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Specification	**RT-301**
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Thermofit® Polyolefin Molded Components
Flame-Retarded. Semi-Rigid, Heat-Shrinkable

1. SCOPE

This specification covers the requirements for one type of semi-rigid, electrical insulating molded component whose expanded dimensions will reduce to a predetermined size upon the application of heat in excess of 121°C (250°F).

2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of referenced documents applies. The following documents form a part of this specification to the extent specified herein.

2.1 GOVERNMENT-FURNISHED DOCUMENTS

Military

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

2.2 OTHER PUBLICATIONS

American Society for Testing and Materials (ASTM)

D 149	Standard Methods of Tests for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies
D 257	Standard Methods of Test for D-C Resistance or Conductance of Insulating Material.
D 412	Standard Method of Tests for Rubber Properties in Tension
D 570	Standard Methods of Test for Water Absorption of Plastics
D 635	Standard Methods of Test for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
D 747	Standard Methods of Test for Stiffness of Plastics by Means of a Cantilever Beam
D 792	Standard Methods of Test for Specific Gravity and Density of Plastics by Displacement
D 2240	Standard Method of Tests for Rubber Property-Durometer Hardness
D 2671	Standard Methods of Testing Heat Shrinkable Tubing for Electrical Use
G 21	Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

(Copies of ASTM Publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 MATERIAL

The molded components shall be fabricated from a crosslinked, thermally stabilized, flame resistant, modified polyolefin composition. They shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks, and inclusions.

3.2 COLOR

The molded components shall be black.

3.3 PROPERTIES

The molded components and the material from which they are fabricated shall meet the requirements of Table 1.

4. QUALITY ASSURANCE PROVISIONS

4.1 CLASSIFICATION OF TESTS

4.1.1 Qualification Tests

Qualification tests are those performed on molded slabs and components submitted for qualification as satisfactory products and shall consist of all tests listed in this specification.

4.1.2 Acceptance Tests

Acceptance tests are those performed on molded slabs and components submitted for acceptance under contract. Acceptance tests shall consist of the following: dimensional recovery, tensile strength, ultimate elongation, heat shock, and flammability.

4.2 SAMPLING INSTRUCTIONS

4 2.1 Qualification Test Samples

Qualification test samples shall consist of six molded slabs, 6 x 6 x 0.075 $\pm$ 0.010 inches *(152 x 152 x 1.9 $\pm$ .25mm)* 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.

4.2.2 Acceptance Test Samples

Acceptance test samples shall consist of specimens cut from a molded slab 6 x 6 x 0.075 $\pm$ 0.010 inches *(152 x 152 x 1.9 $\pm$ .25 mm),* and molded components selected at random in accordance with MIL-STD-105, Inspection Level S-2, AQL 6.5 percent. 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. 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 TEST PROCEDURES

4.3.1 Dimensional Recovery

Samples of molded components, as supplied, shall be measured for dimensions in accordance with ASTM D 2671. The samples then shall be conditioned for 10 minutes in a 150 $\pm$ 2 °C (302 $\pm$ 4°F) oven, or equivalent, cooled to room temperature and remeasured.

4.3.2 Elastic Memory

A 6 x 1/8-inch *(152 x 3.2-mm)* specimen cut from a molded slab shall be marked with two parallel gage lines 1 inch *(25 mm)* apart in the central portion of the specimen. The distance between gage lines shall be recorded as the original length. A 2-inch *(51-mm)* portion of the specimen including both gage lines then shall be heated for 1 minute in a 150 ± 2°C *(302 ± 4°F)* oven, or equivalent, removed from the oven and stretched within 10 seconds, until the gage lines are 4 inches *(102 mm)* apart. The extended specimen shall be cooled to room temperature and released from tension. After 24 hours 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 minute in a 150 ± 2 °C *(302 ± 4°F)* oven, or equivalent, and the distance between gage lines then shall be measured and recorded as the retracted length.

Expansion and retraction shall be calculated as follows:

$$E = \frac{L\,e - Lo}{Lo} \times 100$$

$$R = \frac{L\,e - Lr}{Le - Lo} \times 100$$

Where: E = Expansion (percent)

R = Retraction (percent)

Lo= Original Length (inches) *(mm)*

Le= Extended Length inches *(mm)*

Lr = Retracted Length (inches) *(mm)*

4.3.3 Tensile Strength and Ultimate Elongation

Three specimens cut from a molded slab using Die D of ASTM D 412 shall be tested for tensile strength and ultimate elongation in accordance with ASTM D 412.

4.3.4 Low Temperature Flexibility

Three 6 x 1/4-inch *(152 x 6.3-mm)* specimens cut from a molded slab shall be conditioned, along with a 1 1/8-inch *(28.5-mm)* mandrel, in a cold chamber at -55 ± 2°C *(-67 ±4°F)* for 4 hours. After completion of the conditioning, and while still in the cold chamber, each specimen shall be bent around the mandrel through not tess than 360 degrees *(6.28 rads)* within 10 ± 2 seconds. The specimens then shall be visually examined for cracks.

