



# RAYCHEM RP-4800 Tubing Specification

108-120032

## Raychem RP-4800 Tubing, HIGH EXPANSION Polyolefin, Flexible, Heat Shrinkable, Flame Retarded

RP-4800 is a single walled, high-shrink-ratio, flame-retardant tubing. It is well-suited for repairing harnesses or cables, with the ability to conform to variable substrate dimensions. It has the ability to transition from larger diameters to smaller diameters by shrinking after passing the larger segment.

RP-4800 can withstand exposure to solvents including aviation fuel and hydraulic fluid, without significant degradation. It provides abrasion and fluid resistance needed in harnessing applications.

RoHS compliant.

Continuous operating temperature  $-55^{\circ}\text{C}$  to  $135^{\circ}\text{C}$  ( $-67^{\circ}\text{F}$  to  $275^{\circ}\text{F}$ ).

THIS IS A CLASS 1 DOCUMENT WHICH IS NONCONFIDENTIAL.

*The information contained within this document is the property of TE Connectivity. It is supplied in confidence and the commercial security of the contents must be maintained. It must not be used for any purpose other than that for which it is supplied nor may any information contained in it be disclosed to unauthorized persons. It must not be reproduced in whole or in part without obtaining written permission from TE Connectivity (TE).*

While TE has made every reasonable effort to ensure the accuracy of the information in this catalog, TE does not guarantee that it is error-free, nor does TE make any other representation, warranty or guarantee that the information is accurate, correct, reliable or current. TE reserves the right to make any adjustments to the information contained herein at any time without notice. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. The dimensions in this catalog are for reference purposes only and are subject to change without notice. Specifications are subject to change without notice. Consult TE for the latest dimensions and design specifications.

\*Trademark. TE Connectivity, TE connectivity (logo), and TE (logo) are trademarks. Other logos, product and/or company names may be trademarks of their respective owners.



**Table of Contents**

**1. SCOPE ..... 3**

**2. APPLICABLE DOCUMENTS ..... 3**

    2.1. AMERICAN SOCIETY FOR TESTING AND MATERIAL ..... 3

    2.2. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)..... 3

    2.3. MILITARY DOCUMENTS..... 3

    2.4. OTHER DOCUMENTS..... 3

**3. REQUIREMENTS .....4**

    3.1 MATERIALS ..... 4

    3.2 PROPERTIES ..... 4

**4. QUALITY ASSURANCE PROVISIONS ..... 4**

    4.1 CLASSIFICATION OF TESTS ..... 4

        4.1.1 Qualification Tests ..... 4

        4.1.2 Acceptance Tests ..... 4

    4.2 SAMPLING INSTRUCTIONS ..... 4

        4.2.1 Qualification Test Samples ..... 4

        4.2.2 Acceptance Test Samples ..... 5

        4.2.3 Lot Formation ..... 5

    4.3 TEST PROCEDURES ..... 5

        4.3.1 Dimensions and Longitudinal Change ..... 5

        4.3.2 Tensile Strength and Ultimate Elongation ..... 5

        4.3.3 Secant Modulus..... 6

        4.3.4 Low Temperature Flexibility ..... 6

        4.3.5 Heat Shock..... 6

        4.3.6 Heat Resistance ..... 6

        4.3.7 Copper Stability..... 6

        4.3.8 Dielectric Strength..... 6

        4.3.9 Corrosive Effect..... 6

            4.3.9.1 Copper Mirror Corrosion..... 7

            4.3.9.2 Corrosion in Contact with Copper..... 7

        4.3.10 Flammability..... 7

        4.3.11 Fluid Resistance..... 7

    4.4 REJECTION AND RETEST ..... 7

**5. PREPARATION FOR DELIVERY .....7**

    5.1 FORM ..... 7

    5.2 PACKAGING ..... 7

    5.3 MARKING ..... 8

**APPENDIX ..... 8**

**TABLE 1 REQUIREMENTS..... 8**



## 1. SCOPE

This specification covers the requirements for one type of flexible, electrical insulating, extruded tubing diameter that will reduce to a predetermined size upon the application of heat in excess of 121°C (250°F).

### 1.1. FORM

The tubing shall be flame retarded and shall be black unless otherwise specified.

## 2. APPLICABLE DOCUMENTS

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

### 2.1. AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM D910 Standard Specification for Leaded Aviation Gasolines  
ASTM D2671 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 or via the ASTM website at <http://www.astm.org>).

