



AEROSPACE STANDARD

AS5127™/1**REV. D**Issued 1997-05
Revised 2020-03

Superseding AS5127/1C

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

RATIONALE

Specified number of replicates to be performed for each test. Removed references to "Types" in 4.1 and Figure 2. Changed "Standard Cure" to "Cure to Hardness." Added graphite/epoxy composite substrate to mixed metal corrosion test. Figure 9 was revised. Other minor clarifications/corrections were offered.

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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 +1 724-776-4970 (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
AMS4268	Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.6Mn (2024-T81 Sheet, -T851 Plate), Solution Heat Treated, Cold Worked and Artificially Aged
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

Copies of these documents are available online at <https://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 shall be of the following designations:

3.1 Classes

3.1.1 Class A

Sealing compound are typically used for application by brush but usage is not limited to these applications.

3.1.2 Class B

Sealing compound are typically used for application by extrusion gun or spatula but usage is not limited to these applications. Used primarily for fillet sealing, injection sealing, prepack sealing, and rework of damaged fillet seals.

3.1.3 Class C

Sealing compound are typically used for application by brush, extrusion gun, roller, or spatula but usage is not limited to these applications. Used mostly for fay surface sealing and wet installation of fasteners.

3.1.4 Class D

Sealing compound are typically used for application by extrusion gun or spatula but usage is not limited to these applications. Used for hole and void filling, or for other applications where a very thick sealant is required.

3.1.5 Class E

Sealing compound are typically used for application by automatic riveting equipment, but usage is not limited to these applications.

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 followed by a number in parenthesis represent application time in hours followed by the assembly time in hours in the parenthesis, e.g., C-12(48).

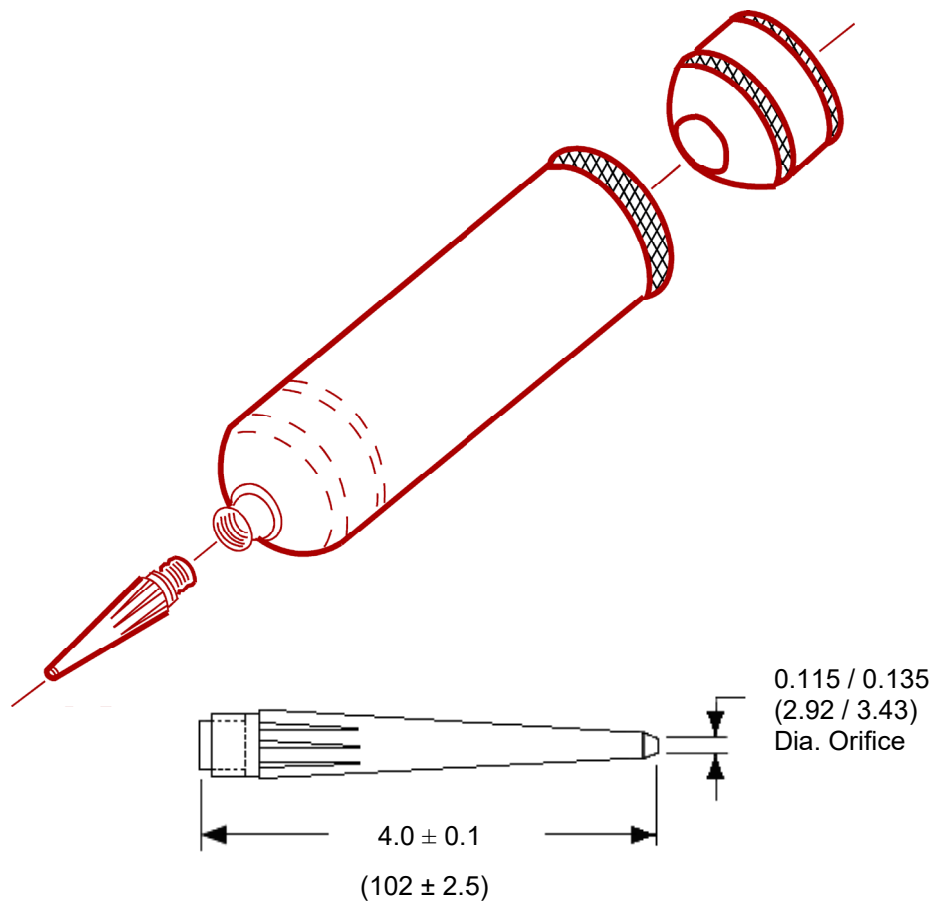
4. PREPARATION OF SEALING COMPOUND

The sealing compound must be mixed according to the manufacturer's instructions.

