



RK6764 Revision 2

RBK-RTP-125-Colours

SCOPE

This Quality Assurance Specification establishes the quality standard for
RBK-RTP-125-Colours.

The objective of this document is to specify tests that will qualify the performance of
RBK-RTP-125-Colours for protecting, insulating and identifying Automotive Ring Terminals.

Due to the variation in size and design of ring terminals no claim is made with respect to sealing
 in this specification.

Approved Signatories*

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1. REVISION HISTORY

Revision Number	Change Request	Date	Incorporated By
1	NEW DOCUMENT	March 2005	B.Jenkins
2	CR07-DM-149	November 2007	B.Jenkins

2. REQUIREMENTS**2.1 Composition, Appearance and Colour**

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, modified polyolefin material. The standard jacket colour shall be White or Black. Other colours may be available on request. Inner adhesive wall shall be light amber.

2.2 Dimensions

Specimens shall be prepared and tested as outlined in section 3.2. Dimensions shall meet the requirements shown in Table 5.

2.3 Test Requirements

The product performance shall meet the requirements of Table 4.

3. PHYSICAL PROPERTY TESTS

3.1 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 minutes and allowed to cool in air to ambient temperature. Unless otherwise specified, all tests shall be made under standard ambient conditions according to IEC Publication 212. In cases of dispute the tests shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$ and at $50 \pm 5\%$ relative humidity.

3.2 Dimensions and Longitudinal Change

The test method shall be as specified in ASTM D2671. The length and inside diameter of five 150mm long specimens of expanded tubing shall be measured. The specimens shall be recovered at $200^\circ\text{C} \pm 5^\circ\text{C}$ for 3 minutes in a fan assisted air circulating oven, and immediately quenched in water at room temperature and the dimensions re-measured. The longitudinal change shall be expressed as a percentage of the original length. The recovered jacket wall thickness shall be determined from four measurements equi-spaced around the circumference and the mean value shall be recorded. Blocking of the adhesive liner shall not constitute a failure.

Dimensions shall meet the requirements in Table 5

3.3 Tensile Strength

5 specimens shall be tested in accordance with ISO37. The Tensile Strength shall be calculated based on the wall thickness of the jacket material only. The result shall be expressed as the average value of the 5 determinations.

For tubing of recovered bore less than or equal to 6mm, five tubular specimens 125mm long shall be tested. Initial jaw separation shall be 50 mm and rate of jaw separation shall be $100 \pm 10\text{mm}$ per minute.

The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

3.4 Ultimate Elongation

5 specimens shall be tested in accordance with ISO37. The result shall be expressed as the average value of the 5 determinations.

For tubing of recovered bore less than or equal to 6mm, five tubular specimens 125mm long shall be tested. Initial jaw separation shall be 50 mm and rate of jaw separation shall be $100 \pm 10\text{mm}$ per minute.

The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

3.5 2% Secant Modulus

5 specimens shall be tested in accordance with ASTM D882. The test shall be carried out using specimens of expanded tubing. The 2% Secant Modulus shall be calculated based on the wall thickness of the jacket material only. The result shall be expressed as the average value of the 5 determinations.

For tubing of recovered bore less than or equal to 6mm five tubular specimens 150mm long shall be tested. Initial jaw separation shall be 100mm and rate of jaw separation $10 \pm 1\text{mm}$ per minute. The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

PHYSICAL PROPERTY TESTS (Continued)**3.6 Split Resistance**

Five standard length cut pieces of RBK-RTP-125-Col tubing material shall be selected at random and slid onto the appropriate mandrels as stated in Table 1.

The specimens shall then be conditioned in a fan assisted air circulating oven at $200 \pm 5^\circ\text{C}$ for 10 minutes \pm 30 seconds. Upon removal from the oven the specimens shall be examined visually for evidence of splitting. There shall be no splitting.

Table 1

Product	Nominal Mandrel Substrate Diameter	
	(mm)	(ins)
RBK-RTP-125-Col-NR500	6.4	1/4
RBK-RTP-125-Col-NR3	9.5	3/8
RBK-RTP-125-Col-NR5	18.25	23/32

3.7 Heat Shock

The test method shall be as specified in ASTM D2671.

Five tubing specimens shall be prepared in accordance with Clause 3. The specimens shall be suspended vertically in a fan assisted air-circulating oven and conditioned at 150°C for 240 hours. After conditioning the specimens shall be allowed to cool naturally to room temperature and visually examined for signs of outer jacket cracking. The samples shall then be tested for Tensile Strength and Ultimate Elongation in accordance with Clause 3.3 and 3.4.

3.8 Heat Ageing (Long Term)

Five tubing specimens shall be prepared in accordance with Clause 3.

