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AEROSPACE MATERIAL SPECIFICATION

AMS 3376

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Revised

SEALING COMPOUND, NON-CURING, GROOVE INJECTION
Temperature and Fuel Resistant

1. SCOPE:

1.1 Form: This specification covers a permanently mastic, fuel-resistant, silicone compound in the form of a paste.

1.2 Application: Primarily for sealing or resealing integral fuel tanks designed for groove-injection type sealing for use from -55° to +180°C (-65° to +360°F).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Materials Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Materials Specifications:

AMS 2350 - Standards and Test Methods
AMS 2471 - Anodic Treatment, Aluminum Alloys, Sulfuric Acid Process, Undyed Coating
AMS 3180 - Thinner, Toluene, Industrial Grade
AMS 3660 - Polytetrafluoroethylene Moldings, As Sintered, General Purpose Grade
AMS 4035 - Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024-0)
AMS 4045 - Aluminum Alloy Sheet and Plate, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075; -T6 Sheet, -T651 Plate)
AMS 5070 - Steel Bars and Forgings, 0.18 - 0.23C (SAE 1022)
AMS 5640 - Steel Bars and Forgings, Corrosion Resistant, 18Cr - 9.0Ni, (SAE 30303, 30303Se, 30303 Mod) Free Machining
AMS 6370 - Steel Bars, Forgings, and Rings, 0.95Cr - 0.20Mo - (0.28 - 0.33C) (SAE 4130)

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D471 - Rubber Property - Effect of Liquids
ASTM D3227 - Mercaptan Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Specifications:

TT-S-735 - Standard Test Fluids, Hydrocarbon

2.3.2 Federal Standards:

FED-STD-791 - Lubricants, Liquid Fuels and Related Products, Method of Testing

2.3.3 Military Specifications:

MIL-P-7105 - Pipe Threads, Taper, Aeronautical National Form, General Specifications for
MIL-S-7742 - Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-C-27725 - Coating, Corrosion Preventive, for Aircraft Integral Fuel Tanks
MIL-P-38714 - Packaging and Packing of Two-Component Materials in Semkits
MIL-C-38736 - Compound, Solvent; for Use in Integral Fuel Tanks

2.3.4 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packing and Packaging of

3. TECHNICAL REQUIREMENTS:

3.1 Material: Sealing compound shall be a permanently deformable, non-curing silicone product which does not contain solvents.

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

3.2 Properties: Sealing compound shall conform to the following requirements, determined in accordance with specified test methods:

3.2.1 Nonvolatile Content, min	98%	4.5.2

3.2.2 Extrusion	150 - 300 lbf (665 - 1335 N)	4.5.3
3.2.3 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.	4.5.4
3.2.4 Pressure Rupture, min	10 in. (255 mm) Hg	4.5.5
3.2.5 Fuel Resistance		4.5.6
3.2.5.1 Volume Change		
3.2.5.1.1 Jet Reference Fluid	+5% to +35%	
3.2.5.1.2 TT-S-735 Fluid	+1% to +15%	
3.2.5.2 Weight Loss, max	6%	
3.2.6 Sealability	No leaks	4.5.7
3.2.7 Reinjection Time, max	20 sec	4.5.7

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of sealing compound shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6.1. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the compound conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for nonvolatile content (3.2.1), extrusion (3.2.2), pressure rupture (3.2.4), and fuel resistance (3.2.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of compound to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

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

4.3 Sampling: Shall be as follows:

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

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

4.3.1.2 An inspection lot shall be not more than 200 gal (750 L) of compound from one batch.

4.3.1.3 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6.1 shall state that such plan was used.

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

4.4 Approval:

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

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

4.5 Test Methods:

4.5.1 Specimen Preparation:

4.5.1.1 Test Conditions: Standard laboratory testing conditions shall be 24°C ± 3 (75°F ± 5) and 50% ± 5 relative humidity. Except as otherwise specified, all test specimens shall be prepared and tested under these conditions.

