



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

**Raychem**

Specification  
This Issue:  
Date:  
Replaces:

**RT-770\_Type-II**  
Issue 3  
November 10, 2009  
Issue 2

**Raychem RT-770 Type II, Molded Components  
Nuclear, Biological, Chemical Contamination Survivable  
Modified Fluoropolymer, Radiation Crosslinked, Heat Shrinkable**

**1. SCOPE**

This specification covers the requirements for a type of electrically insulating molded component (material code -770) whose dimensions will reduce to a predetermined size upon the application of heat in excess of 150°C (302°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-PRF-372	Bore Cleaner
SAE-AMS1424	Deicing fluid (formerly MIL-A-8243)
MIL-PRF-2104	Lubricating Oil, Internal Combustion Engine, Heavy Duty
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-46167	Arctic Lube
MIL-PRF-46170	Hydraulic Fluid, Rust Inhibited, Fire-resistance, Synthetic Hydrocarbon Base
MIL-DTL-83133	Turbine Fuel, Aviation, Grade JP-8

Federal

A-A-52557A	Fuel Oil, Diesel DF-2
A-A-59133	Cleaning Compound, High Pressure (Steam) Cleaner (formerly P-C-437)

Ordnance Drawings

10873919	Electrolyte
----------	-------------

\* Raychem RT-770 Type II is a trade mark of Tyco Electronics/Raychem

## 2.2 OTHER PUBLICATIONS

### American Society for Testing and Materials (ASTM)

ASTM G 21	Standard Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM D 149	Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
ASTM D 412	Standard Methods of Test for Rubber Properties in Tension
ASTM D 570	Standard Methods of Test for Water Absorptions of Plastics
ASTM D 632	Standard Specification for Sodium Chloride
ASTM D 792	Specific Gravity & Density of Plastics by Displacement, Tests for
ASTM D 910	Standard Specification for Gasoline
ASTM D 1876	Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D 2671	Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use

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

### Tyco Electronics Corporation

RT-700	700 Series Harness Component Performance Specification
RT-1012	Epoxy, Flexible, Two-part, Raychem Type S1264

## 3. REQUIREMENTS

### 3.1 MATERIAL

The molded components shall be fabricated from a crosslinked, thermally stabilized, flame-retardant, modified fluoropolymer composition. They shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, 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.

### 3.4 SYSTEM PERFORMANCE

The performance of harness systems fabricated with this material shall satisfy the requirements of Raychem RT-700.

## 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

## 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 required. 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. 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 200 ± 5°C (392 ± 9°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 (100 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, cooled to room temperature 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<sub>o</sub> = Original Length [inches (mm)]
- L<sub>e</sub> = Extended Length [inches (mm)]
- L<sub>r</sub> = 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. A 1 inch (25 mm) bench mark, 2 inch (51 mm) initial jaw separation and a jaw separation speed of 2.0 ± 0.2 inches (51 ± 5 mm) per minute shall be used.

**4.3.4 Secant Modulus**

Three die-cut strips, 6 x 1/4 inch (*152 x 6.3 mm*), cut from a slab, shall be tested in accordance with ASTM D 882, using Method A at 2% strain. A 5 inch (*127 mm*) jaw separation and a jaw separation speed of 0.5 inches (*12.5 mm*) per minute shall be used.

**4.3.5 Low Temperature Flexibility**

Three 6 x 1/4 inch (*152 x 6.3 mm*) specimens cut from a slab shall be conditioned, along with a 1 inch (*25 mm*) mandrel, in a cold chamber at  $-55 \pm 2^{\circ}\text{C}$  ( $-67 \pm 4^{\circ}\text{F}$ ) for 4 hours. After completion of the conditioning and while still in the cold chamber, each specimen shall be bent around the mandrel through no less than 360 degrees within  $10 \pm 2$  seconds. The specimens then shall be visually examined for cracks.