The specimens shall be suspended vertically in a fan assisted air circulating oven and conditioned at $125 \pm 3^\circ\text{C}$ for 3000 hours. After conditioning, the specimens shall be allowed to cool naturally to room temperature and visually examined for signs of outer jacket cracking.

The samples shall then be tested for Tensile strength and Ultimate elongation in accordance with Clause 3.3 and 3.4.

3.9 Inner Wall Flow Test

This test is carried out on standard length cut pieces of tubing material and is intended as a guide to adhesive flow.

Five specimens shall be selected at random and conditioned at $200 \pm 5^\circ\text{C}$ for 3 minutes in a fan assisted air circulating oven after which time approximately 5mm of one end is crimped together using flat faced pliers for approximately 30 seconds.

The specimens are then allowed to cool for a minimum of 15 minutes then reconditioned at $200 \pm 5^\circ\text{C}$ for a further 3 minutes. Upon removal from the oven the specimens shall be allowed to cool for 15 minutes minimum and examined for adhesive blocking. The tests shall be considered satisfactory if all specimens are totally blocked in at least one area of the specimen length.

PHYSICAL PROPERTY TESTS (Continued)

3.10 Flammability

The test method shall be essentially in accordance with ISO6722.

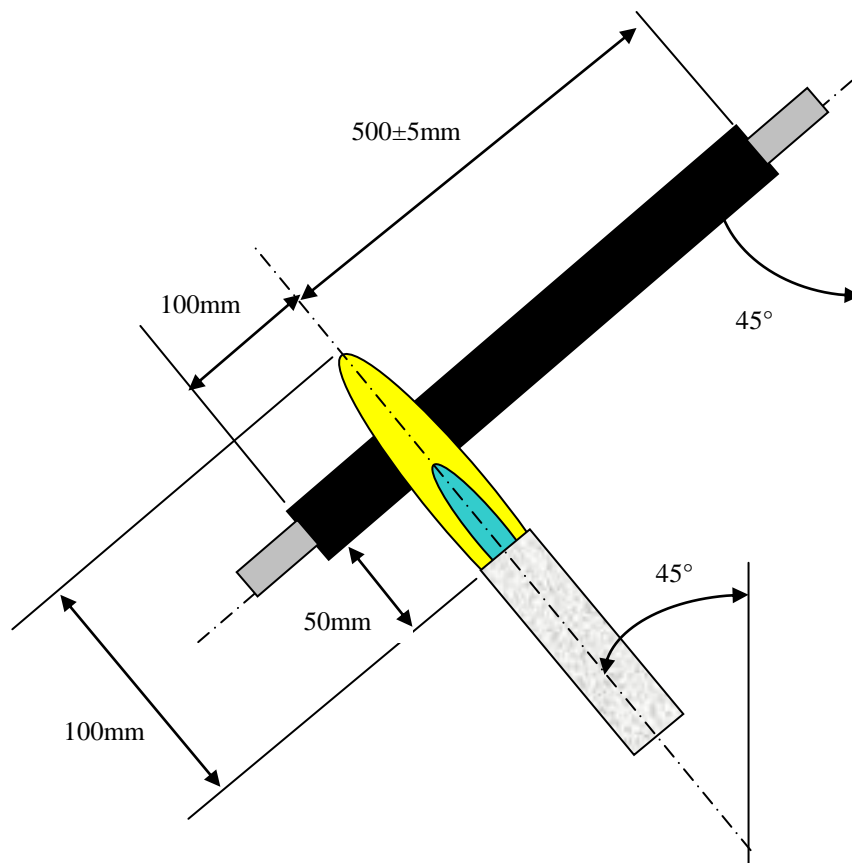
5 lengths of tubing approximately 500mm long shall be shrunk onto metal mandrels having a diameter $75\pm 5\%$ of the specified minimum expanded (as supplied) inside diameter of the tubing.

Use a bunsen burner with a 100mm (4 inch) tube. Adjust the burner to achieve a flame with an inner blue cone of approximately 50mm (2 inches).

Suspend each specimen in a draft free environment in the configuration shown in Fig 1. The time of exposure of the test flame to each specimen is one 30 second application.

Record the time for each specimen to self extinguish after removal of the flame. The result is expressed as the average burning time for the 5 specimens.

Fig 1



INDIVIDUAL PHYSICAL PROPERTY TESTS (continued)

3.11 Scrape Abrasion

The test method is essentially in accordance with that defined in ISO 6722 where a 0.125mm radius needle or profile is drawn back and forth over the tubing material. The tests shall be carried out at an ambient temperature of $23 \pm 3^\circ\text{C}$ on five specimens of tubing. The result shall be recorded as the average of the 5 determinations.