4.5.1.2 Cleaning of Test Panels and Jigs: All test panels and jigs shall be cleaned using MIL-C-38736 solvent and clean gauze free of sizing or any other contaminant.

4.5.1.3 Application of Sealing Compound: Panels shall be given an application of sealing compound 0.060 in. ± 0.010 (1.50 mm ± 0.25) thick.

4.5.1.4 Formulation of Jet Reference Test Fluid: The jet reference fluid required for conducting fluid immersion tests shall be formulated as follows:

Toluene (AMS 3180)	30 volumes
Cyclohexane (technical grade)	60 volumes
Iso-octane (TT-S-735, Type 1)	10 volumes
Tertiary dibutyl disulfide (doctor sweet)	1 volume
Tertiary butyl mercaptan	0.015% ± 0.0015 by weight of other components

4.5.1.4.1 Reference fluid shall have the following properties:

4.5.1.4.1.1 Total sulfur content shall be 0.400% ± 0.005 by weight, determined in accordance with FED-STD-791, Method 5201.

4.5.1.4.1.2 Mercaptan sulfur content shall be 0.005% ± 0.005 by weight, determined in accordance with ASTM D3227.

4.5.1.4.2 The fluid shall be stored out of contact with light in containers which are inert to the fluid ingredients. (Welded aluminum, non-galvanized welded steel, or glass containers are suitable.) If not used within 90 days after blending, the fluid should be retested for mercaptan and total sulfur content.

4.5.2 Nonvolatile Content: Five to 10 g of sealing compound shall be transferred to a tared covered cup approximately 3 in. (75 mm) in diameter and 3/4 in. (20 mm) in depth. The specimen shall be weighed to the nearest milligram and the weight of the sealing compound calculated. The cover shall be removed and the sealing compound heated for 7 days at 70°C ± 1 (158°F ± 2). Compound shall be cooled in a desiccator at standard conditions, the cover replaced, and the specimen reweighed. The test shall be run in duplicate and the average of the results reported. The total nonvolatile content percentage shall be calculated as follows:

$$\text{Percent Nonvolatile Content} = \frac{\text{Final Weight}}{\text{Initial Weight}} \times 100$$

4.5.3 Extrusion: The extrusion plastometer shown in Figs. 1 and 2 shall be packed with a hand rolled, cylindrically shaped mass of sealing compound about 3/4 in. (20 mm) in diameter and 2 1/4 to 2 1/2 in. (57 mm to 63 mm) long. Special precaution should be taken to avoid forming air pockets in

4.5.3 (Continued):

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 hr at 24°C ± 3 (75°F ± 5). 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 in. ± 0.002 (2.5 mm ± 0.05) per minute. When the top of the piston is approximately 1-1/4 in. (32 mm) from the top of the plastometer cylinder, the maximum scale load which occurs during the ensuing 1/4 in. (6 mm) of piston travel shall be recorded. Clean the plastometer completely after each trial. Make a blank determination on the empty plastometer and subtract the scale load obtained from the maximum scale loads obtained when the sealant was tested. The test shall be run in duplicate and the average of the results reported. Individual tests results shall not deviate by more than 10% of the average value.

4.5.4 Corrosion Resistance: Two AMS 4045 panels approximately 0.040 x 2-3/4 x 6 in. (1.00 x 70 x 150 mm) in size shall be cleaned (See 4.5.1.2). Two parallel fillets of sealing compound 1/16 in. (2 mm) thick by 3/4 in. (20 mm) wide by 5 in. (120 mm) long shall be applied to one of the panels. That panel shall be set aside under standard conditions (See 4.5.1.1), lying horizontally with the sealing compound face up for at least 24 hours. Both panels shall be immersed vertically for 20 days in a covered glass vessel containing a 2-layer liquid consisting of a 3% aqueous sodium chloride solution and jet reference fluid (See 4.5.1.4), so that 1-5/8 in. (40 mm) of the panels are exposed to the salt water, 1-5/8 in. (40 mm) exposed to jet reference fluid, and the remainder exposed to air-vapor mixture. The temperature during the exposure shall be maintained at 60°C ± 1 (140°F ± 2). Immediately upon removal from the liquid, the sealant shall be removed using a plastic scraper and the panels examined for evidence of corrosion.

