



# QS1500 Heat Shrink Tubing Specification

TEC-108-120016

## Raychem QS1500 Tubing Flame-Retardant Jacket, Adhesive-Lined, Polyolefin Heat-Shrinkable Tubing

QS1500 dual wall tubing comprises a flexible crosslinked, flame-retardant, polyolefin tubing lined with a hot-melt adhesive to provide faster installation times compared to other dual wall tubing, it is suitable for use in the automotive harness market and other harsh environments.

The QS1500 adhesive lining offers an economical and highly-effective method for permanently sealing and protecting splices, it will adhere to a wide variety of plastics, rubbers, and metals, including PVC, polyethylene, neoprene, lead, and steel. QS1500 has a 4:1 shrink ratio and is available in a comprehensive range of sizes to meet most component sealing requirements, and is compatible with a wide range of application equipment.

RoHS and REACH compliant.

Continuous operating temperature -40 to 110°C (-40 to 230°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

**3. REQUIEMENTS ..... 3**

    3.1 DIMENSIONS ..... 3

    3.2 MATERIALS ..... 3

    3.3 COLOR ..... 3

    3.4 MARKING ..... 4

    3.5 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 ..... 4

        4.2.3 Lot Formation ..... 4

    4.3 TEST PROCEDURES ..... 4

        4.3.1 Dimensions and Longitudinal Change ..... 5

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

        4.3.3 Thermal Aging..... 5

    4.4 REJECTION AND RETEST ..... 5

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

    5.1 FORM ..... 5

    5.2 PACKAGING ..... 6

    5.3 MARKING ..... 6

**APPENDIX ..... 6**

    TABLE 1 TUBING DIMENSIONS ..... 6

    TABLE 2 PROPERTIES ..... 7

    TABLE 3 MANDREL SIZES..... 7



## 1. SCOPE

This Quality Assurance Specification establishes the quality standard for QS1500. The objective of this document is to specify tests that will qualify the performance of QS1500 for protecting, insulating and sealing components in an automotive environment. This specification covers the requirements for a dual wall, flame retarded, electrically insulating, extruded tubing, whose diameter will reduce to a predetermined size upon 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 the referenced documents applies. The following documents form a part of this specification to the extent specified herein.

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

ASTM D149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D257	Standard Test Methods for DC Resistance or Conductance of Insulating Materials
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
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>).

## 3. REQUIREMENTS

### 3.1. DIMENSIONS

The dimensions shall be in accordance with Table 1.

### 3.2. MATERIALS

The tubing components shall be essentially free from pinholes, bubbles, cracks, defects and inclusions and shall be constructed as a dual walled heat shrinkable tubing having a hot melt adhesive inner wall with an outer wall of an irradiated, flame retarded polyolefin material.

### 3.3. COLOR

The jacket color shall be black or red. Inner adhesive wall shall be amber.



### 3.4. MARKING

Marking is QS-1, QS-2, QS-3, QS-4 and QS-5.

### 3.5. PROPERTIES

The tubing shall meet the requirements of Table 2.

## 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 consist of:

Dimensions  
Longitudinal Change

### 4.2. SAMPLING INSTRUCTIONS

#### 4.2.1. Qualification Test Samples

Qualification test samples shall consist of 45 m (*150 feet*) each of tubing of QS1500-1 (qualifies QS1500-1 and QS1500-2) and QS1500-3 (qualifies QS1500-3 through QS1500-5). Black qualifies all colors.

#### 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 lot of tubing or on a skip-lot basis per a statistically justified control plan determined by TE Connectivity.

#### 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

Unless otherwise specified, all tests will be performed on tubing specimens which have been recovered by conditioning for 10 minutes in a 150°C air circulating oven and then allowed to stabilize at 23±3°C for 3 hours. 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.

# QS1500 Specification



## 4.3.1. Dimensions and Longitudinal Change

Measure three 150 mm (*6 inch*) 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 with adhesive for 3 minutes in a  $200 \pm 5^\circ\text{C}$  ( $392 \pm 9^\circ\text{F}$ ) oven, cool to  $23 \pm 3^\circ\text{C}$  ( $73 \pm 5^\circ\text{F}$ ), then re-measure. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with Table 1 and the longitudinal change shall be in accordance with Table 3. Calculate the longitudinal change as follows:

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

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

Perform the tests in accordance with ASTM D2671 using a jaw separation speed of  $50 \pm 5$  mm ( $2.0 \pm 0.2$  *inches*) per minute. Calculate the tensile strength based on the wall thickness of the jacket only.