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 (refer to 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 quickly.

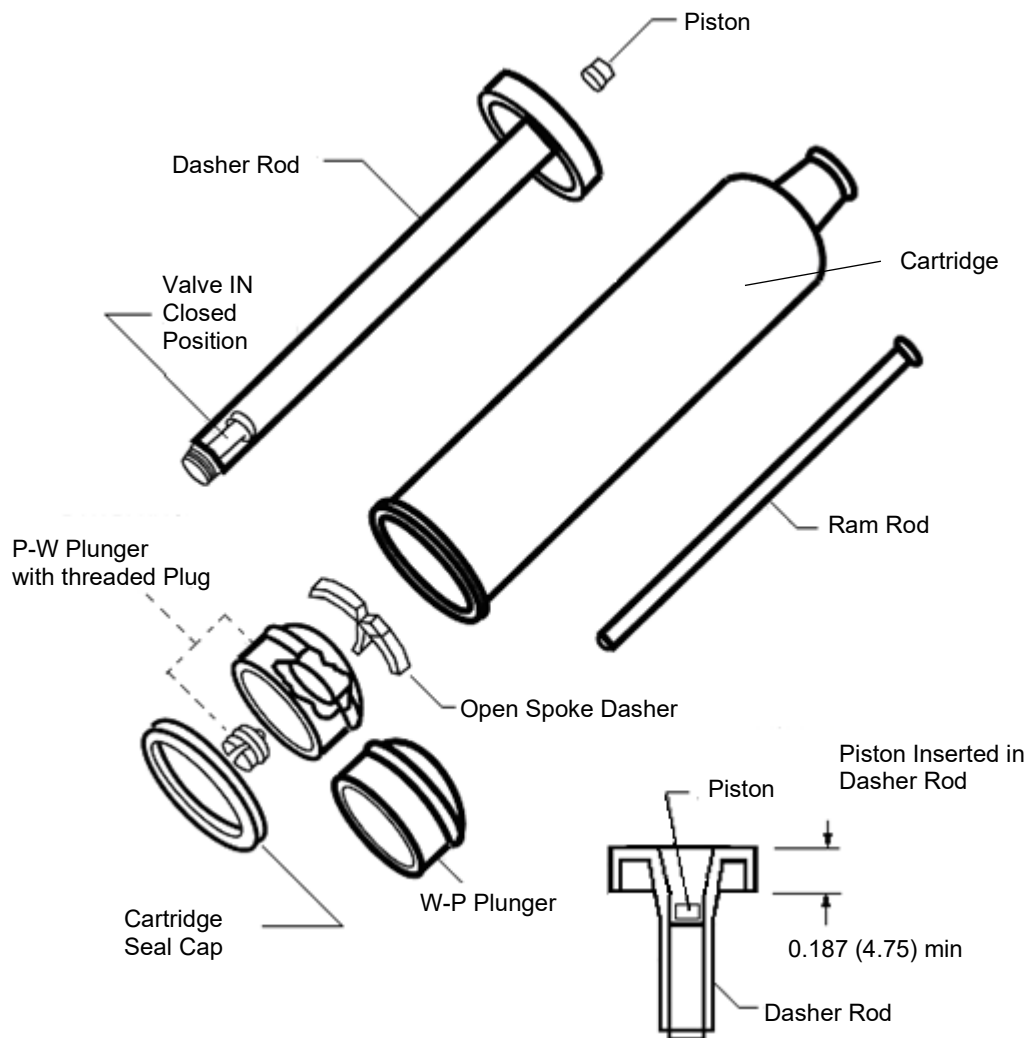
4.1 Qualification Testing

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 and shall be mixed according to sealant manufacturer's instructions.



Note: Dimensions are in inches (millimeters).

Figure 1 - Plastic disposable cartridge, plunger, and nozzle



Note: Dimensions are in inches (millimeters).

Figure 2 - Sealant cartridge for two-component materials

4.2 Acceptance Testing

Sealing compound supplied in multi-component (e.g., barrier or injection) kits for acceptance testing may be mixed following the manufacturer's recommended instructions.

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 or has reached a maximum temperature of 50 °F (10 °C).

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 gram (W_1). Transfer 11 to 12 grams 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 gram (W_2). Reducing the exposure to air can reduce errors when mixing Class A materials or other compounds containing volatile solvents. 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 7 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 gram (W_3). Determine ($W_2 - W_1$) and ($W_3 - W_1$). Calculate the percent nonvolatile content as shown in Equation 1:

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

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

5.2 Air Content (Class B Sealant Base Compound Only)

NOTES: The AMS Committee G-9 is removing this requirement from the AMS sealing compound specifications based on historically high variability within the test method. It is not recommended to use this test for new material specifications. For low density (specific gravity <1.35) sealing compounds, this method was also inaccurate due to the potential inclusion of compressible filler materials.

