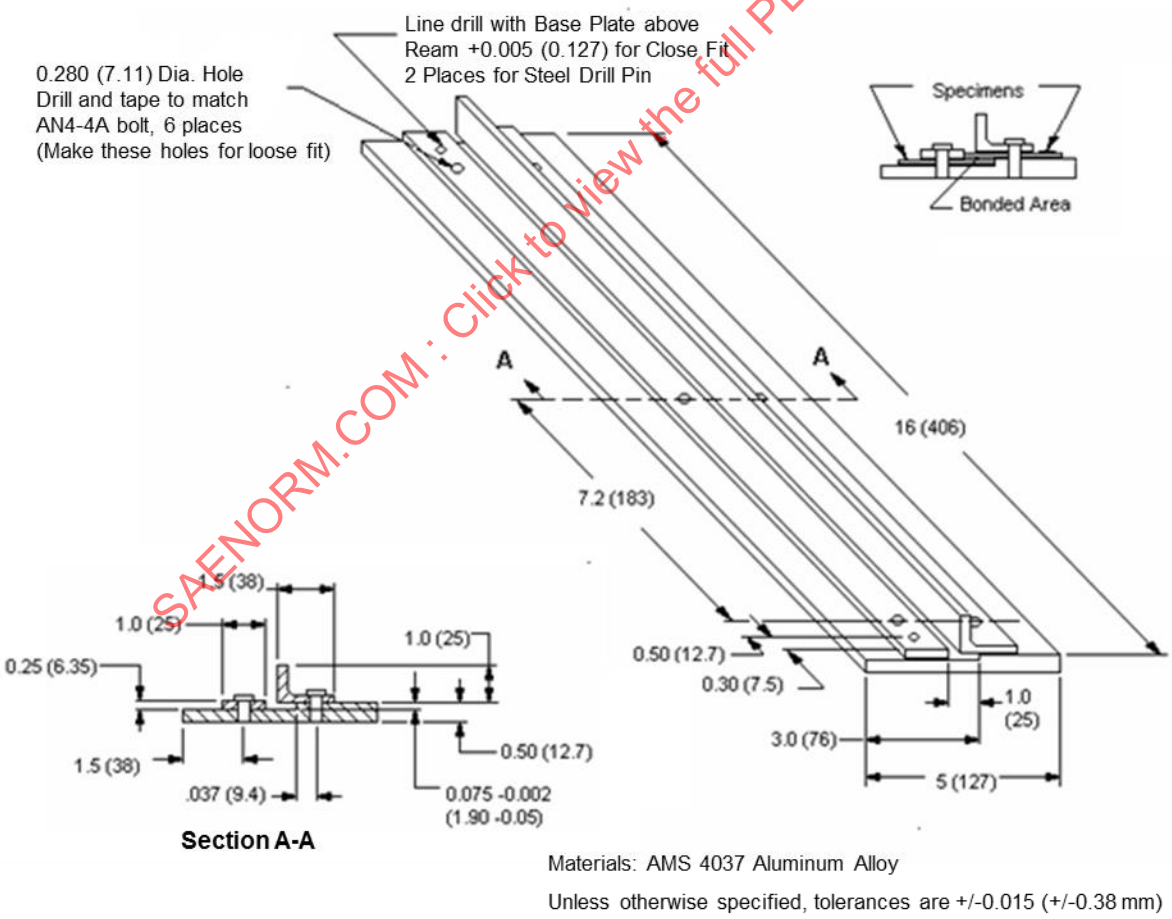
Specimens to be tested after oven aging shall be allowed to cool until the specimens reach standard conditions in accordance with AS5127 (4) before testing.

The tensile and elongation tests shall be conducted at standard test conditions in accordance with AS5127 (4) and tested in accordance with ASTM D412 using a jaw separation rate of 20 inches ± 1 inch (508 mm ± 25 mm) per minute.

All tensile strength and elongation measurements shall be checked for conformance to the applicable material specification.