### 2.2. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 846 Plastics-Evaluation of the action of microorganisms

(Copies of ISO publications may be obtained from the International Organization for Standardization, 1, rue de Varembé, CH-1211 Geneva 20, Switzerland or via the ISO website at <http://www.iso.ch/iso/en/ISOOnline.frontpage>)

### 2.3. MILITARY DOCUMENTS

MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene type, JP-8, NATO F-35, and JP-8+100  
MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance

(Copies of Military documents are available online at <http://quicksearch.dla.mil>.)

### 2.4. OTHER DOCUMENTS

RP-4800 SCD RAYCHEM RP-4800 Tubing SCD



### 3. REQUIREMENTS

#### 3.1. MATERIALS

The tubing shall be fabricated from thermally stabilized, modified polyolefin and shall be crosslinked by irradiation. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks, and inclusions.

#### 3.2. PROPERTIES

The tubing 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 tubing submitted for qualification as a satisfactory product and shall consist of all tests listed in this specification.

##### 4.1.2. Acceptance Tests

Acceptance tests are those performed on tubing submitted for acceptance under contract. Acceptance tests shall be:

Dimensions  
Longitudinal Change  
Tensile Strength  
Ultimate Elongation  
Secant Modulus  
Flammability  
Heat Shock

Statistical process control data may be used to demonstrate conformance for dimensions. Acceptance tests shall consist of:

#### 4.2. SAMPLING INSTRUCTIONS

##### 4.2.1. Qualification Test Samples

Qualification test samples shall consist of 50 feet (15 m) of black tubing and white tubing for all other colors. Qualification of any size within each size range specified below shall qualify all sizes within that size range.

##### **Range of Sizes**

9.53mm (3/8") through 25.4mm (1")  
38.1mm (1-1/2") through 101.6mm (4")



For the following property tests: Color stability, Specific gravity, Fungus resistance, and Volume resistivity, one size within the size range 9.53mm (3/8") through 25.4mm (1") shall qualify all sizes.

4.2.2. Acceptance Test Samples

Acceptance test samples shall consist of not less than 5 m (16 feet) of tubing selected at random from each compound batch or the first sleeving production lot of the batch compound. Physical property tests performed at this time qualify subsequent sleeving lots produced from the same compound batch.

4.2.3. Lot Formation

A lot shall consist of all tubing of the same size, from the same production run, and offered for inspection at the same time.

4.3. TEST PROCEDURES

Dimensions can be found in RP-4800 SCD or the specific drawing for the numbered size.

Unless otherwise specified, perform tests on specimens which have been fully recovered by conditioning for 3 minutes in a  $200 \pm 5^\circ\text{C}$  ( $392 \pm 9^\circ\text{F}$ ) oven. Condition the test specimens (and measurement gauges, when applicable) for 3 hours at  $23 \pm 3^\circ\text{C}$  ( $73 \pm 5^\circ\text{F}$ ) and  $50 \pm 5$  percent relative humidity prior to all testing. Use mechanical convection type ovens in which air passes the specimens at a velocity of 30 to 60 m (100 to 200 feet) per minute.

4.3.1. Dimensions and Longitudinal Change

Measure three 6-inch (150 mm) specimens of tubing, as supplied, for length  $\pm 1$  mm ( $\pm 1/32$  inch), and inside diameter in accordance with ASTM D 2671. Condition the specimens for 3 minutes in a  $200 \pm 5^\circ\text{C}$  ( $392 \pm 9^\circ\text{F}$ ) oven, cool to  $23 \pm 3^\circ\text{C}$  ( $73 \pm 5^\circ\text{F}$ ) and then remeasure. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with TEC-108-120032 RP-4800 SCD and the longitudinal change shall be in accordance with Table 1.

Calculate the longitudinal change as follows:

$$LC = ((L_1 - L_0) / L_0) \times 100$$

Where: LC = Longitudinal Change [percent]  
L<sub>0</sub> = Length Before Conditioning [inches (mm)]  
L<sub>1</sub> = Length After Conditioning [inches (mm)]

4.3.2. Tensile Strength and Ultimate Elongation

Determine the tensile strength and ultimate elongation of the tubing in accordance with ASTM D 2671 using 25-mm (1-inch) bench marks, a 25-mm (1-inch) initial jaw separation (can be greater if a extensometer is used), and jaw separation speed of  $500 \pm 50$  mm ( $20 \pm 2$  inches) per minute.



