



RAYCHEM CRN SPECIFICATION

108-120021

Raychem RT-360 / RK 6003 CRN TUBING Semi-rigid, Flame-retardant, Polyolefin

**CRN is a semi-rigid, electrically insulating, extruded 2:1 heat shrink tubing whose diameter will reduce to a pre-determined size upon application of heat in excess of 135°C (275°F). Well suited for wire strain-relief applications and will provide mechanical protection for delicate components. CRN is flame-retardant (Type 1 only).
UL recognized (Type 1 only).
RoHS and REACH compliant.
Continuous operating temperature: -55°C to 135°C (-67°F to 275°F).**

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RT-360 / RK 6003 CRN TUBING**1. SCOPE**

This specification establishes the quality standard for CRN tubing. CRN is a semi-rigid, electrically insulating, extruded heat shrinkable tubing.

Continuous operating temperature -55°C to 135°C (-67°F to 275°F)

1.1 Type 1

Type 1 tubing shall be flame retarded and be black in colour.

1.2 Type 2

Type 2 tubing shall is not flame retarded and shall be clear.

2. REVISION HISTORY

This document replaces RT-360 issue 9 and RK-6003 revision 4

As RT-360

Revision number	Change request	Date	Incorporated By
9	Not available	24-09-2012	Not Available

As RK6003

4	CR/IND/0036 CR98-DM-0198	03-10-1996 24-09-1998	L.Abrams C.Woosnam
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As TEC-108-120021

A	Via PDM link		C.Diss

3. RELATED 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.

ASTM D882	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
ASTM D2671	Standard Test Methods for Heat Shrinkable Tubing for Electrical Use
IEC 60212	Standard Conditions for Use Prior to and During Testing of Solid Electrical Insulating Materials
IEC 60243-1	Methods of Test for Electric Strength of Solid Insulating Materials Part 1 Tests at Power Frequencies

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IEC 60243-1	Methods of Test for Electric Strength of Solid Insulating Materials part1 Tests at Power Frequencies
MIL-G-5572	Gasoline, Aviation , Grades 80/87 100/130 and 115/145
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordinance
MIL-T-83133	Turbine fuel, Aviation, grades JP-8
ISO 37	Rubber, vulcanized or thermoplastic – Determination of Tensile Stress-Strain Properties
ISO 62	Determination of Water Absorption
ISO 188	Rubber, vulcanized -Accelerated Ageing or Heat Resistance Tests
ISO 1183	Methods for determining the density and relative density of non-cellular plastics
ISO 1817	Rubber, vulcanized – Determination of the effect of liquids

4. REQUIREMENTS**4.1 COMPOSITION, APPEARANCE AND COLOUR**

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 contaminants.

4.2 PROPERTIES

The tubing shall meet the requirements of Table 3.

5. QUALITY ASSURANCE PROVISIONS**5.1 CLASSIFICATION OF TESTS**

Tests shall be carried out on a sample taken at random from each batch of finished tubing. A batch of tubing is defined as that quantity of tubing extruded at any one time. Testing frequency shall be Qualification, or Production routine as detailed below:

5.1.1 Qualification Tests (frequency in accordance with the Design Authority)

Qualification tests are those performed on tubing submitted for qualification as a satisfactory product and shall consist of all tests listed in this specification. Test samples shall consist of 15m of black and clear tubing. Qualification of any size within each range specified below shall qualify all sizes within that size range.

Range of Sizes**3/64 - 1/4****3/8 - 3/4**



5.1.2 Production routine tests (Every Batch)

Visual examination
 Dimensions
 Longitudinal change
 Tensile strength
 Ultimate elongation
 Secant modulus (Expanded)
 Flammability (Type 1 only)
 Heat shock

Production routine test samples shall consist of not less than 5m of tubing selected at random from each compound batch or the first sleeving production lot of the the batch of compound.

Physical property tests performed at this time qualify subsequent sleeving lots produced from the same compound batch.