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.

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

1. When the sealant compound specifications requires air content to be tested, one 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 fully 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.

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

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

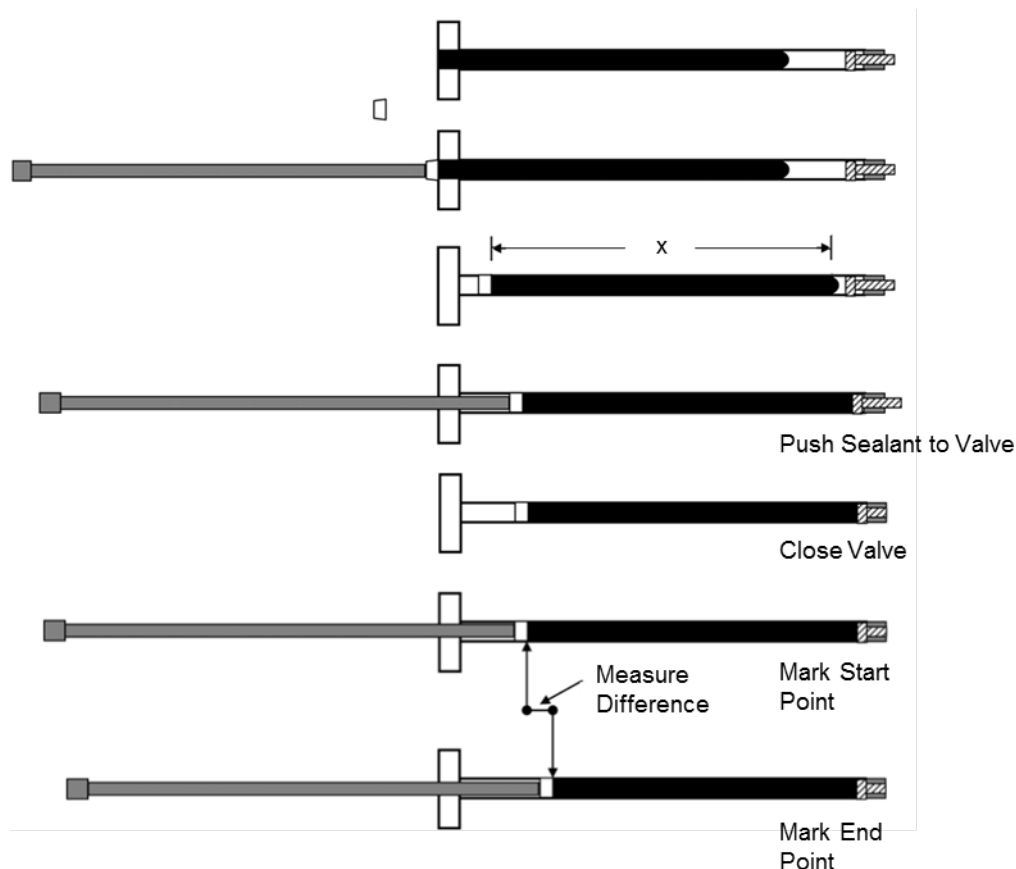


Figure 3 - Diagram of stages in filling dasher rod

5.3 Viscosity of Base Compound

When the sealant compound specifications requires viscosity of the base compound to be tested, one test shall be performed. A 1-pint (473 mL) or larger container with a minimum of 3.0 inch diameter shall be filled with the base compound such that the notch above the spindle is covered and the spindle does not contact 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.

A 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 shall be checked to ensure they are not bent, scratched or nicked. It is not necessary to calibrate in the range of use. It is recommended to calibrate the viscometer in the range of use for less viscous sealing compounds (e.g., Class A) with the readings obtained 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 or 3 full rotations. The measured value shall be checked for conformance to the applicable material specification.

