SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS3376 REV. B

Issued 1985-07
Revised 2009-10

Superseding AMS3376A

(R) Sealing Compound, Non-Curing, Fluorosilicone Groove Injection Temperature and Fuel Resistant

RATIONALE

AMS3376 results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

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

1.2 Application

This product has been used typically for sealing or resealing integral fuel tanks designed for groove-injection type sealing for use from -65 to +360 °F (-54 to +182 °C), but usage is not limited to such applications.

1.3 Classification

Sealing compounds covered by this specification are classified as follows:

Class 1 - High viscosity, permanently mastic, fuel resistant, fluorosilicone paste compound suitable for sealing applications with structural mismatch of 0.005 inch (0.13 mm) or less, normally contains glass bead filler material.

Class 2 - Medium viscosity, permanently mastic, fuel resistant, fluorosilicone paste compound suitable for sealing applications with structural mismatch of 0.005 inch (0.13 mm) or less, normally contains glass bead filler material.

Class 3 - High viscosity, permanently mastic, fuel resistant, fluorosilicone paste compound suitable for sealing applications with structural mismatch of 0.015 inch (0.38 mm) or less, normally contains cured fluorosilicone rubber particles.

1.4 Safety - Hazardous Materials: Shall be in accordance with AS5502 (1.1)

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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
AMS2825	Material Safety Data Sheets
AMS3660	Polytetrafluoroethylene (PTFE) Moldings, General Purpose Grade, As Sintered,
AMS3819	Cloths, Cleaning for Aircraft Primary and Secondary Structural Surfaces
AMS4035	Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024-0), Annealed – UNS A92024
AMS4045	Aluminum Alloy, Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr 7075: (-T6 Sheet, -T651 Plate), Solution and Precipitation Heat Treated – UNS A97075
AMS5070	Steel Bars and Forgings, 0.18 - 0.23C (SAE 1022) – UNS G10220
AMS5640	Steel, Corrosion-Resistant, Bars, Wire, and Forgings, 18Cr - 9.0Ni, Free Machining
AMS6370	Steel Bars, Forgings, and Rings, 0.95Cr - 0.20Mo -(0.28 - 0.33C) (SAE 4130) – UNS G41300
AMS-C-27725	Coating, Corrosion Preventative, for Aircraft Integral Fuel Tanks for Use to 250°F (121°C)
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications
AS4491	Plastic Disposable Cartridge, Plunger, Nozzles and Cartridge Assembly
AS5502	Standard Requirements for Aerospace Sealants
AS71051	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT – Design and Inspection Standard
AS8879	Screw Threads, UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter

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 D 471	Standard Test Method for Rubber Property Effect of Liquids

2.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

A-A-59281	Cleaning Compound, Solvent Mixtures

2.4 PRI Publications

Available from Performance Review Insitute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel:724/772-1616, Fax 724/772-1699, www.pri-network.org.

PD-2000	Procedures for an Industry Qualified Product Management Process

3. TECHNICAL REQUIREMENTS

3.1 Material

Sealing compound shall be a permanently deformable, non-curing fluorosilicone product which does not contain solvents. Sealing compound shall exhibit no separation of components. Occluded gases shall not be permitted.

3.1.1 Qualifications

All products sold to this specification shall be listed or approved for listing, on the Qualified Products List (QPL) PRI-QPL-AMS3376. The QPL shall be in accordance with PD-2000. A responsible agency for the QPL is the Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, phone 724/772-1616, Fax 724/772-1699, www.pri-network.org / Qualified Products Listing.

3.2 Date of Packaging

Shall be in accordance with AS5502 (3.1).

3.3 Toxicological Formulations

Shall be in accordance with AS5502 (3.2).

3.4 Storage Life

Shelf life shall be a minimum of 18 months from the date of packaging when stored at 90 °F (32 °C) or lower. Material may be retested for shelf life extensions per 3.4.1.