4.3.3. Secant Modulus

The secant modulus of the expanded tubing shall be tested in accordance with ASTM D 2671. In initial jaw separation shall be 10 inches (250 mm).

4.3.4. Low Temperature Flexibility

Three 300 mm (12-inch) by 6 mm (1/4 inch) strips cut from the tubing and a 7/16-inch mandrel shall be conditioned for 4 hours at  $-55 \pm 2$  °C ( $-67 \pm 4$  °F). While at this same temperature, the specimens then shall be wrapped around the mandrel for not less than 360 ° in  $10 \pm 2$  seconds. The specimens then shall be visually examined for evidence of cracking.

4.3.5. Heat Shock

Three 300 mm (12-inch) by 6 mm (1/4 inch) strips cut from the tubing shall be conditioned for 4 hours in a  $250 \pm 5$  °C ( $482 \pm 9$  °F) oven. After this conditioning, the specimens shall be removed from the oven, cooled to  $23 \pm 3$  °C ( $73 \pm 5$  °F), wrapped 180 ° around a 7/16-inch mandrel in approximately 2 seconds, and then visually examined for evidence of dripping, flowing, or cracking.

4.3.6. Heat Resistance

Three specimens of tubing prepared in accordance with ASTM D 2671, shall be conditioned for 168 hours in a  $175 \pm 3$  °C ( $347 \pm 5$  °F) oven. After conditioning, the specimens shall be removed from the oven, cooled to  $23 \pm 3$  °C ( $73 \pm 5$  °F) and tested for elongation in accordance with 4.3.2.

4.3.7. Copper Stability

A 150 mm (6-inch) specimen of tubing shall be slid over a snug fitting, straight, clean, bare, solid or tubular copper conductor. The specimens on the conductor shall be conditioned for 24 hours in a desiccator or similar humidity chamber at 90 to 95 percent relative humidity and  $25 \pm 3$  °C ( $77 \pm 5$  °F). The specimens on the conductors then shall be conditioned for 168 hours in a  $160 \pm 3$  °C ( $320 \pm 5$  °F) oven. After conditioning, the specimens shall be removed from the oven and cooled to  $23 \pm 3$  °C ( $73 \pm 5$  °F). The copper conductors then shall be removed from the tubing, and the tubing and conductor shall be examined. Darkening of the copper due to normal air oxidation shall not be cause for rejection. The tubing shall be tested for elongation in accordance with 4.3.2.

4.3.8. Dielectric Strength

The dielectric strength shall be determined by following the ASTM D 2671 procedure for dielectric breakdown. When dielectric breakdown occurs the thickness measurements for calculating dielectric strength shall be made adjacent to the point of breakdown and the dielectric strength shall be calculated in volts per mil.



#### 4.3.9. Corrosive Effect

##### 4.3.9.1. Copper Mirror Corrosion

Two specimens of tubing shall be tested for copper mirror corrosion in accordance with ASTM D 2671, Method A, for 16 hours at  $175 \pm 3^{\circ}\text{C}$  ( $347 \pm 5^{\circ}\text{F}$ ). Specimens shall consist of 6 by 25 mm (*1/4 by 1 inch*) strips cut longitudinally. Evidence of corrosion shall be the removal of copper from a mirror, leaving an area of transparency greater than 5 percent of its total area

##### 4.3.9.2. Corrosion in Contact with Copper

The tubing shall be tested for corrosion in contact with copper in accordance with ASTM D 2671, Method B, for 16 hours at  $175 \pm 3^{\circ}\text{C}$  ( $347 \pm 5^{\circ}\text{F}$ ).

#### 4.3.10. Flammability

A specimen of tubing shall be recovered to an 18-inch length over a 21-inch metal rod with a diameter equivalent to the maximum recovered diameter specified in RP-4800 SCD. The specimen then shall be subjected to the vertical test in accordance with ASTM D 2671 Procedure B. Brown scorching or soot on the indicator flag shall not be cause for rejection.

#### 4.3.11. Fluid Resistance

Six specimens of tubing, prepared and measured in accordance with ASTM D 2671, shall be completely immersed in each listed fluid for  $24 \pm 2$  hours at  $25 \pm 3^{\circ}\text{C}$  ( $77 \pm 5^{\circ}\text{F}$ ). 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. Three specimens then shall be tested for dielectric strength and the other three for tensile strength.