5.4 Viscosity of the Curing Agent

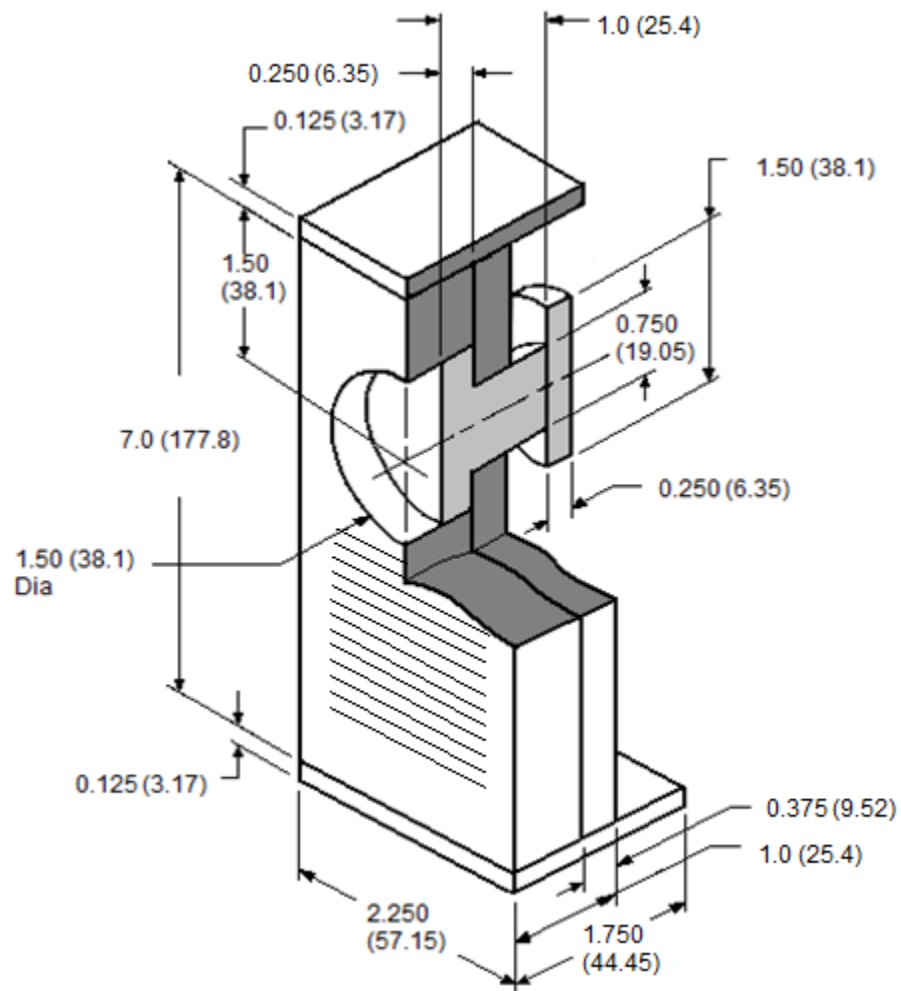
When the sealant compound specifications requires viscosity of the curing agent to be tested, one test shall be performed. The viscosity of the curing agent shall be determined using the same procedure as 5.3. Spindle size and speed of rotation to be used are defined in the applicable material specification 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

When the sealant compound specifications requires flow to be tested, one test shall be performed. 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. The plunger shall move freely over its entire range of travel without sticking or binding. 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. Ten 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 minutes 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: Recommend Flow Jig scribe lines to be 0.10 inch apart.
Dimensions are in inches (millimeters).

Figure 4 - Flow test jig

Table 1 - Typical flow test requirements

Flow Requirement		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

When the sealant compound specifications requires flow to be tested, one test shall be performed. 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. If the material specification does not specify the time of measurement, the measurement shall be taken after the assembly time of the sealing compound.

5.6 Application Time

5.6.1 Class A and E Material

When the sealant compound specifications requires application time to be tested, one test shall be performed. 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 enough curing agent 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 hours 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 s 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 s. The measured viscosity shall be within the limits defined in the applicable material specification.

5.6.2 Class B, C, and D Material

When the sealant compound specifications requires application time to be tested, one test shall be performed. The base compound, curing agent, and application gun shall be stabilized at standard conditions in accordance with AS5127 (4) before mix. Enough base compound to provide 6 fluid oz (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 $\pm$ 0.010 inch (3.18 mm $\pm$ 0.25 mm) and a length of 4.0 inches $\pm$ 0.1 inch (102 mm $\pm$ 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 $\pm$ 5 psi (621 kPa $\pm$ 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 $\pm$ 1 second and the weight of extruded sealing compound determined within $\pm$ 0.1 gram. The weight or volume of sealing compound extruded per minute shall be checked for conformance of the applicable material specification for the sealing compound under test.

If the extrusion rate is anticipated to exceed 100 g/min, it is permissible to extrude material for 30 seconds $\pm$ 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/min, it is permissible to extrude material for 12 seconds $\pm$ 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.