4.5.5 Pressure Rupture: Specimens constructed in accordance with Fig. 3 and finished as listed in Table I shall be used. Pack the sealing compound into the specimens, taking care to eliminate air bubbles, and stabilize the specimens at 24°C ± 3 (75°F ± 5) for not less than 24 hours. The specimens shall be cooled to below -30°C (-20°F) and the excess material trimmed from the surfaces with a razor blade. One of the specimens shall be mounted in the pressure rupture jig (Fig. 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 24°C ± 3 (75°F ± 5) and stabilized for five minutes. Starting at atmospheric pressure, the pressure on the apparatus shall be uniformly increased at the rate of 1 in. (25 mm) of mercury per 15 sec 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 control specimens in the same manner. The average failure pressure of the three specimens shall be reported to the nearest 0.5 in. (12 mm) of mercury.

TABLE I

Pressure Rupture Specimens
(3 each required)

1. Anodized in accordance with AMS 2471.

2. Sulfuric acid anodized in accordance with AMS 2471 and coated with material conforming to MIL-C-27725. Care shall be taken to ensure a thin, even coat in the slot.

4.5.6 Fuel Resistance: Six AMS 4045 aluminum panels, approximately 0.040 x 1 x 2 1/2 in. (1.00 x 25 x 65 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 in. (1.5 x 25 x 50 mm) shall be applied to each panel. One-half in. (12.5 mm) at one end of each panel shall not be coated for handling purposes. The sealant coated panels shall then be weighed in air (W_3) and in water (W_4). The panels shall be conditioned at standard conditions (See 4.5.1.1) for 24 hours. The panel shall then be exposed for 14 days at 70°C ± 1 (160°F ± 2) with three of the panels immersed in jet reference fluid (See 4.5.1.4) and the other three in TT-S-735, Type I, fluid. The panels shall be weighed immediately upon removal from the fluid in air (W_5) and in water (W_6). The procedures in accordance with ASTM D471 shall be used. The percent change in volume shall be determined by the following formula:

$$\text{Percent change in volume} = \frac{(W_3 + W_6) - (W_4 + W_5)}{(W_1 + W_4) - (W_2 + W_3)} \times 100$$

4.5.6.1 The reported value shall be determined by averaging the 3 values obtained for each exposure. The average value shall be determined to the nearest 0.1%. Each specimen shall then be placed in an oven 93°C ± 2 (200°F ± 2) for 24 hr, cooled to room temperature for at least 2 hr, and weighed in air (W_7). The percentage weight loss shall be determined by the following formula:

$$\text{Percentage weight loss} = \frac{W_3 - W_7}{W_3 - W_1} \times 100$$

4.5.6.2 The average of the 3 values obtained for each exposure shall be determined to the nearest 0.1%.

4.5.7 Sealability and Reinjection:

4.5.7.1 Jig Assembly: A groove injection pressure test jig conforming to Fig. 5 shall be cleaned (See 4.5.1.2). Install 5-mil (0.02 mm) washers (0.26 in. [6.6 mm] I.D., 0.50 in. [12.7 mm] O.D.) on every other of the outer circle bolts between the two plates. Four 1 x 1/4 x 0.005 in. (25 x 6 x 0.02 mm) shims shall be installed 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 in.-lb (7 N·m).

4.5.7.2 Sealant Injection: A Grover Smith Model 223 gun, or equivalent, shall be used for sealant injection. The line air pressure shall be maintained so that the maximum pressure developed at the injection tip (See Fig. 4) is 2800 psi (19.5 MPa). 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:

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

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

4.5.7.2.3 Insert a plug screw into B and inject into C until not less than 1 in. (25 mm) sealing emerges from D.

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

4.5.7.2.5 Insert a plug screw into A and D.

4.5.7.3 Pressure Test: To insure that the jig is initially sealed, the following shall be done.

4.5.7.3.1 Pressurize the jig to 5 psig (35 kPa).

4.5.7.3.2 Close the needle valve.

4.5.7.3.3 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.)

