



**RW 2052 Revision 3**

## **HTAT SLEEVING**

### **SCOPE**

**This Quality Assurance Specification establishes the quality standard for a semi-flexible, electrically insulating, selectively cross-linked, dual wall, heat shrinkable sleeving.**

#### **Approved Signatories\***

This document is electronically reviewed and approved and so no signatures will appear

## 1. REVISION HISTORY

Revision Number	Change Request	Date	Incorporated By
0	Formerly RK6192 Revn 2		
1	CRF T1020 CR98-DM-0031	27 August 1997 17 February 1998	C. Woosnam L. Abrams
2	Via DMTEC	05-10-12	C.Diss
3	Via DMTEC	27 February 2014	C. Diss

## 2. REQUIREMENTS

### 2.1 Composition, Appearance and Colour

The jacket of the sleeving shall be homogeneous and free from pinholes, bubbles, cracks and inclusions. The colour shall be black. The liner shall be amber.

### 2.2 Dimensions

Size	Inside Diameter as supplied (min) mm	Inside Diameter after recovery (max) mm	Total Wall Thickness after recovery mm	Inner Meltable Wall Thickness after recovery (nom) mm
4/1	4.0	1.0	1.00 ± 0.30	0.40
8/2	8.0	2.0	1.00 ± 0.30	0.50
12/3	12.0	3.0	1.40 ± 0.30	0.60
16/4	16.0	4.0	1.80 ± 0.40	0.75
24/6	24.0	6.0	2.25 ± 0.55	0.80
32/8	32.0	8.0	2.55 ± 0.55	1.00
48/13	48.0	13.0	2.55 ± 0.55	1.00

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 Preparation of Test Specimens

Unless otherwise specified, tests shall be carried out on specimens of sleeving recovered by conditioning in a fan assisted air circulating oven at  $200 \pm 5^\circ\text{C}$  for  $6 \pm 1$  minutes 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 (Cont'd)****3.2 Dimensions and Longitudinal Change**

The test method shall be as specified in ASTM D2671.

The length and inside diameter of three 150mm 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.

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**3.3 Tensile Strength and Ultimate Elongation**

The test method shall be as specified in ISO 37.

For sleeving of recovered bore greater than 4mm, five Type 2 dumb-bell specimens shall be tested. For sleeving of recovered bore less than or equal to 4mm, five tubular specimens 125mm long shall be tested. Initial jaw separation shall be 50 mm and rate of jaw separation shall be  $100 \pm 10$  mm per minute.

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

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**3.4 Secant Modulus**

The test method shall be as specified in Method A of ASTM D882.

For sleeving of recovered bore greater than 6mm, five strip specimens 150mm long shall be tested. For sleeving 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  $10 \pm 1$  mm per minute.

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

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**3.5 Specific Gravity**

The test method shall be as specified in Method A of ISO 1183.

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**3.6 Inner Wall Adhesion**

Sizes 12/3 and below cannot be tested.

Five cylindrical Aluminium rolling drum adhesion test mandrels, 25mm long and of diameter approximately 25% above the recovered diameter of the sleeving to be tested, shall be abraded with 320 grit emery paper and then degreased with IMS. Specimens of HTAT, approximately 50mm long, shall be recovered onto the mandrels by conditioning in a fan assisted air circulating oven at  $160 \pm 3^\circ\text{C}$  for 20 minutes. After conditioning the specimens shall be removed from the oven and allowed to cool naturally to room temperature. Surplus lengths of HTAT 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 per minute as the mandrel rotates. See Figure 1. 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.

**TEST METHODS (Cont'd)****3.7 Crimp Performance**

A 5mm long crimp area is made at each end of a pre-heated 75mm length of recovered HTAT, by squeezing together, for approximately 30 seconds. The specimen shall be allowed to cool naturally to room temperature for at least one hour, then placed in a fan assisted air circulating oven at the temperature and time specified in Table 1. After conditioning remove from oven and examine visually.