3.4.1 Storage Life Updating

At the expiration of the storage life time, sealing compound meeting the requirements of 3.6.1, 3.6.2, 3.6.4, and 3.6.5 may have its storage life extended 9 months. Up to four extensions will be allowed.

3.5 Quality

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

3.6 Properties

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

TABLE 1 - PROPERTIES

Paragraph	Property	Requirements	Test Method
3.6.1	Nonvolatile Content, minimum	98%	AS5127/1 (5.1)
3.6.2	Extrusion	(See Class)	4.5.2
	Class 1	200 to 275 pounds force (890 to 1223 N)	
	Class 2	100 to 200 pounds force (445 to 890 N)	
	Class 3	250 to 350 pounds force (1112 to 1557 N)	
3.6.3	Corrosion Resistance	The surface of the panel which was in contact with sealing compound shall have no more corrosion or severe discoloration than the uncoated panel.	4.5.3
3.6.4	Pressure Rupture, minimum	10 inches (254 mm) Hg	4.5.4
3.6.5	Fuel Resistance	Weight loss to be less than 6%	4.5.5
3.6.5.1	Volume Change	+5% to +35%	4.5.5.1
3.6.5.2	Weight Loss, maximum	6%	4.5.5.2
3.6.6	Sealability & Re-injection	No leaks	4.5.6
3.6.7	Reinjection Time, maximum	20 seconds	4.5.6

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Shall be in accordance with AS5502 (4.1)

4.1.1 Source inspection

Shall be in accordance with AS5502 (4.1.1)

4.2 Classification of Tests

Shall be in accordance with AS5502 (4.2)

4.2.1 Qualification Tests

Shall be in accordance with AS5502 (4.2.1)

4.2.2 Preproduction Tests

Shall be in accordance with AS5502 (4.2.2)

4.2.3 Acceptance Tests

Shall be in accordance with AS5502 (4.2.3)

Nonvolatile content (3.6.1), extrusion (3.6.2), pressure rupture (3.6.4), and fuel resistance (3.6.5) are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing

Shall be in accordance with AS5502 (4.3)

4.3.1 Acceptance Tests

Shall be in accordance with AS5502 (4.3.1)

4.3.1.1 Nonvolatile content (3.6.1), extrusion (3.6.2), pressure rupture (3.6.4), and fuel resistance (3.6.5) are acceptance tests and shall be performed on each lot.

4.3.1.2 An inspection lot shall provide sufficient sealing compound, taken at random, from one batch to perform all required testing.

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

4.3.2 Shelf Life surveillance and Updating

4.3.2.1 Sampling

Shall be in accordance with AS5502 (4.1.2)

4.3.2.2. Shelf Life Testing

At the expiration of the shelf life, sealing compound meeting the requirements of 3.6.1, 3.6.2, 3.6.4, and 3.6.5 may have its shelf life extended 9 months. Up to four extensions will be allowed.

4.4 Approval

Shall be in accordance with AS5502 (4.4)

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

4.5 Test Methods

4.5.1 Standard Conditions

Shall be in accordance with AS5127 (4.1)

4.5.1.1 Standard Tolerances

Unless otherwise specified herein, standard tolerances shall be shown in Table 2.

TABLE 2 - STANDARD TOLERANCES

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

4.5.1.2 Standard Cleaning

Unless otherwise specified herein, all test panels and jigs shall be cleaned using A-A-59281 solvent and AMS3819, Grade A, cleaning cloths.