6.0 TEST METHODS

6.1 Preparation of Test Specimens

Unless otherwise specified, tests shall be carried out on specimens of tubing recovered by conditioning in a fan assisted air circulating oven at $200 \pm 5^{\circ}\text{C}$ for 3 ± 1 minutes and allowed to cool in air to ambient temperature. Condition the test specimens (and measurement gauges where applicable) for 3 hours at $23 \pm 2^{\circ}\text{C}$ and at $50 \pm 5\%$ relative humidity prior to testing. Use mechanical convection type ovens in which air passes the specimens at a velocity of 30 to 60m per minute.

6.2 Dimensional and Longitudinal Change

The test method shall be as specified in ASTM D2671.

The length and inside diameter of three $150\text{mm} \pm 1\text{mm}$ long specimens of expanded tubing shall be measured in accordance with ASTM 2671. Condition the specimens for 3 minutes in a $200 \pm 5^{\circ}\text{C}$ oven, cool to $23 \pm 2^{\circ}\text{C}$ and re-measure. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with the TABLE 2 and the longitudinal change shall be in accordance with Table 1.

Calculate the longitudinal change as follows:

$$C = \frac{(L_1 - L_0)}{L_0} \times 100$$

Where: C = Longitudinal Change [Percent]
 L₀ = Length Before Conditioning [mm (*inch*)]
 L₁ = Length After Conditioning [mm (*inch*)]



6.3 Tensile Strength and Ultimate Elongation

The test method shall be as specified in ASTM D2671
For tubing of recovered bore greater than 4mm, five tubular specimens five type 2 dumb-bell specimens shall be tested. For tubing of recovered bore less than or equal to 4mm, five tubular specimen 125mm long shall be tested. Initial jaw separation shall be 25mm and rate of jaw separation shall be 50 ± 5 mm per minute.
The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

6.4 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 re-submitted for acceptance. Before re-submitting, full particulars concerning the previous rejection and action taken to correct the defects shall be furnished to the inspector.

7.0 Packaging

Packaging shall be in accordance with good commercial practice. Each package shall bear an identification label showing material quantity, description, size, colour and batch number. Additional information shall be supplied as specified in the contract or order



TABLE 1
Requirements

PROPERTY	TEST METHOD	REQUIREMENT	
		TYPE 1	TYPE 2
PHYSICAL			
Dimensions	mm (inches)	TABLE 2	TABLE 2
Longitudinal Change	ASTM D 2671 Section 6.2	+5 to -5%	+5 to -5%
Tensile Strength	ASTM D 2671 Section 6.3	13.8 MPa (2000psi) minimum	13.8 MPa (2000psi) minimum
Ultimate Elongation	ASTM D 2671 Section 6.3	200% minimum	200% minimum
Secant Modulus @ 2% strain (expanded)	ASTM D 2671	172 MPa (2.5 x 10 ⁴ psi) minimum	172 MPa (2.5 x 10 ⁴ psi) minimum
Specific Gravity	ISO 1183	1.35 maximum	1.0 maximum
Low Temperature Flexibility 4 hours at -55 ± 1°C (-67 ± 2°F)	Table 3 ASTM D 2671 Procedure C	No cracking	No cracking
Heat Shock 4h ± 15m at 250 ± 5°C (482 ± 5°F)	Table 3 ASTM D 2671	No dripping, cracking or flowing of outer wall, edge cracking of flatten sleeve is not cause for failure.	No dripping, cracking or flowing of outer wall, edge cracking of flatten sleeve is not cause for failure.
Heat Ageing 168 ± 2h at 175 ± 2°C (347 ± 4°F) Followed by test for: Ultimate Elongation	ASTM D 2671	150% minimum	150% minimum
ELECTRICAL			
Dielectric Strength	ASTM D 2671 Note 1	19, 680 Volts/mm (500 Volts/mil) Minimum	19, 680 Volts/mm (500 Volts/mil) Minimum