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**3.8 Boiling Water Resistance**

A 5mm long crimp area is made at each end of a pre-heated 75mm length of recovered HTAT by squeezing together for approximately 30 seconds. The specimens shall be allowed to cool naturally to room temperature for at least one hour, then placed into boiling water for one hour, removed and allowed to cool naturally to room temperature then visually examined and slit longitudinally to assess if any water has ingressed.

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**3.9 Dynamic Shear Strength**

Size 12/3 and below cannot be tested.

Five 100mm long rods of material as specified having an outside diameter approximately 25% above the recovered diameter of the sleeving to be tested, shall have at least 25mm from one end abraded with 320 grit emery paper and degreased with IMS. A 100mm length of HTAT shall then be recovered on to the rod by conditioning in a fan assisted air circulating oven at  $160 \pm 3^{\circ}\text{C}$  for 20 minutes, so that a 12-14mm joint is made over the abraded area.

The specimens shall be allowed to cool naturally to room temperature, and tested using a suitable tensile testing machine. Initial jaw separation shall be 100mm. Rate of jaw separation shall be 50mm/minute. The Dynamic Shear Strength shall be reported as the average value of the five breaking loads.

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**3.10 Dynamic Shear Strength at Elevated Temperature**

Five HTAT to Aluminium test specimens shall be prepared as in Clause 3.9. The Dynamic Shear Strength of each specimen shall be determined as in Clause 3.9 except that the test shall be performed at the temperature specified in Table 1.

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**3.11 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.

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**3.12 Heat Ageing**

The test method shall be as specified in ISO 188.

For sleeving of recovered bore greater than 6mm, five strip specimens 75mm x 6mm, shall be tested. For sleeving of recovered bore less than or equal to 6mm, five tubular specimens 75mm long shall be tested. The specimens shall be conditioned in a fan assisted air circulating oven as specified in Table 1.

**TEST METHODS (Cont'd)****3.13 Low Temperature Flexibility**

The test method shall be as specified in Procedure C of ASTM D2671.  
The sleeving shall be tested in the as supplied state.  
Mandrel diameter shall be 20 x specimen thickness  $\pm$  10%.  
The specimens and mandrels shall be conditioned as specified in Table 1.

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**3.14 Flammability**

The test method shall be as specified in Procedure B of ASTM D2671.  
The test shall be carried out on size 16/4.

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**3.15 Electric Strength**

The test method shall be as specified in IEC 243 (Short time test).

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**3.16 Copper Mirror Corrosion**

The test method shall be as specified in ASTM D2671.  
The specimens shall be conditioned as specified in Table 1.

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**3.17 Water Absorption**

The test method shall be as specified in Method 1 of ISO 62.  
For sleeving of recovered bore greater than 8mm, 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 50mm long shall be cut from the sleeving.

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**3.18 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  $1\text{h} \pm 15\text{m}$ . 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.  
Five rolling drum adhesion strength test specimens prepared as in Clause 3.6 shall be immersed in each of the fluids for the times and temperatures specified in Table 1. 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 adhesion of each specimen shall be tested according to Clause 3.6.  
The test shall be repeated on the remaining specified fluids.

**4. RELATED STANDARDS & issue**

ASTM D882: 1991	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
ASTM D2671: 1995	Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use
IEC 212: 1971	Standard Conditions for Use Prior to and During Testing of Solid Electrical Insulating Materials
IEC 243-1: 1988	Methods of Test for Electric Strength of Solid Insulating Materials Part 1 Tests at Power Frequencies
ISO 37: 1994	Rubber, vulcanized or thermoplastic - Determination of Tensile Stress-Strain Properties
ISO 62: 1980	Determination of Water Absorption
ISO 188: 1982	Rubber, vulcanized - Accelerated Ageing or Heat Resistance Tests.
ISO 1183: 1987	Methods for determining the density and relative density of non-cellular plastics
ISO 1817: 1985	Rubber, vulcanized - Determination of the effect of liquids

**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, 10th batch or Qualification. Production Routine tests consisting of Visual Examination, Dimensions and Longitudinal Change shall be carried out on every batch of sleeving. 10th batch tests shall consist of Tensile Strength, Ultimate Elongation, Specific Gravity and Crimp Performance.