7.8 Shear Strength

Six AMS4049 aluminum alloy test panels 0.040 x 1 x 3 inches (1.02 x 25 x 76 mm) in size shall be conversion coated according to AS5127 (6.2). After conversion coating, sealing compound 0.010 to 0.020 inch (0.025 to 0.51 mm) thick shall be applied to one end of the six panels covering approximately 1 inch (25.4 mm) on each panel. Three shear strength specimens shall be formed by mating the sealant coated ends using two panels for each assembly; creating a 1 inch (25 mm) overlap for each specimen. The fixture shown in Figure 16 may be used to control dimensional tolerances. Apply sufficient pressure such that the thickness of the sealant in the bond line is 0.005 to 0.010 inch (0.13 to 0.25 mm). Cure the sealant at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. Shear strength shall be determined using a tensile test machine operated at a jaw separation speed of 2 inches (51 mm) per minute. All shear strength and elongation measurements shall be checked for conformance to the applicable material specification.



Notes: Dimensions in inches (millimeters)
Dimensions that create the 1 inch (25 mm) overlap are required. Other dimensions for the fixture are suggested.

FIGURE 16 - SHEAR SPECIMEN FIXTURE

7.9 Corrosion in Hydrocarbon Fluid/Salt Water

Two AMS4045 aluminum alloy panels measuring 0.040 x 2.75 x 6 inches (1.02 x 69.9 x 152 mm) in size shall be prepared. A controlled area 1 inch (25 mm) wide by 5 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 conversion coated according AS5127 (6.2). Following conversion coating, the masked panel shall be coated and cured in accordance with AMS-C-27725. Before the coating is cured, the masked area shall be uncovered. After the coating cure, the masked area of the panels shall be cleaned according to AS5127 (6.2). Adhesion promoter as recommended by the sealant manufacturer shall be applied according to AS5127 (6.7), followed by a 0.062 inch (1.57 mm) thick layer of sealing compound applied to the area, overlapping a maximum of 0.25 inch (6.4 mm) onto the AMS-C-27725 coated portion of the panels. The sealant shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. After the sealant cure has been completed, the panels shall be conditioned as follows: The panels shall be immersed vertically in a covered glass vessel containing a two layer liquid consisting of a AMS2629 Type 1 jet reference fluid and 3% by weight aqueous sodium chloride solution prepared using reagent water conforming to ASTM D1193 Type IV so that 2 inches (51 mm) of the panel are exposed to the salt solution, 2 inches (51 mm) are exposed to the jet reference fluid, 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 followed by 60 hours at 160 °F (71 °C) and 6 hours at 180 °F (82 °C). Specimens shall be cooled to standard conditions in accordance with AS5127 (4) in the fluid, and immediately upon removal from the fluid, the sealant shall be removed by mechanical means using a non-metallic scraper and/or a sealant remover that does not cause damage to aluminum. Chemical sealing compound strippers, which have demonstrated to cause no damage to aluminum, may be used to facilitate removal. The panels shall be visually examined for signs of corrosion or physical deterioration according to the requirements of the applicable material specification.