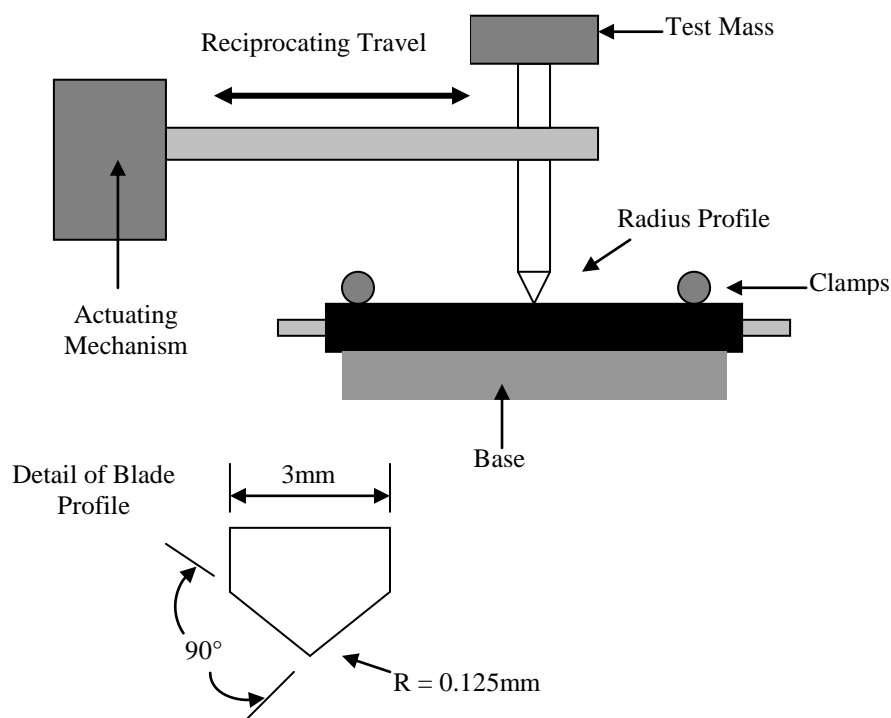
A length of tubing approximately 200mm long shall be installed onto the appropriate mandrel as specified in Table 1 by conditioning in a fan assisted air circulating oven at $200^\circ\text{C} \pm 5^\circ\text{C}$ for 3 minutes then allowed to cool naturally to room temperature.

Each specimen shall be subjected to the test conditions shown below in Table 2 and shall meet or exceed the cycle requirements given in Table 4. A cycle is defined as one complete forward and backward reciprocation of the test probe. Refer to Figure 2.

Table 2 Scrape Abrasion Test Conditions

Test Temperature	$23 \pm 3^\circ\text{C}$
Test Mass	700g
Probe Radius	0.125mm
Cycle Rate	50-60 per minute
Cycle Length	10mm minimum

FIGURE 2 - SCRAPE ABRASION TEST RIG



INDIVIDUAL PHYSICAL PROPERTY TESTS (Cont'd)**4.0 Electrical Properties****4.1 Dielectric Strength**

The test method shall be as specified in IEC 60243 (Recommended Methods of Test for Electric Strength of Solid Insulating Materials at Power Frequencies).

4.2 Volume Resistivity

5 specimens shall be tested in accordance with ASTM D2671. The result shall be expressed as the average value of the 5 determinations.

5.0 Fluid Resistance

The test method shall be as specified in ISO 1817.

Five tensile test specimens prepared as in Clause 3 shall be prepared for each of the fluids shown in Table 3. The specimens shall be completely immersed in each of the fluids for the times and temperatures specified in Table 3. The volume of the fluid shall not be less than 20 times that of the specimen. After immersion, lightly wipe the specimens and allow to air dry at $23 \pm 2^\circ\text{C}$ for $1\text{h} \pm 15\text{m}$. The Tensile Strength and Ultimate Elongation of each specimen shall be tested according to Clause 3.3 and 3.4. The test shall be repeated on the remaining specified fluids.