4.5.7.3.4 If a pressure drop occurs, immerse the pressurized jig in water to determine the location of the leak. Reinject the proper portion of compound into the groove to stop the leak and pressure test again in water.

4.5.7.4 Exposure: The conditioning shall be as follows:

4.5.7.4.1 44 hr ± 2 at 70°C ± 1 (160°F ± 2) in Jet Reference Fluid (JRF) (See 4.5.1.4) at 0 psig (0 kPa)
plus 4 hr ± 1/2 at -54°C ± 1 (-65°F ± 2) in JRF at 5 psig (35 kPa) plus

4.5.7.4.2 Continue conditioning for 16 hr ± 1 at 70°C ± 1 (160°F ± 2) in JRF at 5 psig (35 kPa)
plus 4 hr ± 1/2 at 125°C ± 2 (260°F ± 5) in JRF vapors (5 ml of JRF added to drained jig) at 5 psig (35 kPa)
plus 30 min ± 5 at 180°C ± 2 (360°F ± 5) in JRF vapors at 5 psig (35 kPa)
plus 1 hr at room temperature in JRF vapors at 0 psig (0 kPa)
plus 2 1/2 hr at room temperature in JRF at 0 psig (0 kPa)

4.5.7.4.3 Repeat 4.5.7.4.2 five times for a total of six cycles. (4.5.7.4.1 is not repeated.)

4.5.7.4.4 During any extended time between cycles (such as a weekend), the jig shall remain filled with jet reference fluid and conditioned at room temperature.

4.5.7.5 Reinjection: After completing the aging in 4.5.7.4, the jig shall be reinjected as follows:

4.5.7.5.1 The tip pressure of the gun shall be 2800 psig (19.5 MPa).

4.5.7.5.2 The injecting shall be performed as in 4.5.7.2 except that only two adjacent injection ports will be unplugged at one time, the plug being injected and the next plug to the left.

4.5.7.5.3 Each of the four injections shall be timed to the nearest second from when the trigger is depressed until the piston reaches the end of its travel and the arithmetic average reported.

4.6 Reports:

4.6.1 The vendor of sealing compound shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the compound conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3376, vendor's compound number, lot number, and quantity.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3376, contractor or other direct supplier of compound, supplier's compound number, part number, and quantity. When compound for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of compound to determine conformance to the requirements of this specification and shall include in the report either a statement that the compound conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the sealing compound may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the compound represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging:

5.1.1 The sealing compound shall be furnished in 6 fl oz (180 mL) sectional type cartridges conforming to MIL-P-38714 each containing 5 fl oz ± 1/3 (150 mL ± 10) of sealing compound. The cartridges shall be packaged in sectionalized cardboard boxes containing 12 cartridges per box.

5.1.2 Boxes of compound cartridges shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.1.3 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.1 and 5.1.2 will be acceptable if it meets the requirements of Level C.

5.2 Identification:

5.2.1 Each cartridge and each box shall be permanently marked with not less than the following information:

SEALING COMPOUND, NON-CURING, GROOVE INJECTION, TEMPERATURE AND FUEL RESISTANT
AMS 3376
MANUFACTURER'S IDENTIFICATION _____
COMPOUND NUMBER _____
LOT NUMBER _____
Store below 27°C (80°F)

5.2.2 Each exterior shipping container shall be marked with not less than the following information:

SEALING COMPOUND, NON-CURING, GROOVE INJECTION, TEMPERATURE AND FUEL RESISTANT
AMS 3376
MANUFACTURER'S IDENTIFICATION _____
PURCHASE ORDER NUMBER _____
Store below 27°C (80°F)

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Sealing compound not conforming to this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