4.3.5 Heat Shock

Three 6 x 1/4-inch *(152 x 6.3-mm)* specimens cut from a molded slab shall be conditioned for 4 hours in a 225 ± 5 °C *(437 ± 9°F)* mechanical convection oven with an air velocity of from 100 to 200 feet per minute past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and bent through 360 degrees *(6.38 rads)* over a 3/8-inch *(9.5-mm)* diameter mandrel. The specimens then shall be visually examined for evidence of dripping, flowing or cracking.

4.3.6 Heat Aging

Three specimens, prepared and measured in accordance with 4.3.3 shall be conditioned for 168 hours in a 175 ± 5 °C *(347 ± 9°F)* mechanical convection oven with an air velocity of 100 to 200 feet per minute past the specimens. After conditioning, the specimens shall be removed from the oven, cooled to room temperature, and tested for tensile strength and ultimate elongation in accordance with 4.3.3.

4.3.7 Corrosive Effect

Three 1 x 1/4-inch *(25.4 x 6.3-mm)* specimens cut from a molded slab shall be tested for corrosive effect in accordance with ASTM D 2671, Procedure A. The specimens shall be conditioned for 16 hours at 175 ± 3°C *(347 ± 5°F).*

4.3.8 Fluid Resistance

Three specimens prepared and measured in accordance with 4.3.3 shall be completely immersed in each of the test fluids listed in Table I for 24 hours at 25 ± 3 °C *(77 ±5* °F). The volume of the fluid shall be not less than 20 times that of the specimens. After conditioning, the specimens shall be lightly wiped and then air-dried for 30 to 60 minutes at room temperature. The specimens then shall be tested for tensile strength and ultimate elongation in accordance with 4.3 .3.

4.4 REJECTION AND RETEST

Failure of any sample to comply with any one of the requirements of this specification shall be cause for rejection of the lot represented. Material which has been rejected may be replaced or reworked to correct the defect and then resubmitted for acceptance. Before resubmitting, full particulars concerning the rejection and the action taken to correct the defect shall be furnished to the inspector.

5. PREPARATION FOR DELIVERY

5.1 PACKAGING

Packaging of molded components shall be in accordance with good commercial practice. The shipping container shall be not less than 125 pound test fiberboard.

5.2 MARKING

Each molded component shall be distinctly identified with the manufacturing name or symbol and the manufacturer's part number.

TABLE 1
Requirements

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
PHYSICAL			
Dimensions	Inches *(mm)*	In accordance with applicable specification control drawing	Section 4.3.1 ASTM D 2671
Dimensional Recovery	Inches *(mm)*	In accordance with applicable specification control drawing	
Elastic Memory	Percent	275 minimum expansion 93 minimum retraction	Section 4.3.2
Tensile Strength	psi *(MPa)*	1500 minimum *(10.3)*	Section 4.3.3
Ultimate Elongation	Percent	250 minimum	ASTM D 412
Stiffness	psi *(MPa)*	10,000 minimum *(68.9)* 25,000 maximum *(172)*	ASTM D 747
Specific Gravity	---	1.40 maximum	ASTM D 792
Hardness	Shore D	45 ± 5	ASTM D 2240
Low Temperature Flexibility 4 hours at -55ºC *(-67ºF)*	---	No cracking	Section 4.3.4
Heat Shock 4 hours at 225ºC *(437ºF)*	---	No dripping, flowing o cracking.	Section 4.3.5
Heat Aging 168hours at 175ºC *(347ºF)* Followed by tests for:	---	---	Section 4.3.6
Tensile Strength	psi *(MPa)*	1200 minimum *(8.3)*	Section 4.3.3
Ultimate Elongation	Percent	200 minimum	
ELECTRICAL Dielectric Strength	Volts/mil *(kV/mm)*	200 minimum *(7.9)*	ASTM D 149
Volume Resistivity	ohm-cm	10^{14} minimum	ASTM D 257
CHEMICAL Corrosive Effect 16 hours at 175ºC *(347ºF)*	---	Noncorrosive	Section 4.3.7 ASTM D 2671 Procedure A
Flammability			ASTM D 635
Average Time of Burning	Seconds	150 maximum	
Average Extent of Burning	Inches *(mm)*	1 maximum *(25)*	
Fungus Resistance	---	Rating of 1 or less	ASTM G 21
Water Absorption 24 hours at 23ºC *(73ºF)*	Percent	0.5 maximum	ASTM D 570
Fluid Resistance 24 hours at 23ºC *(73ºF)* in: JP-4 Fuel (MIL-T-5624) Skydrol* 500 Hydraulic Fluid (MIL-H-5606) Aviation Gasoline (100/130) (MIL-G-5572) Water Followed by tests for:	---	---	Section 4.3.8
Tensile Strength	psi *(MPa)*	1200 minimum *(8.3)*	Section 4.3.3
Ultimate Elongation	Percent	200 minimum	

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