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**RK 6204 Revision A**

**DWTC**

**SCOPE**

**This Quality Assurance Specification establishes the quality standard for a dual wall sleeving which shall consist of a non-meltable, heat-shrinkable jacket and a meltable adhesive inner liner. The sleeving will shrink fully and the adhesive will melt on the application of heat at 100°C or above.**

**Approved Signatories\***

	<u>Quality Assurance</u>	<u>Technical</u>	<u>Product Management</u>
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\* This document is electronically reviewed and approved - therefore no signatures will appear.

## 1. REVISION HISTORY

Revision Number	Change Request	Date	Incorporated By
6	CR98-DM-0199	October 1998	Linda Abrams
7	CR07-DM-091	June 2007	Colin Diss
A	Updated LOCAL_DOC_TYPE	15 JUL 2024	Ayeshabanu N

## 2. REQUIREMENTS

### 2.1 Composition, Appearance and Colours

The sleeving shall be homogeneous and free from pinholes, bubbles, cracks and inclusions. The standard product shall be clear. Other colours are possible by special contract.

### 2.2 Dimensions

Size	Inside Diameter as supplied (min) mm	Inside Diameter after recovery (max) mm	Total Wall Thickness after recovery mm	Outer Jacket Wall Thickness after recovery mm
4/1	4.0	1.0	0.8 ± 0.15	0.5 ± 0.12
8/2	8.0	2.0	0.9 ± 0.20	0.6 ± 0.12
12/3	12.0	3.0	1.2 ± 0.25	0.8 ± 0.15
16/4	16.0	4.0	1.5 ± 0.25	1.0 ± 0.20

Sleeving of special expanded or recovered dimensions may be supplied as specified in the contract or order.

### 2.3 Test Requirements

The test requirements shall be as specified in Table 1.

## 3. TEST METHODS

### 3.1.1 Preparation of Test Specimen

Unless otherwise specified, tests shall be carried out on specimens of sleeving recovered by conditioning in a fan assisted air circulating oven at  $150 \pm 5^\circ\text{C}$  for 3 minutes  $\pm$  10 seconds and allowed to cool in air to ambient temperature. No pre-conditioning period is required prior to testing. 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.

**TEST METHODS (continued)****3.1.2 Preparation of Test Specimen (Installed Product)**

For these tests the product shall be installed onto a metal pipe as defined below or as specified for number sizes in the relevant SCD

Size	Pipe / Mandrel Dimensions
4/1	3.17 mm (1/8")
8/2	6.35 mm (1/4")
12/3	9.52 mm (3/8")
16/4	12.50 mm (1/2")

The sleeving shall be installed by heating in an air circulating oven at a temperature not exceeding 150°C (or with a hot air gun) until the product is just recovered and the adhesive has melted onto the substrate. (Note: with this rapidly recovering product excessive heating must be avoided to prevent splitting.) Samples shall then be allowed to cool at room temperature for 10 minutes minimum.

**3.2 Dimensions and Longitudinal Change**

The test method shall be as specified in ASTM D2671.

The length and inside diameter of three 150 mm long specimens of expanded sleeving shall be measured. The specimens shall be recovered in a fan assisted air circulating oven and the length and inside diameter of each shall be measured. The longitudinal change shall be expressed as a percentage of the original length. The minimum and maximum recovered wall thickness shall be determined.

**3.3 Tensile Strength and Ultimate Elongation**

The test method shall be as specified in ISO 37.

Determine the Tensile Strength based on the cross-sectional area of the jacket only. Use suitable optical method (e.g. microscope) to measure the thickness of the outer wall for this calculation. For sleeving of recovered bore greater than 4 mm, five Type 2 dumb-bell specimens shall be tested. For sleeving of recovered bore less than or equal to 4 mm, five tubular specimens 125 mm long shall be tested. Initial jaw separation shall be 50 mm and rate of jaw separation shall be 100 ± 10 mm/minute.

The test shall be carried out at a temperature of 23 ± 2°C.

**3.4 Heat Shock**

The test method shall be as specified in ASTM D2671.

The specimens shall be conditioned in a fan assisted air circulating oven as specified in Table 1.

**TEST METHODS (continued)****3.5 Heat Ageing**

The test method shall be as specified in ISO 188.

Five tensile test specimens prepared as in Clause 3.3 shall be conditioned in a fan assisted air circulating oven as specified in Table 1. After conditioning the specimens shall be removed from the oven, allowed to cool naturally to room temperature and tested for Tensile Strength and Ultimate Elongation according to Clause 3.3.