## 4.3.3. Thermal Aging

Three samples shall be conditioned for 168 hours in an air circulating oven at  $175 \pm 3^\circ\text{C}$ . After conditioning, the specimens shall be cooled to room temperature and bent through  $180^\circ$  over a mandrel selected in accordance to Table 3. Any side cracking caused by flattening of the specimen on the mandrel shall be disregarded.

## 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 cut pieces, unless otherwise specified.



- Public

5.2. PACKAGING

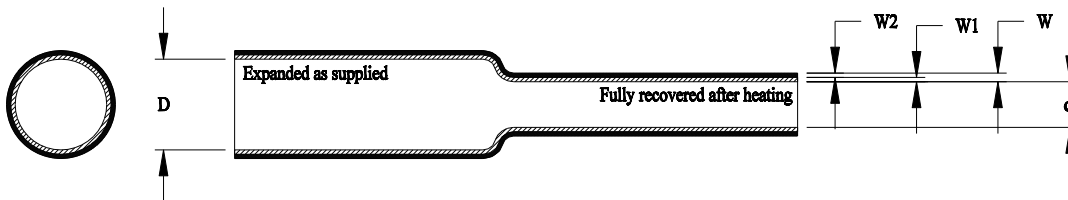
5.2.1. Packaging shall be in accordance with good commercial practice.

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  
Tubing Dimensions



Size	As Supplied		As Recovered							
	Minimum Expanded I.D. Including Core (D)		Maximum Recovered I.D. Including Core (d)		Minimum Recovered Jacket Wall (W2)		Minimum Recovered Adhesive Wall (W1)		Minimum Recovered Total Wall (W)	
	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
No. 1	5.72	0.225	1.27	0.050	0.64	0.025	0.56	0.022	1.2	0.047
No. 2	7.62	0.300	1.65	0.065	0.76	0.030	0.76	0.030	1.52	0.060
No. 3	11.55	0.455	2.41	0.095	0.89	0.035	1.02	0.040	1.91	0.075
No. 4	17.78	0.700	4.45	0.175	1.04	0.041	1.37	0.054	2.41	0.095
No. 5	27.94	1.100	7.62	0.300	1.93	0.076	1.57	0.062	3.51	0.138

Dimensions: mm (inches)



**Table 2  
Properties**

Property	Unit	Requirement	Test Method
Specific Gravity	--	1.35 maximum	ASTM D 792 Note 1
Dimensions	mm ( <i>inches</i> )	Table 1	ASTM D 2671
Longitudinal Change	Percent	0 to -10	ASTM D 2671
Tensile Strength	MPa ( <i>psi</i> )	8.7 ( <i>1,300</i> ) minimum	ASTM D 2671 Speed 2 in./min. Sec. 4.3.2
Ultimate Elongation	Percent	200 minimum	ASTM D 2671 Speed 2 in./min.
Low Temperature Flexibility -40°C	--	No Cracking	ASTM D 2671
Heat Shock 4 hrs. at 250°C	--	No Cracking	ASTM D 2671
Heat Aging, 168 hrs at 175°C	--	No Cracking	Sec 4.3.3
Dielectric Strength, (jacket only)*	Volts/mm ( <i>Volts/mil</i> )	13,800 ( <i>350</i> ) minimum	ASTM D 149
Volume Resistivity	ohm-cm	1012 minimum	ASTM D 257
Flammability	--	Self extinguishing in 1 minute	ASTM D 2671; Procedure B Mandrel size 50% of Expanded I.D.
Water Absorption	Percent	1.0 maximum	ASTM D 570, Procedure A

\* Remove adhesive manually prior to testing.

**Table 3  
Mandrel Sizes**

Recovered Tube Size "I.D."		Mandrel, O.D.	
mm	<i>inches</i>	mm	<i>inches</i>
1.19 ≤ ID < 6.35	.047 $\underline{\underline{\text{I}}}$ ID < .250	7.95	0.313
6.35 ≤ ID < 12.7	.250 $\underline{\underline{\text{I}}}$ ID $\underline{\underline{\text{I}}}$ .500	9.53	0.375
12.7 ≤ ID < 50.8	.500 $\underline{\underline{\text{I}}}$ ID $\underline{\underline{\text{I}}}$ 2.0	11.10	0.437