

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 100°C (212°F) or higher. This product is stable for continuous exposure from -55°C to +135°C (-65°F to +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 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 Material Specifications:

AMS 2350 - Standards and Test Methods

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

ASTM D412 - Rubber Properties in Tension

ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D747 - Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

ASTM D2240 - Rubber Property - Durometer Hardness

ASTM D2671 - Testing Heat-Shrinkable Tubing for Electrical Use

ASTM G21 - Determining Resistance of Synthetic Polymeric Materials to Fungi

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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-F-5572 - Gasoline, Aviation, Grades 80/87, 100/130, 115/145
 MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
 MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5

2.3.2 Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
 MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be a cross-linked, thermally-stabilized, flame-resistant, modified polyolefin.

3.2 Color: Shall be black.

3.3 Properties: Moldings shall conform to the following requirements; reported values shall be the average of all specimens tested for each requirement. Except as otherwise specified, tests shall be performed in accordance with ASTM D2671, insofar as practicable. Tests except dimensions and dimensional recovery (3.3.15) shall be conducted on molded slabs (See 4.3.1 and 4.3.2).

3.3.1 Tensile Strength, min	1200 psi	4.5.2
Jaw separation rate at 20 in.	(8.25 MPa)	
per min. (8.5 mm/sec)		
3.3.2 Elongation, min	250%	4.5.2
3.3.3 Heat Shock	No dripping, flowing, or cracking	4.5.3
3.3.4 Low-Temperature Flexibility	No cracks	4.5.4
3.3.5 Heat Aging, Method A and B		4.5.5
3.3.5.1 Tensile Strength, min	1000 psi	
	(6.90 MPa)	
3.3.5.2 Elongation, min	200%	
3.3.6 Flame Retardance		ASTM D635
3.3.6.1 Time of Burning, max	30 sec	
3.3.6.2 Extent of Burning, max	1.2 in. (30 mm)	

3.3.7	Hardness, D	40 $\pm$ 10	ASTM D2240
3.3.8	Stiffness, max	10,000 psi (69.0 MPa)	ASTM D747
3.3.9	Specific Gravity, max	1.40	
3.3.10	Water Absorption in 24 hr, max	0.50%	
3.3.11	Dielectric Strength	200 V per mil (7875 V/mm)	
3.3.12	Volume Resistivity, min	10 ¹² ohm-cm	
3.3.13	Fungus Resistance	Rating of 1 or less	ASTM G21
3.3.14	Corrosion, Method A after 16 hr $\pm$ 0.25 at 175°C $\pm$ 3 (350°F $\pm$ 5)	Less than 5% removal of copper	
3.3.15	Solvent Resistance		4.5.6
3.3.15.1	Tensile Strength, min	1000 psi (6.90 MPa)	
3.3.15.2	Elongation, min	200%	
3.3.16	Elastic Memory		4.5.7
	Expansion, max	275%	
	Retraction, min	93%	
3.3.17	Dimensions and Dimensional Recovery: Shall be as specified on the drawing or purchase order. The samples shall be measured and then conditioned for 10 min. in an oven which is at 150°C $\pm$ 2 (300°F $\pm$ 4). After conditioning, the samples shall be removed from the oven, held for not less than 4 hr at 23°C $\pm$ 2 (73°F $\pm$ 4) and 45 - 55% relative humidity, and remeasured.		

3.4 Quality: Moldings, as received by purchaser, shall be uniform in quality and condition, smooth, and free from foreign materials and from imperfections detrimental to usage of the moldings.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of moldings 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 moldings conform to the requirements of this specification.

4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: Tests to determine conformance to requirements for tensile strength (3.3.1), elongation (3.3.2), heat shock (3.3.3), flame retardance (3.3.6), hardness (3.3.7), and dimensional recovery (3.3.17) are classified as acceptance tests and shall be performed on each lot.
- 4.2.2 Periodic Tests: Tests to determine conformance to requirements for Low-temperature flexibility (3.3.4), Method A heat aging (3.3.5), stiffness (3.3.8), specific gravity (3.3.9), water absorption (3.3.10), dielectric strength (3.3.11), volume resistivity (3.3.12), fungus resistance (3.3.13), corrosion (3.3.14), solvent resistance (3.3.15), and elastic memory (3.3.16) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.
- 4.2.3 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 molded components 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.
- 4.2.3.1 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; a lot shall be all molded components of the same part number from the same production run presented for vendor's inspection at one time. 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. A lot may be packaged and delivered in smaller quantities under the basic lot approval provided lot identification is maintained.
- 4.3.1 For Acceptance Tests: Not less than one molded slab as in 4.5.1 plus molded components selected at random in accordance with MIL-STD-105, inspection level S-2, AQL 6.5%. When purchased, molded slabs shall be supplied to the purchaser with the molded components.
- 4.3.1.1 When a statistical sampling plan and acceptance quality level (AQL) other than as specified in 4.3.1 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 Periodic Tests and Preproduction Tests: Not less than six molded slabs as in 4.5.1 plus molded components as specified by purchaser.