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**3.6 Low Temperature Flexibility**

The test method shall be as specified in Procedure C of ASTM D2671.

For sleeving of recovered bore 6 mm or less, apply the test to whole sections of recovered sleeving. For sleeving of recovered bore greater than 6 mm, apply the test to strips 6 mm wide, cut from the recovered sleeving, with their lengths parallel to the extruded axis.

Mandrel diameter shall be  $20 \times$  specimen thickness  $\pm 10\%$ . For tubular specimens the thickness is the outside diameter.

The specimens and mandrel shall be conditioned as specified in Table 1.

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**3.7 Flame Resistance**

The test method shall be as specified in MVSS 302.

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**3.8 Electric Strength**

The test method shall be as specified in IEC 60243-1 (short-time test).

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**3.9 Water Absorption**

The test method shall be as specified in Method 1 of ISO 62.

For sleeving of recovered bore greater than 8 mm, three disc specimens of diameter  $25 \pm 1$  mm shall be cut from the sleeving. For sleeving of recovered bore less than or equal to 8mm, three tubular specimens 50 mm long shall be cut from the sleeving.

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**3.10 Fluid Resistance**

The test method shall be as specified in ISO 1817.

Five tensile test specimens prepared as in Clause 3.3. shall be completely immersed in each of the fluids for the times and temperatures specified in Table 1. 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  $1 \text{ h} \pm 15 \text{ min}$ . The Tensile Strength and Ultimate Elongation of each specimen shall be tested according to Clause 3.3. The test shall be repeated on the remaining specified fluids.

**TEST METHODS (continued)****3.11 Inner Wall Adhesion**

The test shall be carried out on Size 16/4 DWTC. Five cylindrical aluminium rolling drum adhesion test mandrels 25 mm long by 7 mm diameter shall be abraded and degreased. Specimens of Size 16/4 DWTC approximately 50 mm long shall be recovered on to the mandrels by conditioning in a fan assisted air circulating oven at  $150 \pm 3^\circ\text{C}$  for 15 minutes. After conditioning the specimens shall be removed from the oven and allowed to cool naturally to room temperature. Surplus lengths of DWTC shall be trimmed level with the ends of the mandrels. The specimens shall be slit axially and peeled from the mandrels in a suitable tensile testing machine such that the sleeving peels off at a rate of  $50 \pm 5$  mm length per minute as the mandrel rotates. The test shall be carried out at a temperature of  $23 \pm 2^\circ\text{C}$ . The mean peel-off force for each specimen shall be recorded, and the mean of the five recorded measurements reported as the Inner Wall Adhesion.

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**3.12 Split Resistance**

For these tests the product shall be installed onto a metal pipe or mandrel selected as being conveniently close to the dimensions recommended in Clause 3.1.2, according to the size of sleeving being tested. Five samples each 100 mm in length, cut with a sharp blade from the sleeving supplied, shall be installed as specified in Clause 3.1.2. The samples shall be conditioned in a fan assisted air circulating oven as specified in Table 1. After conditioning the specimens shall be removed from the oven, allowed to cool naturally to room temperature for 10 minutes minimum and examined for splitting.

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**3.13 Cold Impact**

The test method shall be as described in RTM 2574 which is based on VDE 0472 Part 611. Drop height shall be 100 mm. Conditioning shall be  $-40 \pm 2^\circ\text{C}$  for 4 hours. The falling weight shall have a mass of 1 kg.

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**3.14 Bend and Low Temperature Resistance**

Sleeving of dimensions 8/2 or below installed onto pipe as per Clause 3.1.2 shall be bent around a mandrel of  $50 \pm 2$  mm diameter through  $180^\circ$  in a period of not more than 2 seconds. The sample shall subsequently conditioned as specified in Table 1.

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**3.15 Scrape Wear**

The test method shall be as described in RTM 2575 which is based on VG 95343 Part 2. Five tests shall be carried out with a load of 500 grams on the specified steel wire.

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**3.16 Fluid Resistance – Installed Product**

Five test specimens prepared as in Clause 3.1.2. shall be completely immersed in each of the fluids for the times and temperatures specified in Table 1. 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  $1\text{h} \pm 15\text{min}$ . The Cold Impact Test according to Clause 3.13 shall be carried out on each specimen. The test shall be repeated on the remaining specified fluids.