7.10 Corrosion Stressed Assembly and Mixed Metals

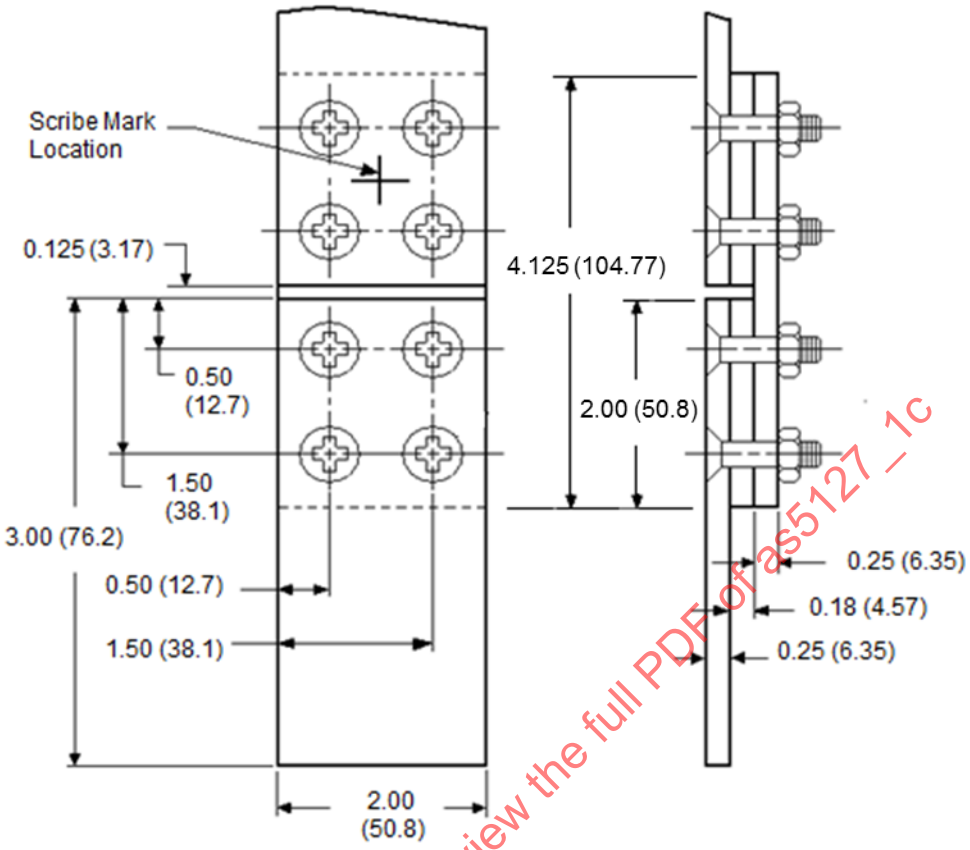
7.10.1 Stressed Assembly

Corrosion testing shall consist of stressed aluminum assemblies, as shown in Figure 17, undergoing exposure to a corrosive environment. Sufficient panels conforming to AMS4045 and conversion coated in accordance with AS5127 (6.2) shall be prepared to produce two assemblies for corrosion testing. Each assembly shall be prepared according to the procedure in Table 3.

The assemblies shall be installed vertically in the jaws of a machine and exposed to a temperature of -65 °F (-54 °C) for 30 minutes. The assemblies shall be cycled at a temperature of -65 °F (-54 °C) between 0 and 5000 pounds ± 50 pounds (0 and 22240 N ± 222 N) for 250 cycles with a loading rate of 10 inches (254 mm) per min. After conditioning, the specimens shall be corrosion tested per 7.10.3.

7.10.2 Mixed-Metal Assemblies

Two of each type of mixed metal assemblies, as indicated in Table 4 and configured as shown in Figure 18, shall be used for each sealant. Sealant 0.005 to 0.007 inch (0.13 to 0.18 mm) thick shall be applied to one side of each metal shown in Figure 18. The coated portions shall be mated using inert non-metal fasteners (e.g., nylon) tightened to produce a total sealant thickness of approximately 0.007 inch (0.18 mm). A 0.007 inch (0.18 mm), unreinforced, non-conductive polymer film (e.g., clear Mylar) washer may be used around the fasteners to control final sealant thickness; washer must be a minimum of 0.250 inch (6.3 mm) from the edge to ensure it does not compromise edge sealing. Excess sealant shall be carefully removed from the panel surface leaving a 0.063 to 0.125 inch fillet around the perimeter of Metal A. The sealant assemblies shall be cured at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification. The specimens shall be tested per 7.10.3.



Note: Dimensions in inches (millimeters)

