Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 3674

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Revised

PLASTIC MOLDINGS, ELECTRICAL INSULATION
Cross-linked Polyolefin, Pigmented, Flexible, Heat Shrinkable

1. SCOPE:

1.1 Form: This specification covers a cross-linked, thermally-stabilized, modified polyolefin plastic in the form of flexible, electrically-insulating, heat-shrinkable molded components.

1.2 Application: Primarily for parts whose expanded dimensions can be reduced to a predetermined size upon exposure to temperatures higher than 100 C (212 F). This product is stable for continuous exposure from -55 C (-67 F) to +135 C (+275 F).

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

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 3032 - Aviation Fuel, Grade 100/130

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

ASTM D257 - D-C Resistance or Conductance of Insulating Materials
ASTM D412 - Tension Testing of Vulcanized Rubber
ASTM D570 - Water Absorption of Plastics
ASTM D635 - Flammability of Self-Supporting Plastics
ASTM D747 - Stiffness of Plastics by Means of a Cantilever Beam
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D876 - Testing Nonrigid Vinyl Chloride Polymer Tubing
ASTM D2240 - Indentation Hardness of Rubber and Plastics by Means of a Durometer

2.3 Government Publications: Available from Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

2.3.1 Military Specifications:

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missiles, and Ordnance
MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5

2.3.2 Military Standard:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS:

3.1 Composition: The material shall be a cross-linked, thermally-stabilized, flame-resistant, modified polyolefin.

3.2 Color: Shall be black.

3.3 Properties: The product shall conform to the requirements of 3.3.1 through 3.3.5 and shall be capable of meeting the requirements of 3.3.6 through 3.3.16; tests, except dimensional recovery (3.4) shall be conducted on molded slabs (see 4.3.1 and 4.3.2) and in accordance with specified ASTM methods, insofar as practicable.

3.3.1	Tensile Strength, min	1200 psi ($8\ MN/m^2$)	See 3.3.1.1
3.3.1.1	Three specimens cut from a molded slab using die D or ASTM D412 shall be tested for tensile strength and elongation in accordance with ASTM D412.		
3.3.2	Elongation, min	250%	See 3.3.1.1
3.3.3	Heat Shock: Shall pass the test of 3.3.3.1.		
3.3.3.1	Three 6 x 1/4 in. (152.4 x 6.35 mm) specimens cut from a molded slab shall be conditioned for 4 hours in a mechanical-convection oven which is at 225C ± 5 (437 F ± 9) with an air velocity of 100 - 200 ft per min. (508 - 1016 mm/s) past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and examined visually for evidence of dripping, flowing, or cracking.		
3.3.4	Flammability	Nonburning	ASTM D635
3.3.5	Hardness, Shore D	30-50	ASTM D2240
3.3.6	Stiffness, max	10,000 psi ($68.9\ MN/m^2$)	ASTM D747
3.3.7	Specific Gravity, max	1.40	ASTM D792 Method A
3.3.8	Water Absorption in 24 hr, max	0.50%	ASTM D570
3.3.9	Dielectric Strength, short time test, min	200 v per mil (78 74 V/mm)	ASTM D876
3.3.10	Volume Resistivity, min	10^{12} ohm-cm	ASTM D257
3.3.11	Fungus Resistance	Rating of 1 or less	ASTM D876

3.3.12 Low Temperature Flexibility: Shall pass the test of 3.3.12.1.

3.3.12.1 A 6 x 1/4 in. (152.4 x 6.35 mm) specimen cut from a molded slab shall be mounted in a loop position between movable, parallel sets of jaws 2-1/2 in. (63.5 mm) apart mounted on a test fixture. Each end of the specimen shall extend at least 3/4 in. (19.05 mm) into a set of jaws and shall be firmly fastened. The specimen and the test fixture shall be conditioned for 4 hr at -55 C ± 2 (-67 F ± 3.6). While at this temperature, the sets of jaws shall be moved rapidly from a 2-1/2 in. (63.5 mm) to a 1 in. (25.4 mm) separation. The specimen shall be free from cracks.

3.3.13 Heat Aging: Shall pass the tests of 3.3.13.1 and 3.3.13.2.

3.3.13.1 Procedure A: Three specimens, prepared and measured in accordance with 3.3.1.1, shall be conditioned for 168 hr in a mechanical convection oven which is at 175 C ± 5 (347 F ± 9) with an air velocity of 100 - 200 ft. per min. (508 - 1016 mm/s) past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for tensile strength and elongation in accordance with 3.3.1 and 3.3.2. Specimens shall have tensile strength not lower than 1000 psi (6.9 MN/m^2) and elongation not lower than 200%.

3.3.13.2 Procedure B: Three specimens, prepared and measured in accordance with 3.3.1.1, shall be conditioned for 1000 hr in a mechanical convection oven which is at 150 C ± 3 (302 F ± 5.4) with an air velocity of 100 - 200 ft. per min. (508 - 1016 mm/s) past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for tensile strength and elongation in accordance with 3.3.1 and 3.3.2. Specimens shall have tensile strength not lower than 1000 psi (6.9 MN/m^2) and elongation not lower than 200%.