4.5.2 Extrusion

The extrusion plastometer shown in Figures 1 and 2 shall be packed with a hand rolled, cylindrically shaped mass of sealing compound about 0.75 inch (19 mm) in diameter and 2.25 to 2.50 inch (57.2 to 63.5 mm) long. Special precaution should be taken to avoid forming air pockets in the slug of sealing compound. Sufficient fingertip pressure shall be used to force the sealing compound into intimate contact with the cylinder walls. The packed apparatus shall be stabilized for 24 hours at standard conditions. At the end of the stabilization period, insert the plastometer piston, center the assembly on the fixed base of a tensile machine, and load in compression at the constant rate of 0.100 inch ± 0.002 (2.54 mm ± 0.05) per minute. When the top of the piston is approximately 1.25 inches (31.8 mm) from the top of the plastometer cylinder, the maximum scale load which occurs during the ensuing 0.25 inch (6.4 mm) of piston travel shall be recorded. Clean the plastometer completely per 4.5.1.2 after each trial. Repeat the test on the empty plastometer, measuring the scale load during the same piston travel location and the scale load obtained from the maximum scale loads obtained when the sealing compound was tested. The test shall be run in duplicate and the average of the results reported. Individual test results shall not deviate by more than 10% of the average value.

4.5.3 Corrosion Resistance

Two AMS4045 panels approximately 0.040 x 2.75 x 6 inches (1.02 x 69.8 x 152 mm) in size shall be cleaned. Two parallel fillets of sealing compound 0.06 inch (1.5 mm) thick by 0.75 inch (19 mm) wide by 5 inches (127 mm) long shall be applied to one side of one of the panels. That panel shall be set aside under standard conditions, lying horizontally with the sealing compound face up, for a minimum of 24 hours. Both panels shall be immersed vertically for 20 days in a covered glass vessel containing a 2-layer liquid consisting of a 3% aqueous sodium chloride solution and AMS2629, Type I, jet reference fluid, so that 2 inches (51 mm) of the panels are exposed to the salt water, 2 inches (51 mm) are exposed to jet reference fluid, and the remainder is exposed to air-vapor mixture. The temperature during the exposure shall be maintained at 140 °F (60 °C) for 20 days. Immediately upon removal from the liquid, the sealing compound shall be removed using a non-metallic scraper and the panels examined for evidence of corrosion.

4.5.4 Pressure Rupture

Specimens constructed in accordance with Figure 3 and finished as listed in Table 3 shall be used. Pack the sealing compound into the specimens, taking care to eliminate air bubbles, and stabilize the specimens at standard conditions for not less than 24 hours. The specimens shall be cooled to below -20 °F (-29 °C) and the excess material trimmed from the surfaces with a razor blade. One of the specimens shall be mounted in the pressure rupture jig (Figure 3). One air hose bib of the apparatus shall be connected to a manometer, the other to a variable pressure source. The assembly shall be immersed in a water bath at 77 °F (25 °C) and stabilized for 5 minutes. Starting at atmospheric pressure, the pressure on the apparatus shall be uniformly increased at the rate of 1 inch (25 mm) of mercury per 15 seconds until failure occurs. A continuous stream of air bubbles observed to come from the specimen shall constitute a failure. The pressure applied at the time of failure shall be recorded. Test the other two specimens in the same manner. The average failure pressure of the three specimens shall be reported to the nearest 0.5 inch (13 mm) of mercury (Hg).

TABLE 3 - PRESSURE RUPTURE SPECIMENS (3 EACH REQUIRED)

1. Sulfuric acid anodized in accordance with AMS2471.
2. Sulfuric acid anodized in accordance with AMS2471 and coated with AMS-C-27725 corrosion preventive coating. Application, coating thickness, and curing shall be in accordance with manufacturer's recommendations. Care shall be taken to ensure a thin, even coat in the slot.

4.5.5 Fuel Resistance

4.5.5.1 Volume Change

Six AMS4045 aluminum panels, approximately 0.040 x 1 x 2.50 inches (1.02 x 25 x 63.5 mm), shall be weighed accurately to the nearest milligram in air (W_1), and in water (W_2). A pad of sealing compound 0.06 x 1 x 2 inches (1.5 x 25 x 51 mm) shall be applied to each panel. One-half inch (12.7 mm) at one end of each panel shall not be coated for handling purposes. The sealing compound coated panels shall then be weighed in air (W_3) and in water (W_4). The panels shall be conditioned at standard conditions for 24 hours. The panels shall then be exposed for 14 days at 160 °F (71°C) with three of the panels immersed in AMS2629, Type I, fluid and the other three in ASTM D 471 Reference Fuel A. The panels shall be weighed immediately upon removal from the fluid in air (W_5) and in water (W_6). The procedures in ASTM D 471 for weighing specimens after fluid exposure shall be used. The percent change in volume shall be determined by the formula, Equation 1. The reported value shall be determined by averaging the three values obtained for each exposure. The average value shall be determined to the nearest 0.1%.

