SAE The Engineering Society For Advancing Mobility Land Sea Air and Space

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3373A

Issued 1-15-81
Revised 7-1-87

Superseding AMS 3373

COMPOUND, SILICONE RUBBER, INSULATING AND SEALING
35 - 55

1. SCOPE:

1.1 Form: This specification and its supplementary detail specifications cover elastomeric silicone insulating and sealing compounds supplied as two-component systems which cure at room temperature.

1.2 Application: Primarily for protecting the electrical integrity of electrical and electronic components by excluding moisture and contamination and by providing resilient cushioning between -60° and +205°C (-80° and +400°F). Compound may be applied by potting or encapsulating.

1.3 Classification: This compound shall be classified by purpose and by viscosity of the base polymer as shown in the detail specifications.

1.4 Safety - Hazardous Materials: While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material 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.

REAFFIRMED

Printed in U.S.A.

10-91, 4/94

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2825 - Material Safety Data Sheets
AMS 3020 - Oil, Reference, for "L" Stock Rubber Testing
AMS 3021 - Reference Fluid for Testing Di-Ester (Polyol) Resistant Materials
AMS 4049 - Aluminum Alloy Sheet and Plate, Alclad, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (Alclad 7075; -T6 Sheet, - T651 Plate), Solution and Precipitation Heat Treated

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

ASTM D149 - Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D150 - A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials
ASTM D257 - D-C Resistance or Conductance of Insulating Materials
ASTM D412 - Rubber Properties in Tension
ASTM D471 - Rubber Property - Effect of Liquids
ASTM D495 - High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D573 - Rubber - Deterioration in an Air Oven
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D1824 - Apparent Viscosity of Plastisols and Organosols at Low Shear Rates by Brookfield Viscometer
ASTM D2240 - Rubber Property - Durometer Hardness

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

2.3.1 Military Specifications:

MIL-L-23699 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-H-83282 - Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft

2.3.2 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Detail Specifications: The requirements for a specific material shall consist of all the requirements specified herein in addition to the requirements specified in the applicable detail specification. In case of conflict between requirements of this basic specification and an applicable detail specification, requirements of the detail specification shall govern.

3.2 Material: The compound shall be based on polysiloxane polymer and shall be supplied with the applicable curing agent. The base compound shall cure (polymerize) at room temperature when mixed with the curing agent.

3.2.1 Primer: Shall be used in all adhesion and repairability tests when specified by the manufacturer.

3.2.2 Color: The base compound shall be furnished in the color manufactured. The curing agent shall be of a contrasting color to facilitate proper mixing.

3.2.3 Storage Life: The polymer and curing agent shall meet the requirements of 3.3 at any time up to one year from date of shipment when stored below 38°C (100°F) in the original, unopened containers.

3.2.4 Application Life: Shall be 1 - 3 hr, unless shorter or longer life is ordered, determined in accordance with 4.5.2.

3.3 Properties: Compound, mixed and cured as in 4.5.1 and tested at 23°C ± 1 (73°F ± 2) and 50% ± 5 relative humidity, shall conform to the requirements specified in the applicable detail specification and the following:

3.3.1 As Cured:

3.3.3.1	Hardness, Durometer A or equiv, min	45 ± 10	ASTM D2240
3.3.1.2	Elongation, min	100%	ASTM D412
3.3.1.3	Linear Shrinkage, max	1.0%	4.5.3
3.3.1.4	Specific Gravity, max	1.55	ASTM D792
3.3.1.5	Adhesion, min	4.0 lb (1.8 kg)	4.5.4
3.3.1.6	Repairability, min	4.0 lb (1.8 kg)	4.5.5
3.3.1.7	Dielectric Strength, min	400 V per mil (15,750 V/mm	ASTM D149
3.3.1.8	Volume Resistivity, min	$1x10^{11}$ Ω.cm	ASTM D257
3.3.1.9	Surface Resistivity, min	$1x10^{13}$ Ω	ASTM D257