3.3.14 Corrosion: Shall pass the test of 3.3.14.1.

3.3.14.1 A 1 x 1/4 in. (25.4 x 6.35 mm) specimen cut from a molded slab, shall be placed in the bottom of each of two clean 1/2 x 12 in. (12.7 x 304.8 mm) test tubes. A third tube shall be used for control. A copper-glass mirror, approximately 1 x 1/4 in. (25.4 x 6.35 mm), shall be suspended 6 - 7 in. (152.4 - 177.8 mm) above the bottom of each tube by a fine copper wire attached to a silicone rubber stopper wrapped in aluminum foil. The mirrors shall be vacuum-deposited copper, on one side only, with a thickness equal to 10% ± 5 transmission of normal incident light of 5000 Angstroms (5×10^{-7} m). The coated mirrors shall be stored in vacuum and may be used for test only if no oxide film is present and the copper is not visibly damaged. The three test tubes shall be tightly sealed. The lower 2 in. (50.8 mm) of each tube shall be placed in an oven or oil bath at 175 C ± 3 (347 F ± 5.4) for 16 hours. After cooling, the mirrors shall be examined in a good light against a white background. The copper shall not have been removed from a mirror leaving an area of transparency greater than 5% of the total area. Discoloration of the copper film shall not be considered corrosion.

3.3.15 Solvent Resistance: Shall pass the test of 3.3.15.1.

3.3.15.1 Three specimens, prepared and measured in accordance with 3.3.1.1, shall have tensile strength not lower than 1000 psi (6.9 MN/m^2) and elongation not lower than 200% after being immersed for 24 hr ± 2 at 23 C ± 3 (73.4 F ± 5.4) in JP-4 Fuel (MIL-T-5624), SAE Phosphate ester fluid No. 1, hydraulic oil (MIL-H-5606), aviation gasoline 100/130 (AMS 3032), and water. Three specimens (a total of 15) shall be immersed in each of the fluids. The volume of the fluid shall be not less than 20 times that of the specimens. After immersion, the specimens shall be lightly wiped, air dried for 30 - 60 min. at room temperature, and subjected to the tensile and elongation tests.

3.3.16 Elastic Memory: Shall be as follows, determined in accordance with 3.3.16.1:

expansion, min	275%
retraction, min	93%

3.3.16.1 A 6 x 1/8 in. (152.4 x 3.18 mm) specimen cut from a molded slab shall be marked with two parallel gage lines 1 in. (25.4 mm) apart in the central portion of the specimen. The distance between gage lines shall be recorded as the original length. A 2 in. (50.8 mm) portion of the specimen including both gage lines then shall be heated for 1 min. in an oven or equivalent which is at 150 C ± 2 (302 F ± 3.6), removed from the oven, and stretched within 10 sec. until the gage lines are 4 in. (101.6 mm) apart. The extended specimen shall be cooled to room temperature and released from tension. After 24 hr at room temperature, the distance between the gage lines shall be measured and recorded as the extended length. The portion of the specimen including both gage lines then shall be reheated for 1 min. in an oven or equivalent which is at 150 C ± 2 (302 F ± 3.6), and the distance between gage lines shall then be measured and recorded as the retracted length. Expansion and retraction shall be calculated as follows:

$$E = \frac{L_e - L_o}{L_o} \times 100 \qquad R = \frac{L_e - L_r}{L_e - L_o} \times 100$$

where, E = expansion (%)
R = retraction (%)
L_o = original length (in. or mm)
L_e = extended length (in. or mm)
L_r = retracted length (in. or mm)

3.4 Dimensional Recovery: Recovery dimensions shall be as specified on the drawing or purchase order. The samples then shall be conditioned for 10 min. in an oven or equivalent which is at 150 C ± 2 (302 F ± 3.6), cooled to room temperature, and remeasured.

3.5 Quality: The product shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from internal and external imperfections detrimental to fabrication, appearance, or performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that material conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Routine Control Tests: Tests to determine conformance to tensile strength (3.3.1), elongation (3.3.2), heat shock (3.3.3), flammability (3.3.4), hardness (3.3.5), and dimensional recovery (3.4) requirements are classified as routine control tests.

4.2.2 Periodic Control Tests: Tests to determine conformance to stiffness (3.3.6), specific gravity (3.3.7), water absorption (3.3.8), dielectric strength (3.3.9), volume resistivity (3.3.10), fungus resistance (3.3.11), low temperature flexibility (3.3.12), heat aging (3.3.13), corrosion (3.3.14), solvent resistance (3.3.15), and elastic memory (3.3.16) requirements are classified as qualification and/or periodic control tests.

4.3 Sampling:

4.3.1 Routine Control Test Samples: Shall consist of specimens cut from a molded slab, 6 x 6 x 0.075 ± 0.010 in. (152.4 x 152.4 x 1.095 ± 0.254 mm), and molded components selected at random in accordance with MIL-STD-105, inspection level S-2, AQL 6.5%. The molded slab shall be fabricated from the same lot of material and shall be subjected to the same degree of crosslinking as the molded components. When purchased, molded components in each lot shall be accompanied by molded slabs. A lot of components shall consist of all molded components from the same lot of material, from the same production run, and offered for inspection at the same time.

4.3.2 Periodic Control Test Samples: Shall consist of six molded slabs, 6 x 6 x 0.075 ± 0.010 in. (152.4 x 152.4 x 1.095 ± 0.254 mm), and the number of molded components specified. The molded slabs shall be fabricated from the same lot of material and shall be subjected to the same degree of crosslinking as the molded components.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of routine control tests made on the lot and a statement that the product conforms to all other technical requirements of this specification. This report shall include the purchase order number, material specification number, vendor's compound number, part number, and quantity.