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

4.5.5.2 Weight Loss

Each panel shall then be placed in an oven at 200 °F (93 °C) for 24 hours, cooled to standard conditions for at least 2 hours, and weighed in air (W_7). The percentage weight loss shall be determined by the formula, Equation 2. The reported value shall be determined by averaging the three values obtained for each exposure. The average value shall be determined to the nearest 0.1%.

$$\text{Percent Weight Loss} = \frac{W_3 - W_7}{W_3 - W_1} \times 100 \qquad \text{(Eq. 2)}$$

4.5.6 Sealability and Reinjection

4.5.6.1 Jig Assembly

Washer and shim thicknesses required for jig assembly are shown in Table 4.

TABLE 4 - JIG ASSEMBLY

Sealant Class	Washer and Shim Thickness Inch	Washer and Shim Thickness Millimeter
Class 1	0.005 inch ± 0.0002	0.13 mm ± 0.005
Class 2	0.005 inch ± 0.0002	0.13 mm ± 0.005
Class 3	0.015 inch ± 0.0002	0.38 mm ± 0.005

4.5.6.1.1 A groove injection pressure test jig conforming to Figure 4 shall be cleaned. Install washers 0.26 inch (6.6 mm) ID by 0.50 inch (12.7 mm) OD by appropriate thickness specified in Table 4 on every other of the outer circle bolts between the two plates. Install four shims 1.00 inch by 0.25 inch (25.4 mm by 6.4 mm) by appropriate thickness specified in Table 4 in the faying surface between the fuel cavity and the groove so that the shims do not protrude into the groove but may protrude into the fuel cavity. The bolts shall be torqued to 60 inch/pounds ± 2 (6.8 Nm ± 0.2).

4.5.6.2 Sealant Injection

A suitable sealing compound injection gun with a 70 to 1 injection pressure to air line pressure ratio shall be used for sealant injection. The line air pressure shall be maintained so that the maximum pressure developed at the injection tip (See Figure 5) is 2800 psi ± 70 (19.3 MPa ± 0.5). The sealing compound shall be injected into the jig through the four injection ports calling the first port injected A and going clockwise calling the other ports B, C, and D as follows:

4.5.6.2.1 With all injection ports unplugged, inject into A until not less than 1 inch (25 mm) sealing compound emerges from ports B and D (i.e. the two ports adjacent to the port being injected).

4.5.6.2.2 Insert a plug screw into port A and inject B until not less than 1 inch (25 mm) of sealing compound emerges from C.

4.5.6.2.3 Insert a plug screw into B and inject into C until not less than 1 inch (25 mm) of sealing compound emerges from D.

4.5.6.2.4 Insert a plug screw into C and remove the plug screw from A. Inject into D until not less than 1 inch (25 mm) of sealing compound emerges from A.

4.5.6.2.5 Insert a plug screw into A and D.

4.5.6.3 Pressure Test

To ensure that the jig is initially sealed, perform the following procedure:

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

4.5.6.3.2 Close the needle valve.

4.5.6.3.3 Watch for a pressure drop for 60 seconds. Pressurized system shall be leak-free from the needle valve through the pressure gauge to the test jig.

4.5.6.3.4 If a pressure drop occurs, immerse the pressurized jig in water to determine the location of the leak. Reinject sealing compound into the proper portion of the groove to stop the leak and pressure test again. Specimens are ready for conditioning when no pressure drop occurs after 60 seconds of pressurization.