FIGURE 17 - ASSEMBLY CONFIGURATION FOR CYCLE AND EXPOSURE

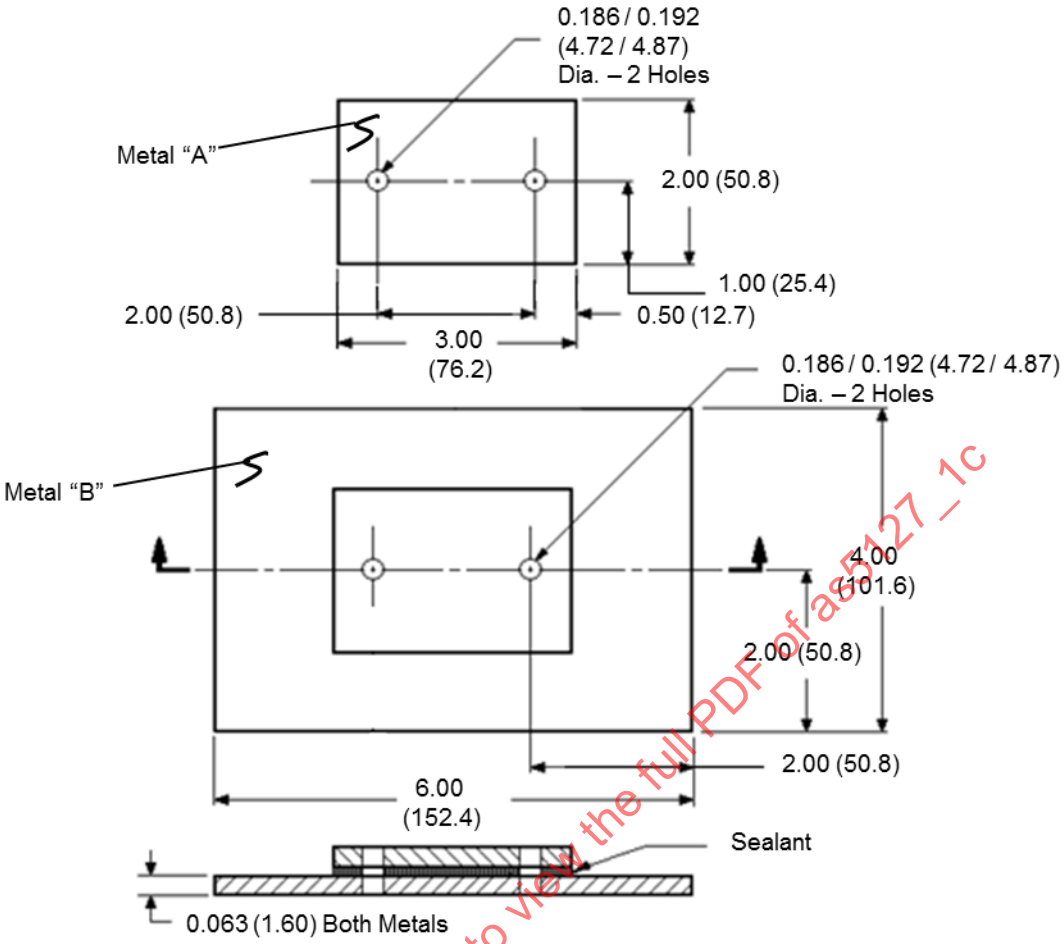
TABLE 3 - PREPARATION SEQUENCE OF CORROSION TEST ASSEMBLIES

Sequence Step	Assembly Preparation
	Two assemblies shall be prepared as follows:
1	0.005 to 0.007 inch (0.13 to 0.18 mm).sealing compound shall be applied to one side of each panel.
2	Threaded fasteners conforming to NASM7839 shall be installed wet with sealing compound, then inserted into the freshly mated panels and torqued to 40 inch-pound ± 2 inch-pound (4.5 N·m ± 0.11 N·m).
3	Sealing compound shall be applied by gun to the butt joint. Using a spatula, cover over and around the fastener head, backs (nuts), and all edges.
4	Brush sealing compound over the entire assembly to a thickness of 0.005 to 0.007 inch (0.13 to 0.18 mm).
5	Cure the assembly at standard conditions in accordance with AS5127 (4), for the time defined in the applicable material specification.
6	After curing, scribe one half of the front side of each assembly as shown in Figure 17. Assemblies are now ready for cyclic loading.

TABLE 4 - MIXED METAL ASSEMBLIES

Assembly	Metal B (Figure 18)	Metal A (Figure 18)
1	Aluminum[1]	Titanium[2]
2	Aluminum[1]	Magnesium[3]

[1] AMS4045 chemically treated in accordance with AS5127 (6.2).
[2] AMS4901 or AMS4911 cleaned in accordance with AS5127 (6.4).
[3] AMS4377, chemically treated in accordance with AS5127 (6.2).