**4. RELATED STANDARDS & issue**

ASTM D2671-00	Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use
IEC 60212: 1971	Standard Conditions for Use Prior to and During Testing of Solid Electrical Insulating Materials
IEC 60243-1: 1998	Electrical Strength Of Insulating Materials - Test Methods - Tests At Power Frequencies
ISO 37: 1994	Rubber, vulcanized or thermoplastic - Determination of Tensile Stress-Strain Properties
ISO 62: 1999	Determination of Water Absorption
ISO 188: 1998	Rubber, vulcanized - Accelerated Ageing or Heat Resistance Tests.
ISO 1817: 2005	Rubber, vulcanized - Determination of the effect of liquids
MVSS 302: 1975	Flammability of Materials - Passenger Cars, Multiple Passenger Vehicles, Trucks and Buses (Docket N. 3-3;Notice 4)
RTM 2574	Raychem Test Method – Cold Impact Test
RTM 2575	Raychem Test Method – Scrape Wear Test
VDE 0472-611: 1985	Testing Of Cables, Wires & Flexible Cords - Cold Impact Test
VG 95343-2: 2004	Heat Shrinkable Components – Generic Specification

**Subsequent amendments to, or revisions of, any of the above publications apply to this standard only when incorporated in it by updating or revision.**

**5. 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. Production Routine tests consisting of Visual Examination, Dimensions, Longitudinal Change and Split Resistance shall be carried out on every batch of sleeving.

Qualification tests shall be carried out to the requirements of the Design Authority.

**6. 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 Test Requirements

Test	Test Method	Test Requirements
Visual Examination	-	As per Clause 2.1
Dimensions	ASTM D2671	As per Clause 2.2 or the relevant SCD
Longitudinal Change	ASTM D2671	0 to -15%
Tensile Strength	ISO 37	20.0 MPa minimum
Ultimate Elongation	ISO 37	250 % minimum
Heat Shock (4 h ± 15 min at 200 ± 5°C)	ASTM D2671	No dripping, cracking or flowing of outer wall
Heat Ageing (168 ± 2 h at 120 ± 3°C)	ISO 188	
- Tensile Strength	ISO 37	15 MPa minimum
- Ultimate Elongation		200 % minimum
Low Temperature Flexibility (4 h ± 15 min at -55 ± 2°C)	ASTM D2671	No cracking
Flame Resistance	MVSS 302	100 mm/min maximum
Electric Strength	IEC 60243-1	20 MV/m minimum
Water Absorption (24 ± 2 h immersion at 23 ± 2°C)	ISO 62	0.5 % maximum
Fluid Resistance 24 ± 2 h immersion at 23 ± 2°C	ISO 1817	
• Diesel Fuel		
• Hydraulic Fluid to SAE J1703		
• Lubricating Oil to O-149		
• Antifreeze (Ethylene Glycol/Water 50/50 v/v)		
• Battery Acid to BS 3031		
- Tensile Strength	ISO 37	15 MPa minimum
- Ultimate Elongation		200 % minimum

TABLE 1 Test Requirements (Cont'd)

Test	Test Method	Test Requirements
Inner Wall Adhesion - DWTC to Aluminium	Clause 3.11	60 N /25 mm minimum
Split Resistance (20 min $\pm$ 15s at 100 $\pm$ 2°C)	Clause 3.12	No splitting greater than 1 mm
Cold Impact (4 h $\pm$ 15 min at -40 $\pm$ 2°C)	RTM 2574	No cracking of inner or outer wall
Bend and Low Temp Resistance (4 h $\pm$ 15 min at -40 $\pm$ 2°C)	Clause 3.14	No cracking, splitting or wrinkling of sleeving
Scrape Wear	RTM 2575	5000 strokes minimum to penetration
Fluid Resistance (Installed Product) 168 $\pm$ 2 h immersion at 23 $\pm$ 2°C <ul style="list-style-type: none"> <li>• Diesel Fuel</li> <li>• Hydraulic Fluid to SAE J1703</li> <li>• Hydraulic Fluid DTD900/4881</li> <li>• Lubricating Oil to O-149</li> <li>• Antifreeze (Ethylene Glycol/Water 50/50 v/v)</li> <li>• Battery Acid to BS 3031</li> </ul>	ISO 1817	
- Cold Impact (4 h $\pm$ 15 min at -40 $\pm$ 2°C)	RTM 2574	No cracking of inner or outer wall

**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.**