4.5.6.4 Exposure

The conditioning shall be as follows:

4.5.6.4.1 Fourty-four hours ± 2 at 160 °F (71 °C) filled with AMS2629, Type I, jet reference fluid (JRF) at 0 psi (0 kPa) plus 4 hours at -65 °F (-55 °C) in JRF at 5 psi (34.5 kPa).

4.5.6.4.2 Continue conditioning for 16 hours at 160 °F (71 °C) at 5 psi (34.5 kPa) filled with JRF fluid. Drain jig assembly and add 5 mL of JRF fluid at 5 psi (34.5 kPa) to drained jig to obtain JRF vapors and continue conditioning in JRF vapors for 4 hours at 260 °F (127 °C) at 5 psi (34.5 kPa), plus 30 minutes at 360 °F (182 °C) at 5 psi (34.5 kPa); plus 60 minutes at room temperature in JRF vapors at 0 psi (0 kPa). Refill the jig with JRF and continue conditioning for 150 minutes at room temperature at 0 psi (0 kPa).

4.5.6.4.3 Repeat 4.5.6.4.2 five times for a total of 6 cycles. Paragraph 4.5.6.4.1 shall not be repeated.

4.5.6.4.4 During any extended time between cycles, such as a weekend, the jig shall remain filled with JRF and conditioned at standard conditions with no pressure.

4.5.6.5 Reinjection

After completing the exposure in 4.5.6.4, the jig shall be reinjected as follows:

4.5.6.5.1 The calculated tip pressure of the gun shall be 2800 psi ± 70 (19.3 MPa ± 0.5).

4.5.6.5.2 The injection shall be performed as in 4.5.6.2 except that only two adjacent injection ports shall be unplugged at one time, the plug being injected and the next plug clockwise.

4.5.6.5.3 Four injections (i.e. plug A to B, plug B to C, plug C to D, and plug D to A) shall be timed to the nearest second from when the trigger is depressed until the piston reaches the end of its travel. The arithmetic average of the times shall be reported.

4.6 Reports

Shall be in accordance with AS5502 (4.5)

4.6.1 A material safety data sheet conforming to AMS2825, or equivalent, shall be supplied to each purchaser prior to or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of the product for production use. Each request for modification of product formulation shall be accompanied by a revised material safety data sheet for the proposed formulation.

4.7 Resampling and Retesting

Shall be in accordance with AS5502 (4.6)

5. PREPARATION FOR DELIVERY

Shall be in accordance with AS5502 (5.)

5.1 Unless otherwise agreed upon between purchaser and manufacturer, the sealing compound shall be furnished in 6 fluid ounce (177 ml) sectional type cartridges, conforming to AS4491; each cartridge containing 5 fluid ounces ± 0.3 (148 ml ± 9) of sealing compound. The cartridges shall be packaged in sectionalized cardboard boxes containing 12 cartridges per box.

6. ACKNOWLEDGMENT

Shall be in accordance with AS5502 (6.)

6. REJECTIONS

Shall be in accordance with AS5502 (7.)

8. NOTES

8.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 Qualification of Sealing Compound

Shall be in accordance with AS5502 (4.7)

