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Raychem

Specification

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**Raychem RT-780 Type II, Molded Components
Nuclear, Biological, Chemical Contamination Survivable
Modified Fluoropolymer, Radiation Crosslinked, Flexible, Heat Shrinkable**

1. SCOPE

This specification covers the requirements for a type of electrically insulating molded component whose dimensions will reduce to a predetermined size upon the application of heat in excess of 180°C (356°F). The material is suitable for use in wire harness systems requiring resistance to the effects of nuclear, biological and chemical contamination and decontamination using solution of STB as defined herein and in RT-700.

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-AMS-1424	Deicing/Anti-Icing Fluid, Aircraft, SAE Type I (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	Lubricating Oil, Internal Combustion Engine, Arctic
MIL-PRF-46170	Hydraulic Fluid, Rust Inhibited, Fire-resistance, Synthetic Hydrocarbon Base
MIL-DTL-83133	Turbine Fuel, Aviation, Kerosene Type, 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
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2.2 OTHER PUBLICATIONS

American Society for Testing and Materials (ASTM)

ASTM D149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.

ASTM D412 Standard Methods of Test for Rubber Properties in Tension

ASTM D570 Standard Methods of Test for Water Absorption of Plastics

ASTM D632 Standard Specification for Sodium Chloride

ASTM D792 Specific Gravity & Density of Plastics by Displacement, Tests for

ASTM D910 Standard Specification for Gasoline

ASTM D1876 Test Method for Peel Resistance of Adhesives (T-Peel Test)

ASTM D2671 Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use

ASTM G21 Standard 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.)

Tyco Electronics Corporation

RT-700 700 Series Harness Component Performance Specification

RT-1014 S1255-04 One-part Tape Epoxy, Flexible

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 1.91 ± .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 1.91 ± .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 D2671. The samples then shall be conditioned for 10 minutes in a 250 ± 5°C (482 ± 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 250 ± 5°C (482 ± 9°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 250 ± 5°C (482 ± 9°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_o = Original Length [inches (mm)]
- L_e = Extended Length [inches (mm)]
- L_r = 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 ± 3°C (-67 ± 5°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.

4.3.6 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 $275 \pm 5^{\circ}\text{C}$ ($527 \pm 9^{\circ}\text{F}$) 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 $200 \pm 5^{\circ}\text{C}$ ($392 \pm 9^{\circ}\text{F}$) 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 1/4 x 1 inch (*6 x 25 mm*) specimens cut longitudinally from a molded slab shall be tested for copper mirror corrosion in accordance with ASTM D 2671, Procedure A, for 16 hours at $175 \pm 2^{\circ}\text{C}$ ($347 \pm 4^{\circ}\text{F}$). Evidence of corrosion shall be the removal of copper from the mirror, leaving an area of transparency greater than 5 percent of its total area.

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. Additionally, if the flame front fails to reach the 25mm 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 4.3.1 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 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 (-780) Molded Components	
PHYSICAL Dimensions	inches (<i>mm</i>)	In accordance with applicable specification control drawing.	Section 4.3.1 ASTM D2671
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>)	3000 (20.7) minimum	Section 4.3.3
Ultimate Elongation	Percent	300 minimum	ASTM D412
Secant Modulus, 2%	psi (<i>MPa</i>)	50,000 (345) maximum	Section 4.3.4 ASTM D882
Specific Gravity	---	2.0 maximum	ASTM D792
Low Temperature Flexibility 4 hours at $-55 \pm 3^{\circ}\text{C}$ ($-67 \pm 5^{\circ}\text{F}$)	---	No cracking	Section 4.3.5
Heat Shock 4 hours at $275 \pm 5^{\circ}\text{C}$ ($527 \pm 9^{\circ}\text{F}$)	---	No dripping, flowing or cracking.	Section 4.3.6
Heat Resistance 336 hours at $200 \pm 3^{\circ}\text{C}$ ($392 \pm 5^{\circ}\text{F}$) Followed by tests for Tensile Strength Ultimate Elongation	---	---	Section 4.3.7
	psi (<i>MPa</i>) percent	2000 (13.8) minimum 250 minimum	Section 4.3.3 Section 4.3.3
ELECTRICAL Dielectric Strength	Volts/mil (<i>kV/mm</i>)	200 (7.9) minimum	ASTM D149
Volume Resistivity	ohm-cm	1×10^{11} minimum	ASTM D257
CHEMICAL Copper Mirror Corrosion 16 hours at $175 \pm 3^{\circ}\text{C}$ ($347 \pm 5^{\circ}\text{F}$)	---	Noncorrosive	Section 4.3.8 ASTM D2671 Procedure A
Fungus Resistance	---	Rating of 1 or less	ASTM G21
Water Absorption 24 hours at $23 \pm 2^{\circ}\text{C}$ ($73 \pm 4^{\circ}\text{F}$)	Percent	0.5 maximum	ASTM D570

TABLE 1
Requirements
(Continued)

PROPERTY	UNIT	REQUIREMENTS	TEST METHOD
		TYPE II (-780) Molded Components	
CHEMICAL (continued) Fluid Resistance <u>24 hours at 23 ± 2°C (73 ± 4°F)</u> JP-8 Fuel (MIL-DTL-83133) <u>24 hours at 50 ± 3°C (122 ± 5°F)</u> a) Bore Cleaner (MIL-PRF-372) b) Diesel Fuel, DF-2, A-A-52557A c) Anti-Icing Fluid (SAE-AMS-1424) d) Salt-5% solution (ASTM D632) e) Lubricating Oil (MIL-PRF-2104) f) Lubricating Oil (MIL-PRF-23699) g) Arctic Lube (MIL-PRF-46167) h) Cleaning Compound (A-A-59133) i) Electrolyte (p/n 10873919) <u>24 hours at 71 ± 2°C (160 ± 4°F)</u> Hydraulic Fluid (MIL-PRF-46170) Followed by tests for: Tensile Strength Ultimate Elongation Weight Increase	---	---	Section 4.3.9
	psi (MPa) Percent Percent	2000 (13.8) minimum 250 minimum 3 maximum	Section 4.3.3 Section 4.3.9
Flammability Average Time of Burn/Glow Average Extent of Burning, (from end of specimen.)	Seconds inches (mm)	15 1 (25)	ASTM D 635-98 Section 4.3.10
NUCLEAR Radiation Resistance Followed by tests for: Tensile Strength Ultimate Elongation	psi (MPa) percent	2000 (13.8) minimum 150 minimum	Section 4.3.11 Section 4.3.3