3.3.1.10	Dielectric Constant, max	4.5	ASTM D149
3.3.1.11	Dissipation Factor, 1 kilocycle, max 1 megacycle, max	 0.020 0.010	 ASTM D150
3.3.1.12	Arc Resistance, min	100 sec	ASTM D495
3.3.1.13	Corrosivity	No worse than control	4.5.6
3.3.2	Water Resistance:		ASTM D471 Medium: Distilled Water
3.3.2.1	Weight Change, max	-2 to +2%	Temperature: 70°C + 2 (160°F + 5)
3.3.2.2	Volume Change, max	-3 to +3%	Time: 3 hr ± 0.25
3.3.2.3	Hardness Change, Durometer A or equiv, max	0 to -10	
3.3.3	Dry Heat Resistance:		ASTM D573
3.3.3.1	Hardness Change, Durometer A or equiv, max	-10 to +10	Temperature: 200°C + 3 (390°F ±5)
3.3.3.2	Tensile Strength Change, max	-25%	Time: 70 hr ± 2
3.3.3.3	Elongation Change, max	-35%	
3.3.4	Oil Resistance:		4.5.7
3.3.4.1	Hardness Change, Durometer A or equiv., max	-10	
3.3.4.2	Tensile Strength Change, max	-25%	
3.3.4.3	Elongation Change, max	-25%	
3.3.4.4	Volume Change, max	0 to +10%	
3.3.4.5	Weight Change, max	0 to +5%	
3.3.5	Reversion, Hydrolytic Stability, Durometer A or equiv., min	30	4.5.8
3.3.6	Reversion, Closed Mold, Durometer A or equiv., min	30	4.5.9

3.4 Quality: Compound, as received by purchaser, shall be uniform in quality and condition 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 the 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. 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 and the applicable detail specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

Requirement	Paragraph Reference
Viscosity, as received	See Detail Specification
Application Life	3.2.4
Hardness, mixed and cured	3.3.1.1

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification and the applicable detail 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 approval 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 contacting 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. Except as specified in 4.5, 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 lot shall be all compound produced in a continuous production run from the same batches of raw materials under the same fixed conditions and presented for vendor's inspection at one time. A lot shall not exceed 2000 lb (908 kg) of compound and may be packaged and delivered in smaller quantities under a basic lot approval provided lot identification is maintained.

4.3.1.2 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.

4.4.2 Vendor shall use ingredients, manufacturing procedures and processes, and methods of inspection on production compound which are essentially the same as those used on the approved sample compound. If necessary to make any change in ingredients, in type of equipment of 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: Shall be as specified in 3.3 and the applicable detail specification and as follows:

4.5.1 Specimen Preparation:

4.5.1.1 Mixing: The base compound and the curing agent, both in their original unopened containers, together with the required spatulas, beakers, and other mixing equipment shall be held at 23°C ± 1 (73°F ± 2) for not less than 6 hours. The individual components shall be thoroughly mixed, at 23°C ± 1 (73°F ± 2) and 50% ± 5 relative humidity, in their respective containers prior to combining in the proportions recommended by the manufacturer. Proper care shall be exercised to avoid incorporation of air by too rapid stirring or folding action. Deaeration by vacuum or centrifuge shall be employed.

4.5.1.2 Curing: Test specimens shall be cured for 72 hr ± 2 at 23°C ± 1 (73°F ± 2). All molded specimens shall be removed from the molds in 24 hr ± 2; total cure time shall include the time the specimen is in the mold. Cured specimens shall be tested within 2 hr from the end of the cure period.

4.5.2 Application Life: Approximately 50 g of catalyzed compound shall be placed in a suitable container so that a layer of compound approximately 1/2 in. (12 mm) thick is obtained. A microspatula having a flat tip approximately 1/4 in. (6 mm) wide is to be utilized in this test. The spatula shall periodically be dipped well below the compound surface, slowly withdrawn, and the stringy compound observed. The length of time required for the strings to first break without stretching more than approximately 1 in. (25 mm) shall be considered the application life.

4.5.3 Linear Shrinkage: Shall be determined as follows:

4.5.3.1 Evacuate the catalyzed compound to eliminate presence of air due to mixing.

4.5.3.2 Slightly overfill a 6 x 6 x 0.075 in. (150 x 150 x 2 mm) cavity with a sufficient amount of compound. Place a flat cover plate upon the mold and press out the excess compound. Remove from mold in accordance with 4.5.1.2.