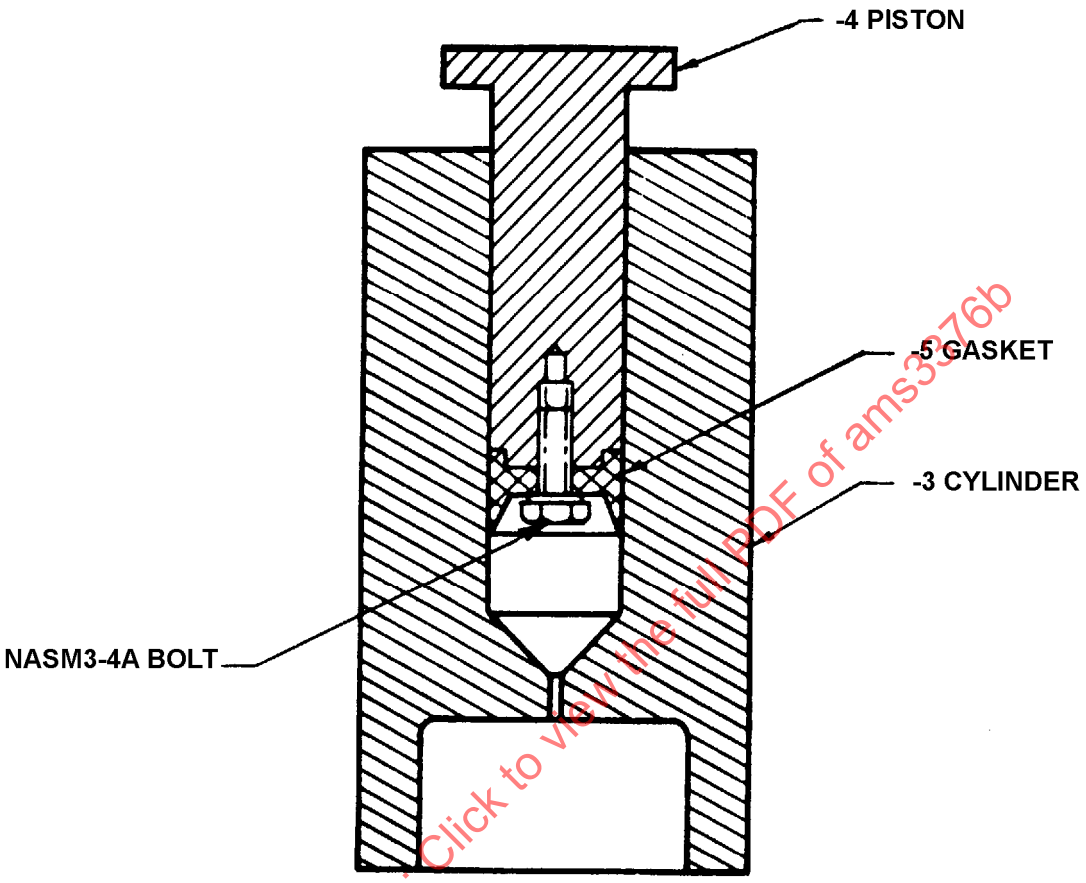
8.3 Terms used in AMS are clarified in ARP1917.

8.4 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.5 Purchase documents should specify not less than the following:

AMS3376B
Class of sealing compound desired
Type and size of container desired
Quantity of containers desired.
Special packaging, if required

PREPARED BY AMS COMMITTEE "G-9"



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NOTES

1. The plastometer shall be maintained at standard conditions during testing.
2. The rate of plastometer piston travel is very critical. The rate of head travel of the tensile machine should be checked with a dial micrometer while testing.
3. The plastic gasket should be frequently checked for wear and replaced if undersize or irregular.
4. The plastometer piston shall be removed immediately following a test to avoid permanent compression of the plastic gasket.
5. If the plastometer is not to be used for 5 days or longer, the inside surface shall be thoroughly covered with a protective oil.
6. The plastometer shall be cleaned in accordance with 4.5.1.3 before use.