Table 3 Test Fluids

	Test Fluid	Immersion Time	Immersion Temp
a)	Engine Oil ISO 1817 (Oil No 1)	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
b)	Automatic Transmission Fluid Dexron 2™	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
c)	Brake Fluid to DOT 4	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
d)	Gunk™ Degreaser	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
e)	Wash Fluid (1% Teepol/Water) by volume	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
f)	Battery Acid to BS3031 (SG 1.25)	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$
g)	Engine Coolant/Antifreeze 50/50 by volume	30 ± 2 minutes	$23 \pm 2^\circ\text{C}$

6. RELATED DOCUMENTS

ASTM D2671-00	Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use
ASTM D882: 1991	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
BS 3031: 1996	Sulphuric Acid for Use in Lead Acid Batteries
Dot 4	Hydraulic Brake Fluid
IEC 60243	Recommended Methods of Test for Electric Strength of Solid Insulating Materials at Power Frequencies
ISO 37: 1994	Rubber, vulcanized or thermoplastic - Determination of Tensile Stress-Strain Properties
ISO 1817: 1999	Rubber, vulcanized - Determination of the effect of liquids
ISO 6722: 2002	Road Vehicles - 60 V And 600 V Single-Core Cables - Dimensions, Test Methods And Requirements

7. SAMPLING

Tests shall be carried out on a sample taken at random from each batch of finished sleeving. A batch of sleeving is defined as that quantity of sleeving extruded at any one time. Testing frequency shall be Production Routine or Qualification. Qualification tests shall be carried out to the requirements of the Design Authority.

7.1 Production Routine

Production Routine Tests must be carried out on every batch of finished tubing and shall consist of the following:

Visual Appearance, Dimensions, Longitudinal Change, Inner Wall Flow and Split Resistance.

A minimum of 5 tests shall be carried out on sample lengths taken at random from each batch of finished tubing.

Qualification**7.2**

Qualification tests are those performed on tubing submitted for qualification as a satisfactory product and when a change of formulation takes place, and shall consist of all tests listed in this Specification. Tube sizes NR3 or NR500 in any colour shall qualify the product range.

8.0 PACKAGING

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

9.0

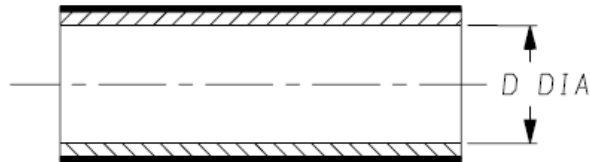
TABLE 4 Test Requirements

Test	Test Method	Test Requirements
Dimensions	Clause 2.2 & 3.2 ASTM D2671	Table 1 Clause 2.2
Longitudinal Change	Clause 3.2 ASTM D2671	0 to -12% (Nr3 and NR500) 0 to -10% (Nr5)
Tensile Strength	Clause 3.3 ISO 37	10Mpa min
Ultimate Elongation	Clause 3.4 ISO 37	250% min
2% Secant Modulus	Clause 3.5 ISO D882	137MPa min
Split Resistance	Clause 3.6	No Splitting
Heat Shock 240hrs x 150°C	Clause 3.7 ASTM D2671	No cracking or splitting of jacket T/S 7MPa min U/E 200% min
Heat Age 3000hrs at 125°C	Clause 3.8	No cracking or splitting of jacket T/S 7MPa min U/E 200% min
Inner Wall Flow	Clause 3.9	Total blocking
Flammability	Clause 3.10 ISO 6722	Self extinguishing within 30 seconds
Scrape Abrasion	Clause 3.11 ISO 6722	5000 cycles min to cut through
Dielectric Strength	Clause 4.1 IEC60243	20MV/m min
Volume Resistivity	Clause 4.2 ASTM D2671	1.0×10^{12} ohm-cm
Fluids Resistance 30 mins immersion at 23°C	Clause 5.0 Clause 3.3 Clause 3.4	 T/S 10MPa min U/E 250% min

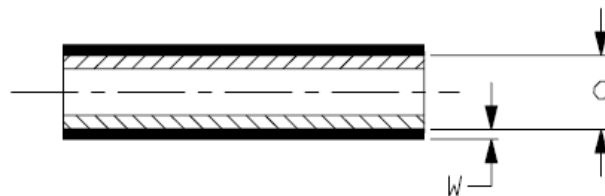
TABLE 5 Dimensional Requirements

a) Part as supplied.

RBK-RTP-125-NR*



b) Part after unrestricted recovery.



D (min) Expanded as supplied	D (max) Jacket Recovered after heating	W (min) Recovered Jacket After heating	W + adhesive Liner (min) *	Ordering Description
mm	mm	mm	mm	
11	3.45	0.70	1.4	RBK-RTP-125-NR500-Col
11	4.65	0.80	1.8	RBK-RTP-125-NR3-Col
20.20	11.4	1.25	2.31	RBK-RTP-125-NR5-Col

Supplied tube lengths will be per customer order.

The wall thickness of the tubing will be less than specified if recovery is restricted during shrinkage.

* Nominal values for reference only.

In line with a policy of continual product development, Tyco reserves the right to make changes in construction, materials and dimensions without further notice. You are advised, therefore, to contact Tyco Electronics, should it be necessary to ensure that this document is the latest issue.