Note: Dimensions in inches (millimeters)

FIGURE 18 - MIXED METAL ASSEMBLY

7.10.3 Corrosion Exposure Conditions and Examination

The stressed and mixed metal assemblies shall be exposed to 4 weeks of SO_2-Salt spray in accordance with ASTM G85 Annex 4. At the end of the exposure, the sealing compound shall be removed and each assembly shall be disassembled using non-metallic scrapers and/or chemical removers that do not cause damage to aluminum. The assembly shall be evaluated for corrosion with respect to sealing compound function (e.g., fasteners, faying surface, etc.). Countersinks as well as adjacent areas, and faying surfaces shall be examined for corrosion using an unaided eye but can be examined under up to 30X magnification to confirm corrosion. All surfaces shall be examined for compliance to the applicable material specification.

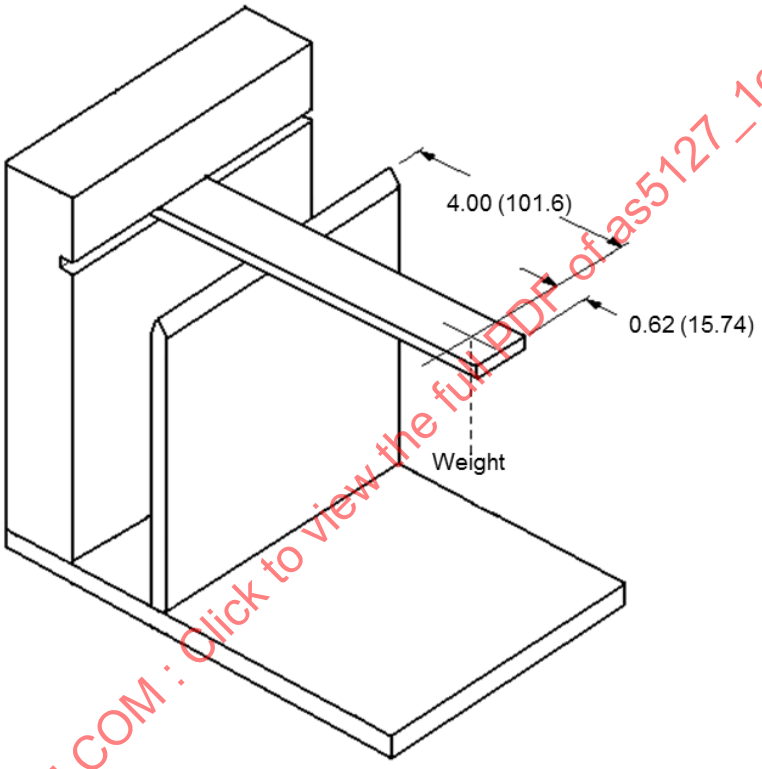
7.11 Crazing

Four panels 0.25 x 1.00 x 7 inches (6.35 x 25.4 x 178 mm) of each of the following plastics shall be prepared and cleaned according to AS5127 (6.8):

MIL-PRF-5425 - "As cast" Acrylic
MIL-PRF-25690 - "Stretched" Acrylic
AMS-P-83310 - Polycarbonate

Insert the panels into the test apparatus and apply the load as shown in Figure 19. The upper surface directly above the central fulcrum of three of the four panels of each transparency shall be coated with a 0.062 inch (1.57 mm) layer of sealing compound and covered with a piece of low density polyethylene sheeting. All panels shall be allowed to remain under the stress required according to the applicable material specification for the class and application time of the sealing compound under test as shown in Figure 19 for a period of 72 hours ± 1 hour. After this period, and while still under stress, the sealing compound shall be cleaned off the panels by means of an acrylic plastic spatula and 50% solution of isopropyl alcohol and water. The method of inspection and calculation of the required stress is shown in Figure 20. Detailed dimensional information concerning the test fixture design is contained in Figure 21.

The panels shall then be examined for evidence of crazing, cracking, or other chemical degradation according to requirements of the applicable material specification.



Note: Dimensions in inches (millimeters)

FIGURE 19 - CRAZING TEST SHOWING TRANSPARENCT IN TEST POSITION