4.4 Approval:

- 4.4.1 Sample moldings shall be approved by purchaser before moldings for production use are supplied, unless such approval be waived by purchaser. Results of tests on production moldings shall be essentially equivalent to those on the approved samples.
- 4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production moldings which are essentially the same as those used on the approved sample moldings. 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 moldings. Moldings made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

- 4.5.1 Specimen Preparation: Specimens for the tests of 4.5.2 through 4.5.7 shall be cut from molded slabs nominally 6 in. (150 mm) square by 0.075 in. + 0.010 (2.00 mm + 0.25) thick fabricated from the same batch of compound and subjected to the same degree of crosslinking as the molded components represented.
- 4.5.2 Tensile Strength and Elongation: Three specimens, cut using die D of ASTM D412, shall be tested for tensile strength and elongation in accordance with ASTM D2671.
- 4.5.3 Heat Shock: Three specimens, 6 x 1/4 in. (150 x 6 mm), shall be conditioned for 4 hr + 0.1 in an oven which is at 225°C + 5 (440°F + 10). After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and examined visually for evidence of dripping, flowing, or cracking.
- 4.5.4 Low-Temperature Flexibility: Three specimens 6 x 1/4 in. (150 x 6 mm), and a mandrel 1.125 in. + 0.005 (28.00 mm + 0.12) in diameter, shall be conditioned for 4 hr + 0.1 at -55°C + 2 (-65°F + 4). While still at this temperature, the specimens shall be bent around the mandrel for not less than 360 deg within 10 sec + 2, and visually examined for cracks.
- 4.5.5 Heat Aging:
- 4.5.5.1 Method A: Three specimens, prepared and measured as in 4.5.1, shall be conditioned for 168 hr + 2 in an oven which is at 175°C + 5 (350°F + 10). After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for tensile strength and elongation in accordance with 4.5.2.
- 4.5.5.2 Method B: Three specimens, prepared and measured as in 4.5.1, shall be conditioned for 1000 hr + 10 in an oven which is at 150°C + 3 (300°F + 5). After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for tensile strength and elongation in accordance with 4.5.2.

- 4.5.6 Solvent Resistance: Three specimens, prepared and measured as in 4.5.1, shall be immersed for 24 hr + 1 at 23°C + 3 (73°F + 5) in MIL-T-5624 JP-4 Fuel, SAE phosphate ester fluid No. 1 (See 8.2), MIL-H-5606 hydraulic oil, MIL-F-5572, Grade 100/130, aviation gasoline, 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 tested for tensile strength and elongation in accordance with 4.5.2.
- 4.5.7 Elastic Memory: A specimen, 6 x 1/8 in. (150 x 3 mm), shall be marked with two parallel gage lines 1 in. (25 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-mm) portion of the specimen including both gage lines then shall be heated for 60 sec + 5 in an oven, or equivalent, at 150°C + 2 (300°F + 4), removed from the oven, and stretched within 10 sec until the gage lines are 4 in. (100 mm) apart. The extended specimens 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 shall be reheated for 60 sec + 5 in an oven, or equivalent, at 150°C + 2 (300°F + 4), and the distance between gage lines measured and recorded as the retracted length. Expansion and retraction shall be calculated as follows:

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

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)

4.6 Reports:

- 4.6.1 The vendor of moldings shall furnish with each shipment a report showing the results of the tests to determine conformance to the acceptance test requirements and stating that the moldings conform to the other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 3674B, vendor's compound number, part 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 3674B, contractor or other direct supplier of moldings, supplier's compound number, part number, and quantity. When moldings for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of moldings to determine conformance to the requirements of this specification and shall include in the report either a statement that the moldings conform or copies of laboratory reports showing the results of tests to determine conformance.