Tyco Electronics Corporation
300 Constitutional Drive
Menlo Park, CA 94025 USA

Raychem

Specification	**RT-1325**
This Issue:	Issue 6
Date:	February 23, 2001
Replaces:	Issue 5

THERMOFIT® ELASTOMERIC MOLDED COMPONENTS
Flame-Retarded, Semi-Rigid, Heat-Shrinkable

1. SCOPE

This specification covers the requirements for one type of flexible, electrical insulating molded component whose expanded dimensions will reduce to a predetermined size upon the application of heat in excess of 175°C *(347°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

Federal

P-C-437	Cleaning Compound, High Pressure (Steam) Cleaner
VV-F-800	Diesel Fuel

Military

MIL-G-3056	Gasoline, Automotive, Combat
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-PRF-6083	Hydraulic Fluid, Petroleum Base, for Preservation and Operation
MIL-A-8243	Anti-Icing and Deicing-Defrosting Fluid
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-H-46170	Hydraulic Fluid, Rust Inhibited Fire Resistant, Synthetic Hydrocarbon Base
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 Materials
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 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 form 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 elastomeric 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: dimensions, 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 ± 0.010 inches *(152 x 152 x 1.9 ± .25 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.

4.2.2 Acceptance Test Samples

Acceptance test samples shall consist of specimens cut from a molded slab 6 x 6 x 0.075 ± 0.010 inches *(152 x 152 x 1.9 ± .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 175 ± 2°C *(347 ± 5°F)* oven, or equivalent, cooled to room temperature and re-measured.

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 gauge lines 1 inch *(25 mm)* apart in the central portion of the specimen. The distance between gauge lines shall be recorded as the original length. A 2-inch *(51-mm)* portion of the specimen including both gauge lines then shall be heated for 1 minute in a 175 ± 2°C *(347 ± 4°F)* oven, or equivalent, removed from the oven and stretched within 10 seconds, until the gauge 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 gauge lines shall be measured and recorded as the extended length. The portion of the specimen including both gauge lines then shall be reheated for 1 minute in a 175 ± 2°C *(347 ± 4°F)* oven, or equivalent, and the distance between gauge lines then shall be measured and recorded as the retracted length.

Expansion and retraction shall be calculated as follows:

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

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

Where:
- E = Expansion (percent)
- R = Retraction (percent)
- L_o = Original Length [inches *(mm)*]
- L_e = Extended Length [inches *(mm)]*
- L_r = Retracted Length [inches *(mm)*]

4.3.3 Tensile Strength, Tensile Stress and Ultimate Elongation

Three specimens cut from a molded slab using Die D of ASTM D 412 shall be tested for tensile strength, tensile stress 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 3/8-inch *(9.5-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 less than 360 degrees 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 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 150 ± 3°C *(302 ± 5°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 Fluid Resistance

Six specimens prepared and measured in accordance with 4.3.3 shall be completely immersed in each of the test fluids listed in Table 1 for 24 hours at the temperature specified. 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 23 ± 2°C *(73 ± 4°F)* . The three specimens intended for the tensile strength and elongation tests shall then be tested for tensile strength and ultimate elongation in accordance with 4.3.3. The other three specimens shall be weighed before and after immersion and the weight change calculated as a percent.

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 them 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 on the part and/or package with the manufacturing name or symbol, the manufacturer's part number, lot number, date of manufacture, and use before date.

.

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	200 minimum expansion 90 minimum retraction	Section 4.3.2
Tensile Strength	psi *(MPa)*	1500 minimum *(10.3)*	Section 4.3.3
Tensile Stress @100% Elongation	psi *(MPa)*	1500 maximum *(10.3)*	
Ultimate Elongation	Percent	350 minimum	ASTM D 412
Specific Gravity	---	1.40 maximum	ASTM D 792
Hardness	Shore D	45 + 10	ASTM D 2240
Low Temperature Flexibility 4 hours at -55°C *(-67°F)*		No cracking	Section 4.3.4
Heat Shock 4 hours at 225°C *(437°F)*	---	No dripping, flowing or cracking	Section 4.3.5
Heat Aging 168 hours at 150°C *(302°F)* Followed by tests for:	---	---	Section 4.3.6
Tensile Strength	psi *(MPa)*	1200 minimum *(8.3)*	Section 4.3.3
Elongation	Percent	300 minimum	
ELECTRICAL Dielectric Strength	Volts/mil *(kV/mm)*	300 minimum *(11.8)*	ASTM D 149
Volume Resistivity	ohm-cm	10^{12} minimum	ASTM D 257
CHEMICAL Corrosive Effect 16 hours at 150°C *(302°F)*	---	Noncorrosive	Section 4.3.7 ASTM D 2671 Procedure A
Flammability Average Time of Burning	Seconds	120 maximum	ASTM D 635
Average Extent of Burning	Inches *(mm)*	1.0 maximum *(25)*	
Fungus Resistance	---	Rating of 1 or less	ASTM G 21
Fluid Resistance 24 hours at 25 ± 3°C *(77 ± 5°F)* in: JP-4 Fuel (MIL-T-5624) Hydraulic Fluid (MIL-H-5606) Defrosting Fluid (MIL-A-8243) Lubricating Oil (MIL-L-23699) Cleaning Compound (P-C-437) Water Followed by tests for:	---	---	Section 4.3.8
Tensile Strength	psi *(MPa)*	1000 minimum *(6.9)*	Section 4.3.3
Ultimate Elongation	percent	200 minimum	
Weight Increase	percent	8 maximum	Section 4.3.8

TABLE 1
Requirements

CHEMICAL (Continued) Fluid Resistance 24 hours at 50 ± 3°C *(122 ± 5°F)* in: DF-2 (VV-F-800) JP-4 Fuel (MIL-T-5624) Followed by tests for:	---	---	Section 4.3.8
Tensile Strength	psi *(MPa)*	1000 minimum *(6.9)*	Section 4.3.3
Ultimate Elongation	percent	200 minimum	
Weight Increase	percent	15 maximum	Section 4.3.8
Fluid Resistance 24 hours at 71 ± 3°C *(160 ± 5°F)* in: Hydraulic Fluid (MIL-PRF-6083) Hydraulic Fluid (MIL-H-46170)	---	---	Section 4.3.8
Followed by tests for:			
Tensile Strength	psi *(MPa)*	1000 minimum *(6.9)*	Section 4.3.3
Ultimate Elongation	percent	200 minimum	
Weight Increase	percent	25 maximum	Section 4.3.8

.