Volume resistivity	ASTM D 2671	10 ¹⁴ ohm-cm minimum	10 ¹⁶ ohm-cm minimum
PROPERTY	TEST METHOD	REQUIREMENT	
		TYPE 1	TYPE 2
CHEMICAL			
Flammability	ASTM D 2671 Procedure B	Self-extinguishing within 1 minute, 25% maximum flag burn, no falling burning particles	Not applicable
Copper Mirror Corrosion 16h ± 2h at 150 ± 3°C (302 ± 4°F)	ASTM D 2671 Procedure A	No removal of copper	No removal of copper
Copper Contact Corrosion 168 hours at 150 ± 2°C (302 ± 4°F)	ASTM D 2671 Procedure B	No pitting or blackening of copper	No pitting or blackening of copper
Fungus Resistance Followed by tests for: Tensile Strength Ultimate Elongation Dielectric Strength	ISO 846 Method B Section 6.3	13.8 MPa (2000 psi) minimum 200% minimum 19,680 Volts/mm (500 Volts/mil) minimum	13.8 MPa (2000 psi) minimum 200% minimum 19,680 Volts/mm (500 Volts/mil) minimum
Water Absorption (24 ± 2h at 23 ± 2°C) (73 ± 5°F)	ASTM D 2671	0.5% maximum	0.2% max



PROPERTY	TEST METHOD	REQUIREMENT	
		TYPE 1	TYPE 2
Fluid Resistance			
24 ± 2h immersion at 23 ± 2°C (73 ± 5°F)	ISO1817		
Gasoline Fuel to ISO 1817 Test liquid B			
Hydraulic fluid (phosphate Ester based) to ISO 1817 Test liquid 103			
Lubricating oil (Ester based) to ISO1817 Test liquid 101			
-Tensile strength - Ultimate elongation	Sec 6.3	12MPa (1740 psi) min 200% minimum	N/A N/A
JP-8 Fuel (MIL-T-83133) Skydrol * 500 Hydraulic Fluid (MIL-PRF-5606) Aviation Gasoline (100/130) MIL-G-5572 Water Followed by test for: - Dielectric strength	ASTM D2671	15,760 Volts/mm (400 Volts/mil) minimum	15,760 Volts/mm (400 Volts/mil) minimum
Tensile strength	Sec 6.3	11.0 MPa (1600 psi) minimum	11.0 MPa (1600 psi) minimum

Notes

Note 1: Recover the specimens on the metal mandrels for 10 minutes, minimum, at 175 ± 3°C (347 ± 5°F) or until the tubing is completely shrunk on the mandrels.

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TABLE 2
Tubing Dimensions

	As Supplied		As Recovered							
	Inside diameter		Inside Diameter		Wall Thickness					
	Minimum		Maximum		Minimum		Maximum		Nominal	
	mm	in	mm	in	mm	in	mm	in	mm	in
3/64	1.17	.046	0.58	.023	0.43	.017	0.58	.023	0.50	.020
1/16	1.60	.063	0.79	.031	0.43	.017	0.58	.023	0.50	.020
3/32	2.36	.093	1.17	.046	0.43	.017	0.58	.023	0.50	.020
1/8	3.17	.125	1.57	.062	0.43	.017	0.58	.023	0.50	.020
3/16	4.74	.187	2.36	.093	0.56	.022	0.71	.028	0.63	.025
1/4	6.35	.250	3.17	.125	0.56	.022	0.71	.028	0.63	.025
3/8	9.50	.375	4.74	.187	0.69	.027	0.84	.033	0.76	.030
1/2	12.70	.500	6.35	.250	0.69	.027	0.84	.033	0.76	.030
3/4	19.05	.750	9.53	.375	0.76	.030	1.016	.040	0.889	.035

TABLE 3
Mandrel Dimensions for Bend Testing

Tubing Size	Mandrel Diameter	
	mm	in
3/64 to 1/4 inclusive	7.9	5/16
3/8 to 1/2 inclusive	9.5	3/8