4.5.3.3 Cure for 21 days.

4.5.3.4 Measure the linear shrinkage using a rule having 0.01 in. (0.2 mm) divisions.

4.5.3.5 Calculate the shrinkage of the compound from the equation:

$$\% \text{ Shrinkage} = \frac{(\text{Molded slab measurement} - \text{Cavity measurement}) \times 100}{\text{Cavity measurement}}$$

4.5.4 Adhesion:

4.5.4.1 Specimen Preparation: A coating of compound approximately 1/8 in. (3 mm) thick shall be applied to the primed side (as recommended by the manufacturer) of an AMS 4049 aluminum alloy panel nominally 3 x 6 x 1/6 in. (75 x 150 x 1.5 mm) thick. Two strips, nominally 1 x 12 x 0.006 in. (25 x 300 x 0.15 mm) of a thin flexible material, such as 30-mesh (600 μm) aluminum screen (primed as specified by the manufacturer), shall be placed, primed side down, on the surface of the freshly applied compound. The strips shall be placed so that they are approximately 0.25 in. (6 mm) from each edge and 0.5 in. (12 mm) apart, leaving a tail approximately 6 in. (150 mm) long. Two panels, prepared as above, shall be cured for 72 hr + 2. Two similar panels, prepared as above, shall be cured for 72 hr + 2, and oven aged for 72 hr + 2, and oven aged for 72 hr + 2 at 205°C + (400°F + 5).

4.5.4.2 Procedure: The panels shall be individually tested on an autographic testing machine having a capacity such that the load at failure is 15 - 85% of the full scale load. If the machine is of the pendulum type, the weight shall swing as a free pendulum without engagement of the pawls. The rate of separation of the jaws shall be nominally 2 in. (50 mm) per minute. Specimens shall be mounted in the machine so that the loose end of the aluminum mesh strip will be folded 180 deg as it is pulled from the panel. Each strip shall be pulled as follows: A cut through the compound to the panel at the junction of separation shall be made at an angle of 45 deg in the direction of separation. If the compound separates from the aluminum mesh, similar 45-deg cuts shall be made to promote separation of the sealant from the panel. A maximum of 5 cuts shall be made. The adhesion shall be automatically recorded on a chart as a continuous curve. The adhesion value shall be calculated by averaging the maximum forces required to separate the compound from the panel.

4.5.5 Repairability: A coating of compound, approximately 1/8 in. (3 mm) thick, shall be applied to the primed side (as specified by the manufacturer) of two AMS 4049 aluminum alloy panels nominally 3 x 6 x 1/16 in. (75 x 150 x 1.5 mm) thick (See Fig. 1). One panel shall be cured for 72 hr + 2, and oven aged for 72 hr + 2 at 205°C + 3 (400°F + 5). The panels shall then be recoated with newly mixed compound approximately 1/8 in. (3 mm) thick. Two strips, approximately 1 x 12 in. (25 x 300 mm) of a thin flexible material such as 30-mesh (600 μm) aluminum screen (primed as specified by the manufacturer), shall be placed, primed side down, on the surface of the freshly-applied compound. The strips shall be placed so that they are approximately 0.25 in. (6 mm) from each edge and 0.5 in. (12 mm) apart, leaving a tail approximately 6 in. (150 mm) long. The panels shall be cured for 72 hr ± 2 and tested in accordance with 4.5.4.2.

4.5.6 Corrosivity: Prepare two lengths of copper wire (AWG size No. 10), approximatley 1.5 in. (40 mm) long, by removing all insulation, cleaning with a degreasing agent, and buffing to a bright copper finish. A previously cured section of the same silicone compound undergoing test shall be placed in the mold as a support for the wires. The wires used for this test shall not be treated with a primer. Encapsulate these two wire specimens centrally into a suitable mold approximately 1 x 2 x 0.5 in. (25 x 50 x 12 mm) (See Fig. 2). The compound, prepared in accordance with the manufacturer's mixing instructions, shall be cured for 72 hr + 2. The curing agent used for this test shall be the same used in sample preparation for all other physical and electrical tests. Place the specimen along side an unpotted 1.5 in. (40 mm) length of the above specified wire (control) into an environment of 95 - 98% relative humidity and 50°C + 1 (120°F + 2) for 28 days. At the end of this period, the mold shall be slit open and the encapsulated wire compared visually with the control as to corrosive effects.