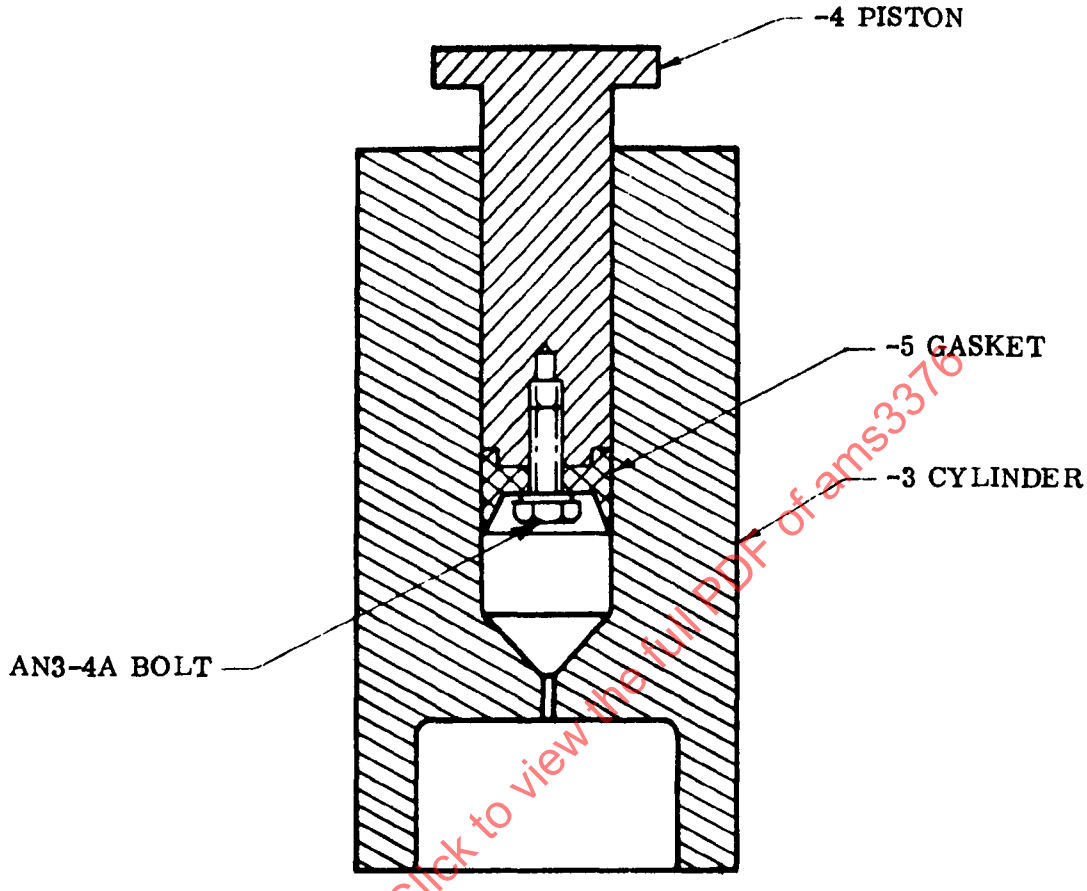
8.1 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.2 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Quantity of cartridges desired
Applicable level of packaging (See 5.1.3)

8.3 Sealing compound meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 8030.

This specification is under the jurisdiction of AMS Committee "G-9".



NOTES:

1. Material of -3 Cylinder; AMS 6370 Steel Bar, Heat Treat 180,000 to 200,000 psi (1240 to 1380 MPa)

2. Material of -4 Piston; AMS 5070 Steel Bar,
   Case Harden 0.032 in. (0.8 mm) Deep
   Case 55 HRA, min
   Core Strength 55,000 psi (380 MPa), min