**4.3.6 Heat Shock**

Three 6 x 1/4 inch (*152 x 6.3 mm*) specimens cut from a molded slab. They shall be conditioned for 4 hours in a  $225 \pm 5^{\circ}\text{C}$  ( $437 \pm 9^{\circ}\text{F}$ ) mechanical convection oven with an air velocity of from 100 to 200 feet (*30 to 60 m*) per minute past the specimens. After conditioning, the specimens shall be removed from the oven and cooled to room temperature. The specimens then shall be visually examined for evidence of dripping, flowing or cracking.

**4.3.7 Heat Resistance**

Three specimens, prepared and measured in accordance with 4.3.1, shall be conditioned for 336 hours in a  $175 \pm 5^{\circ}\text{C}$  ( $347 \pm 9^{\circ}\text{F}$ ) mechanical convection oven in which air passes the specimens at a velocity of 100 to 200 feet (*30 to 60 m*) per minute. After conditioning, the specimens shall be removed from the oven, cooled to room temperature and tested for ultimate elongation in accordance with 4.3.3.

**4.3.8 Corrosive Effect - Copper Mirror**

Three 1 x 1/4 inch (*25 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  $175 \pm 3^{\circ}\text{C}$  ( $347 \pm 5^{\circ}\text{F}$ ).

**4.3.9 Fluid Resistance**

Three Die D (of ASTM D 412) specimens shall be prepared and measured in accordance with 4.3.1 for each of the fluids listed in Table 1. Three specimens of each configuration shall be immersed in each of the fluids for the time and temperatures specified in Table 1. The volume of the fluid shall not be less than 20 times that of the specimens. After immersion, all the specimens shall be lightly wiped and air dried for 30 to 60 minutes at room temperature. The three specimens shall be weighed and the weight change calculated as a percentage. They shall then be tested for tensile and elongation in accordance with 4.3.3.

**4.3.10**     Flammability

Prepare the specimen for the horizontal burn test in accordance with ASTM D 635-98. Report results in accordance with ASTM D 635-98. Additionally, if the flame front fails to reach the 25 mm mark, record the average total time to self-extinguish the flame and glow of the specimen [ (t-30) / number of specimens] and the average total distance charred by the flame, measured from the 100 mm mark on the specimen, subtracting the measurement from 100 to get the resulting burned length. A passing result is automatically achieved when the flame self extinguishes prior to reaching the 25 mm mark.

**4.3.11**     Radiation Resistance

Three specimens prepared in accordance with Section 4.3.3 shall be subjected to gamma radiation for a total dosage of 10 Mrad at a rate of less than 0.5 Mrad per hour. The specimens shall be measured for tensile strength and ultimate elongation in accordance with Section 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 the cause for rejection of the lot represented. Material that has been rejected may be replaced or reworked to correct the defect and then resubmitted for acceptance. Before resubmitting, full details concerning the rejection and the action taken to correct the defect shall be furnished to the inspector.

**5.            PREPARATION FOR DELIVERY****5.1**            **PACKAGING**

If not specified, packaging of molded components shall be in accordance with good commercial practice.

**5.2**            **MARKING**

Each molded component shall be distinctly identified on the part or package with the manufacturer's name or symbol, the manufacturer's part number, date of manufacture and lot number.