4.5.7 Oil Resistance: Separate specimens, cured for 72 hr + 2, shall be immersed at 60°C + 1 (140°F + 2) in accordance with ASTM D471 in each of the following oils: AMS 3020 oil, AMS 3021 oil, MIL-H-83282 hydraulic oil, and MIL-L-23699 lubricating oil. The specimens shall be tested to determine conformance to the applicable detail specification.

4.5.8 Revision, Hydrolytic Stability:

4.5.8.1 Specimen Preparation: Sufficient base compound and curing agent shall be mixed to prepare 3 molded test specimens, approximately 2-1/2 in. (60 mm) in diameter by 1/2 in. (12 mm) thick. Hardness shall be determined in accordance with ASTM D2240 using a Type A Durometer after 3 sec application time. Hardness shall be determined at the same locations before and after exposure.

4.5.8.2 Procedure: After determining hardness before exposure, the specimens shall be placed vertically in a suitable holder, on a tray in a suitable glass desiccator. The desiccator shall contain a 22% by weight solution of glycerine in water in the bottom which will produce a relative humidity of 95% at the test etmperature. The desiccator, containing the specimens, shall then be closed and inserted into a circulating-air oven maintained at 70°C + 1 (160°F + 2) for 120 days. At the end of the exposure period, the desiccator shall be removed from the oven and cooled to the testing conditions of 3.3 for 16 to 24 hours. Hardness shall again be determined.

4.5.9 Reversion, Closed Mold:

4.5.9.1 Specimen Preparation: The container for the confinement of the compound shall be a metal tube 4.250 in. + 0.005 (106 mm + 0.1) long, threaded at both ends, having an inner diameter of approximately 2.5 in. (60 mm) and a wall thickness suitable for threading. Metal screw caps and aluminum foil gaskets which provide an air-tight seal shall be used for end closures and designed so that the total inside height of the capped tube does not exceed 4.25 in. + 0.005 (106 mm + 1). Seal one end of the tube and pour the mixed and deaerated catalyzed sealing compound to a depth of 4.125 in. + 0.032 (105 mm + 1). Where possible, the compound shall be vacuum deaerated for 5 min. at less than 5 mm mercury (Hg) pressure at 23°C + 1 (73°F + 2). Allow the compound to cure for 72 hr + 2 at 23°C + 1 (73°F + 2) and 50% + 5 relative humidity with the container top uncapped.

4.5.9.2 Procedure: Remove the bottom cap and obtain the hardness in the center area of the bottom surface, using Type A durometer. Seal both ends of the tube and condition the test fixture at 200°C + 1 (390°F + 2) for 28 days. At the expiration of the heat aging period, allow the test fixutre to cool for 24 hr + 1. Obtain a hardness reading in the same location where the original hardness was determined. Tests shall be made in duplicate.

4.6 Reports:

4.6.1 The vendor of the 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 3373A and the applicable detail specification number and its revision letter if any, vendor's material designation, lot number, date of manufacture, and quantity.

4.6.1.1 A material safety data sheet conforming to AMS 2825, 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 compound for production use. Each request for modification of compound formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3373A and the applicable detail specification number and its revision letter, contractor or other direct supplier of compound, supplier's material designation, part number, and qualtity. 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 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 OF DELIVERY:

5.1 Packaging and Identification:

5.1.1 The base compound and the correct amount of curing agent shall be packaged in individual containers of a type and size agreed upon by purchaser and vendor.

5.1.2 Each unit package and each intermediate and exterior shipping container shall be legibly marked with not less than AMS 3373A and the applicable detail specification number, manufacturer's identification, lot number, quantity, date of manufacture, and any directions for mixing and use and precautions for handling and storage of toxic and hazardous materials. In addition, the label shall indicate that the compound should be stored at a temperature not exceeding 38°C (100°F).

5.1.3 Each exterior shipping container in the shipment shall contain the same type, number, and size of unit packages (or two-unit packages) supplied to the same purchase order number.

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

5.1.5 For direct U.S. Military procurement, packaging shall be in accordance wih MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.1, 5.1.3, and 5.1.4 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and the applicable detail specification number and their revision letters in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Compound not conforming to this specification and the applicable detail specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: This revision is a five-year editorial update and, therefore, no phi (Ø) symbol has been used to indicate technical changes from the previous issue of this specification.