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

4. Machine finish all surfaces 250 µin. (6.35 µm) except as noted

5. Tolerances to be ± 0.005 in. (± 0.12 mm), except as noted.

FIGURE 1 EXTRUSION PLASTOMETER

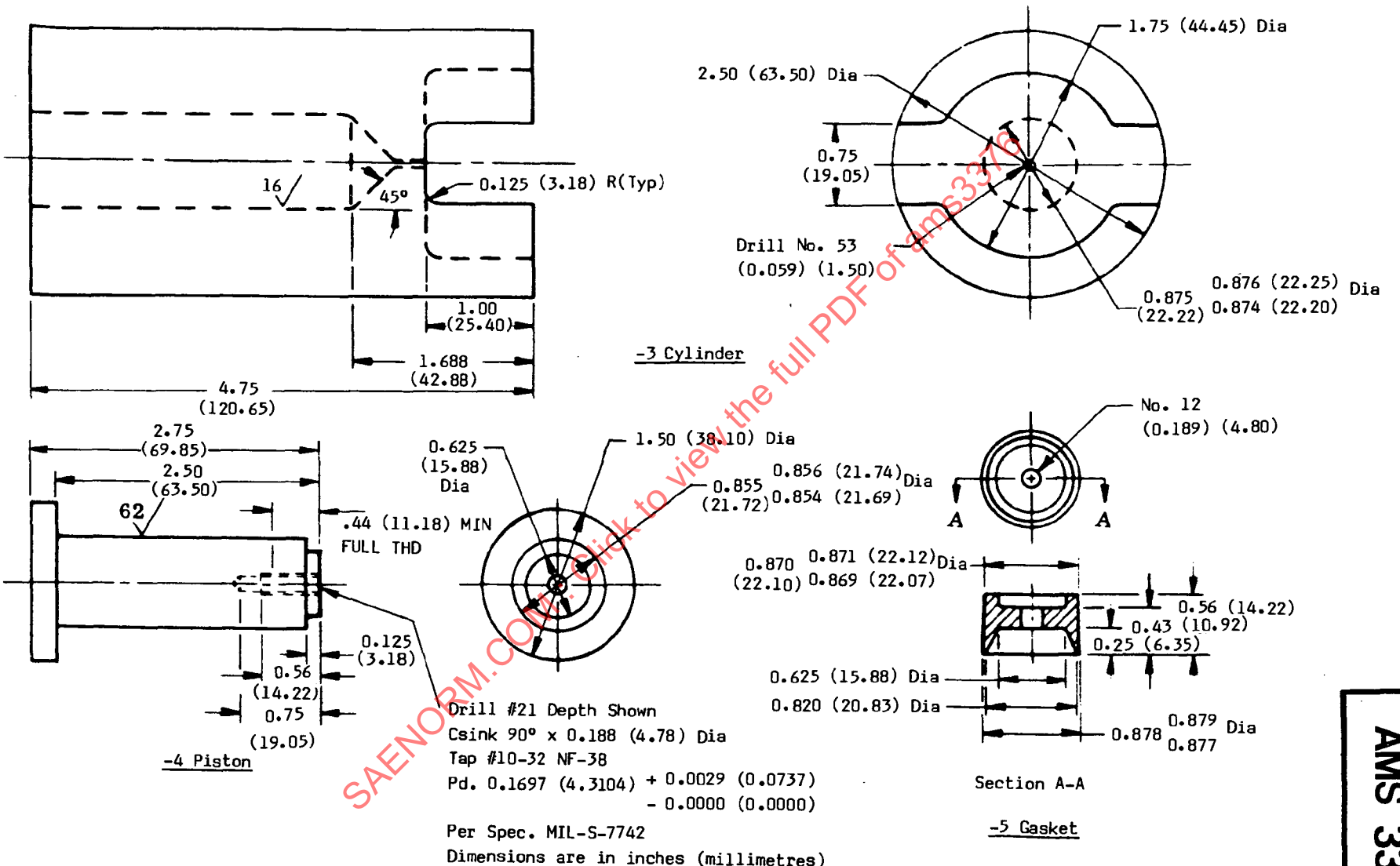


FIGURE 2 EXTRUSION PLASTOMETER

NOTES TO FIGURE 2

1. The temperature of the plastometer shall be maintained at 24°C ± 3 (75°F ± 5) 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 a period of five days or longer the inside surface shall be thoroughly covered with a protective oil.

6. The plastometer shall be cleaned in accordance with 3.2.1 before use.