**TABLE 1**  
**Requirements**

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
		TYPE II (-770 ) Molded Components	
<b>PHYSICAL</b> Dimensions	inches ( <i>mm</i> )	In accordance with applicable specification control drawing.	Section 4.3.1 ASTM D 2671
Dimensional Recovery	inches ( <i>mm</i> )	In accordance with applicable specification control drawing.	
Elastic Memory expansion retraction	Percent	275 minimum	Section 4.3.2
	Percent	90 minimum	
Tensile Strength	psi ( <i>MPa</i> )	2500 (17.2) minimum	Section 4.3.3 ASTM D 412
Ultimate Elongation	Percent	300 minimum	
Secant Modulus, 2%	psi ( <i>MPa</i> )	100,000 (689) maximum	Section 4.3.4 ASTM D 882
Specific Gravity	---	1.85 maximum	ASTM D 792
Low Temperature Flexibility 4 hours at $-55 \pm 3^{\circ}\text{C}$ ( $-65 \pm 5^{\circ}\text{F}$ )	--	No cracking	Section 4.3.5
Heat Shock 4 hours at $225 \pm 5^{\circ}\text{C}$ ( $437 \pm 9^{\circ}\text{F}$ )	---	No dripping, flowing or cracking.	Section 4.3.6
Heat Resistance 336 hours at $175 \pm 3^{\circ}\text{C}$ ( $347 \pm 5^{\circ}\text{F}$ ) Followed by tests for Tensile Ultimate Elongation	---	---	Section 4.3.7 Section 4.3.3
	psi ( <i>MPa</i> ) percent	2000 (13.8) minimum 250 minimum	
<b>ELECTRICAL</b> Dielectric Strength	Volts/mil ( <i>kV/mm</i> )	400 (15.8) minimum	ASTM D 149
Volume Resistivity	ohm-cm	$1 \times 10^{11}$ minimum	ASTM D 257
<b>CHEMICAL</b> Copper Mirror Corrosion 16 hours at $175 \pm 3^{\circ}\text{C}$ ( $347 \pm 5^{\circ}\text{F}$ )	---	Noncorrosive	Section 4.3.8 ASTM D 2671 Procedure A
Flammability Average Time of Burn/Glow Average Extent of Burning, (from end of specimen)	Seconds	15	ASTM D 635-98 Section 4.3.10
	inches ( <i>mm</i> )	1 (25) maximum	
Fungus Resistance	---	Rating of 1 or less	ASTM G 21
Water Absorption 24 hours at $23 \pm 2^{\circ}\text{C}$ ( $73 \pm 4^{\circ}\text{F}$ )	Percent	0.5 maximum	ASTM D 570

**TABLE 1**  
**Requirements**  
(continued)

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
		TYPE II (-770) Molded components	
<p><b>CHEMICAL</b> (continued)</p> <p>Fluid Resistance  <u>24 hours at 23 ± 3°C (73 ± 5°F)</u>            a) JP-8 Jet Fuel (MIL-DTL-83133)            b) Diesel Fuel DF-2 (A-A-52557A)            Followed by tests for:            Tensile Strength            Ultimate Elongation            Weight Increase</p> <p><u>24 hours at 50 ± 3°C (122 ± 5°F)</u>            a) Bore Cleaner (MIL-PRF-372)            b) Anti-Icing Fluid (SAE AMS 1424)            c) Salt-5% solution (ASTM D632)            d) Lubricating Oil (MIL-PRF-2104)            e) Lubricating Oil (MIL-PRF-23699)            f) Arctic Lube (MIL-PRF-46167)            g) Cleaning Compound (A-A-59133)            h) Electrolyte (p/n 10873919)</p> <p>Followed by tests for:            Tensile Strength            Ultimate Elongation            Weight Increase</p> <p><u>24 hours at 71 ± 3°C (160 ± 5°F)</u>            Hydraulic, synthetic, (MIL-PRF-46170)</p> <p>Followed by tests for:            Tensile Strength            Ultimate Elongation            Weight Increase</p>	<p>psi (<i>Mpa</i>)            Percent            Percent</p> <p>psi (<i>MPa</i>)            Percent            Percent</p> <p>psi (<i>MPa</i>)            Percent            Percent</p>	<p>2000 (13.8) minimum            250 minimum            3 maximum</p> <p>2000 (13.8) minimum            250 minimum            3 maximum</p> <p>2000 (13.8) minimum            250 minimum            3 maximum</p>	<p>Section 4.3.9</p>
<p><b>NUCLEAR</b></p> <p>Radiation Resistance-10 Mrads total            Followed by tests for:            Tensile Strength            Ultimate Elongation</p>	<p>psi (<i>MPa</i>)            percent</p>	<p>2000 (13.8) minimum            150 minimum</p>	<p>Section 4.3.11            Section 4.3.3</p>