8.2 This material has limited tear resistance.

8.3 Addition-cure compounds may require a barrier material on certain surfaces such as chloroprene rubber, amine compounds, certain other room-temperature-vulcanizing silicones, etc to prevent cure inhibition.

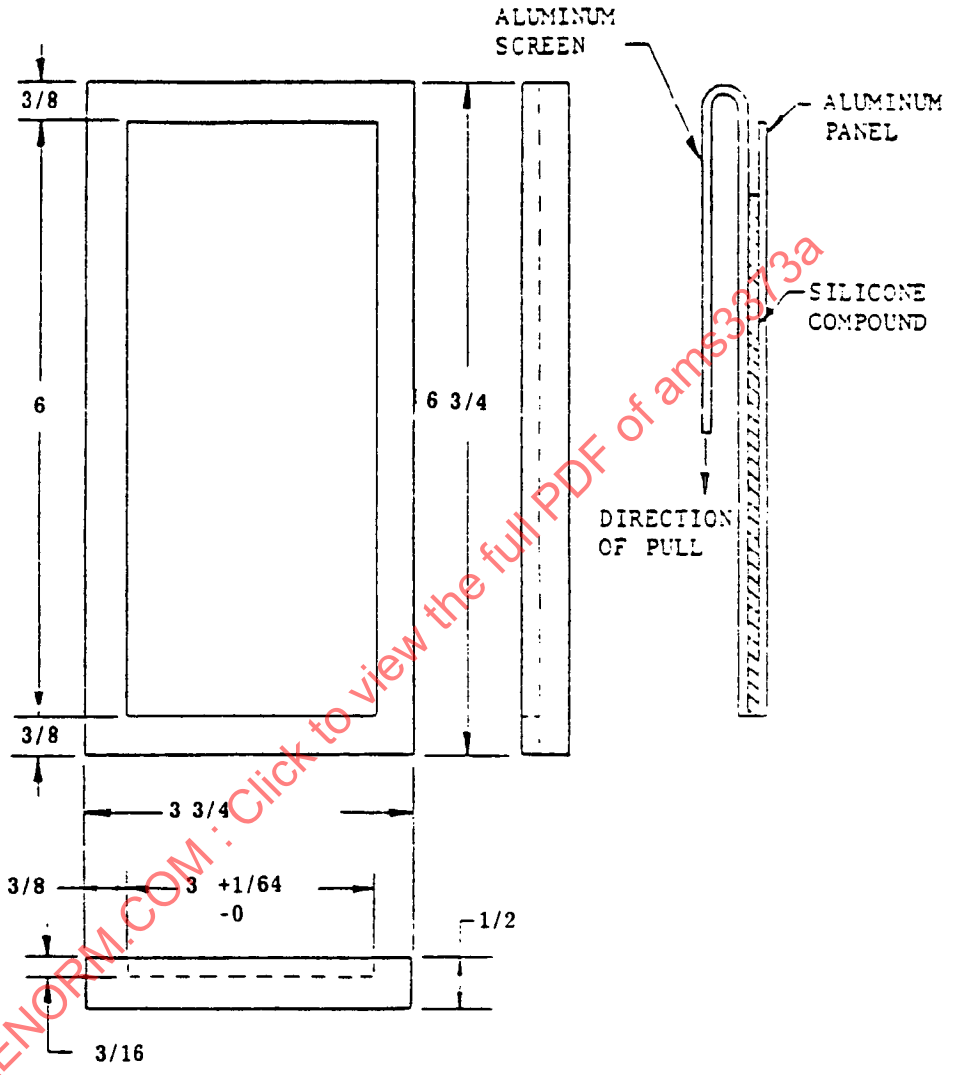
8.4 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

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

Title, number, and date of this specification and the applicable detail specification
Type and size of containers desired
Quantity of compound desired
Applicable level of packaging (See 5.1.5)

8.6 Compound meeting the requirements of this specification and any applicable detail specification has been classified under Federal Supply Classification (FSC) 8030.

This specification and its detail specifications are under the jurisdiction of AMS Committee "CE".



MATERIAL: STEEL (ASSEMBLY JIG)
Dimensions are in inches

ADHESION ASSEMBLY JIG AND TEST SPECIMEN
FIGURE 1