### 4.4. REJECTION AND RETEST

Failure of any sample of tubing to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Tubing which has been rejected may be replaced or reworked to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and action taken to correct the defects shall be furnished to Quality.

## 5. PREPARATION FOR DELIVERY

### 5.1. FORM

5.1.1. The tubing shall be supplied in lengths of 1220 +25, -0 mm (*48 +1, -0 inches*) or on spools.

### 5.2. PACKAGING

5.2.1. Packaging shall be in accordance with good commercial practice.



5.3. MARKING

5.3.1. Each container of tubing shall be permanently and legibly marked with the size, quantity, manufacturer's identification, part number and lot number.

APPENDIX

TABLE 1  
REQUIREMENTS

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
<b>PHYSICAL</b>			
Dimensions	mm ( <i>inches</i> )	In accordance RP4800 SCD	Section 4.3.1 ASTM D 2671
Longitudinal Change	Percent	-10 maximum	
Tensile Strength	MPa ( <i>psi</i> )	10.3 minimum ( <i>1500</i> )	Section 4.3.2 ASTM D 2671
Ultimate Elongation	Percent	200 minimum	
Secant Modulus (Expanded)	MPa ( <i>psi</i> )	172 maximum ( <i>2.5 x 10<sup>4</sup></i> )	Section 4.3.3 ASTM D 2671
Specific Gravity	---	1.35 maximum	ASTM D 2671
Low Temperature Flexibility 4 hours at -55 ± 1°C ( <i>-67 ± 2°F</i> )	---	No cracking	Section 4.3.4
Heat Shock 4 hours at 250 ± 3°C ( <i>482 ± 5°F</i> )	---	No dripping, flowing or cracking	Section 4.3.5
Heat Resistance 168 hours at 175 ± 2°C ( <i>347 ± 4°F</i> ) Followed by test for: Ultimate Elongation	---	---	Section 4.3.6 ASTM D 2671
	Percent	150 minimum	Section 4.3.2
<b>ELECTRICAL</b>			
Dielectric Strength	Volts/mm ( <i>Volts/mil</i> )	19,680 minimum ( <i>500</i> )	Section 4.3.8 ASTM D 2671
Volume Resistivity	ohm-cm	1 x 10 <sup>14</sup> minimum	ASTM D 2671
<b>CHEMICAL</b>			
Corrosive Effect 16 hours at 175 ± 2°C ( <i>347 ± 4°F</i> )	--	No removal of copper	Section 4.3.9
Copper Stability 168 hours at 160 ± 2°C ( <i>320 ± 4°F</i> )  Followed by test for: Ultimate Elongation	---	No brittleness, glazing, cracking, or severe discoloration of tubing	Section 4.3.7
	Percent	200 minimum	Section 4.3.2
Flammability, Average time of burning	seconds	60 maximum 25%maximum flag burn	Section 4.3.10 ASTM D 2671 Procedure B
Water Absorption 24 hours at 23°C ( <i>73°F</i> )	Percent	0.5 maximum	ASTM D 2671

Requirements are continued on next page.





**TABLE 1**  
**REQUIREMENTS**  
(continued)

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
<b>CHEMICAL</b> (continued)	---	---	
Fluid Resistance			Section 4.3.11 ASTM D 2671
24 hours at 23°C (73°F) in:			
JP-8 Fuel (MIL-DTL-83133)			
Skydrol* 500			
Hydraulic Fluid (MIL-PRF-5606)			
Aviation Gasoline (100)			
(ASTM D 910)			
Water			
Followed by tests for:			
Dielectric Strength	Volts/mm (Volts/mil)	15,760 minimum (400)	
Tensile Strength	MPa (psi)	6.9 minimum (1000)	
Fungus Resistance			ISO 846 Method B
Followed by tests for:			
Tensile Strength	MPa (psi)	10.3 minimum (1500)	Section 4.3.2
Ultimate Elongation	percent	200 minimum	ASTM D 2671
Dielectric Strength	Volts/mm (Volts/mil)	19,700 minimum (500)	ASTM D 2671

\*Trademark of the Monsanto Company

**NOTE 1: Recover the specimens on the metal mandrels for 10 minutes, minimum, at 150 ± 3°C (302 ± 5°F) or until the tubing is completely shrunk on the mandrels.**