FIGURE 1 - EXTRUSION PLASTOMETER

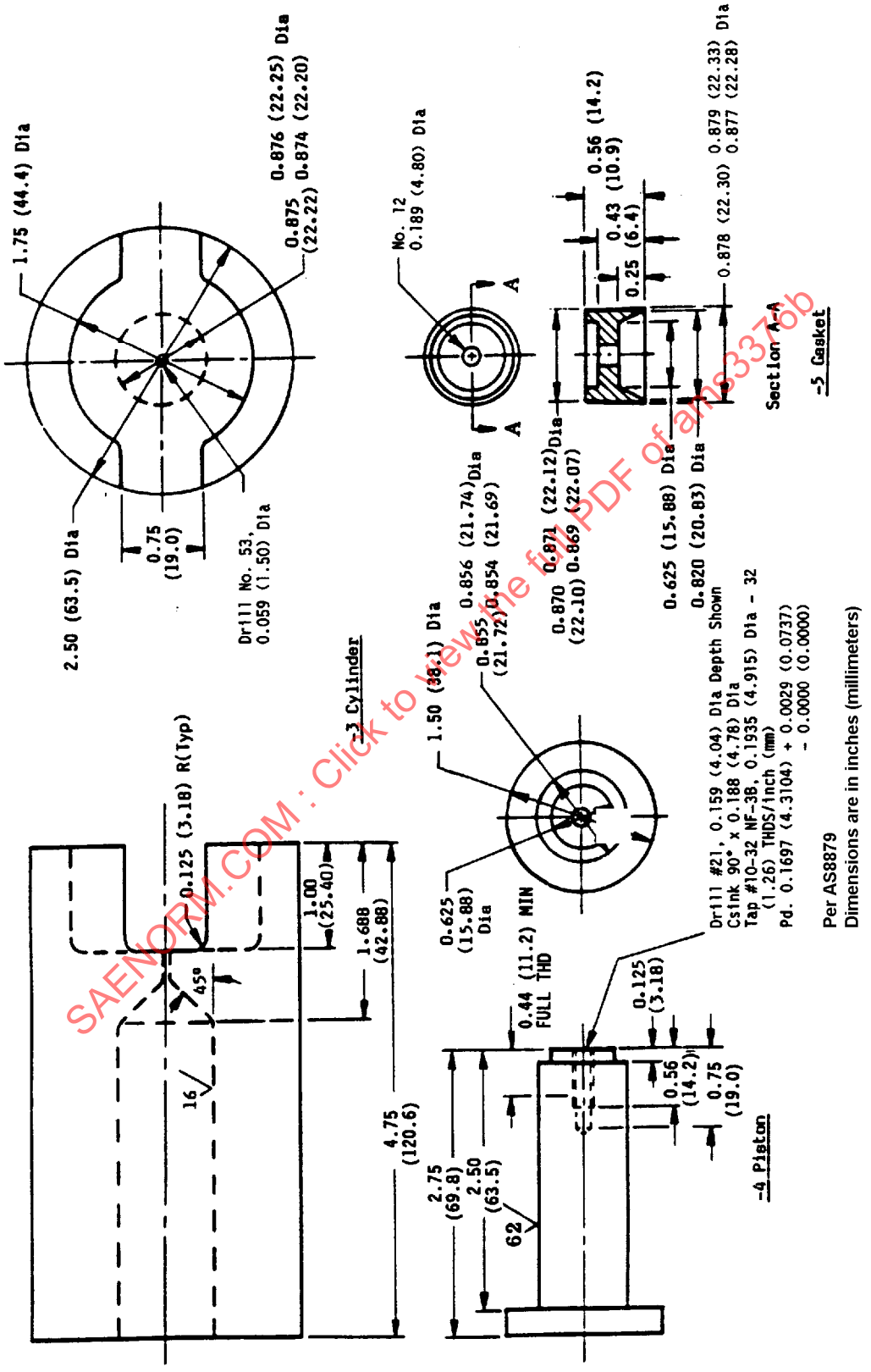

FIGURE 2 - EXTRUSION PLASTOMETER

NOTES FOR EXTRUSION PLASTOMETER (FIGURE 2)

1. Material of -3 Cylinder; AMS6370 Steel Bar, Heat Treat 180 to 200 ksi (1241 to 1379 MPa)
2. Material of -4 Piston; AMS5070 Steel Bar,

   Case Harden 0.032 inch (0.81 mm) Deep

   Case 55 HRA, minimum

   Core Strength 55.0 ksi (379 MPa), minimum
3. Material of -5 Gasket; AMS3660 Plastic Rod
4. Machine finish all surfaces 250 microinches (6.35 mm) except as noted
5. Tolerances to be ± 0.005 inch (± 0.13 mm), except as noted.