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.

Figure 1 - Peel Specimen in Tensile Tester

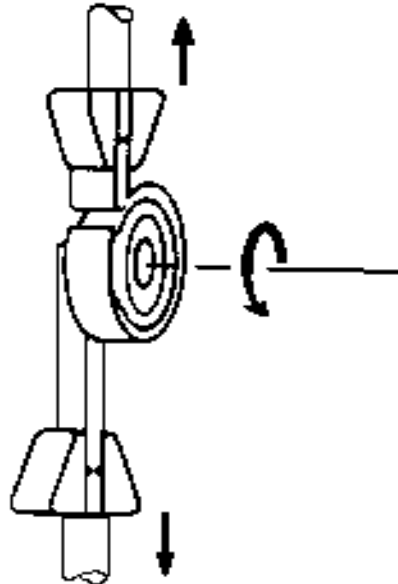


TABLE 1 Test Requirements

Test	Test Method	Test Requirements
Visual Examination	-	As per Clause 2.1
Dimensions	ASTM D2671	As per Clause 2.2
Longitudinal Change	ASTM D2671	0 to -20%
Tensile Strength	ISO 37	9 MPa minimum
Ultimate Elongation	ISO 37	300% minimum
Secant Modulus at 2% Strain	ASTM D882	125 MPa maximum
Specific Gravity	ISO 1183	1.25 maximum
Inner Wall Adhesion - HTAT to Aluminium	Clause 3.6	80N/25mm minimum
Crimp Performance (2h at 100 ± 3 °C)	Clause 3.7	No reopening of crimped joint
Resistance to Boiling Water	Clause 3.8	No reopening of crimped joint, no ingress of water
Dynamic Shear Strength - HTAT to Aluminium - HTAT to Steel - HTAT to Nylon 6/6	Clause 3.9	200N min 200N min 200N min
Dynamic Shear Strength at Elevated Temperatures - HTAT to Aluminium • 50 ± 2° C • 70 ± 2 °C • 90 ± 2 °C	Clause 3.10	150N minimum 75N minimum 25N minimum
Heat Shock (4 hr ± 15 min at 225 ± 5°C)	ASTM D2671	No dripping, cracking or flowing of outer wall



TABLE 1 Test Requirements (Cont'd)

Test	Test Method	Test Requirements
Heat Ageing (168 ± 2 hr at 150 ± 3°C)	ISO 188	No dripping, cracking or flowing of outer wall
Low Temperature Flexibility (4 hr ± 15 min at -55 ± 2°C)	ASTM D2671	No cracking
Flammability	ASTM D2671 Procedure B	Duration of burning 60s max. No burning or charring of indicator
Electric Strength	IEC 243	12 MV/m minimum
Copper Mirror Corrosion (16 hr ± 30 min at 150 ± 3°C)	ASTM D2671	No corrosion of mirrors
Water Absorption (24 ± 2h immersion at 23 ± 2°C)	ISO 62	0.5% maximum
Fluid Resistance (24 ± 2h immersion at 23 ± 2°C) <ul style="list-style-type: none"> <li>• Diesel Fuel to BS 2869 Class A1</li> <li>• Hydraulic Fluid to H-515 (Mil-H-5606)</li> <li>• Lubricating Oil to O-149</li> <li>• Salt Water 5% solution</li> <li>• Hydraulic Fluid to SAE J1703</li> <li>• Motor Engine Oil to SAE 20W/55 <ul style="list-style-type: none"> <li>- Tensile Strength</li> <li>- Ultimate Elongation</li> <li>- Inner Wall Adhesion</li> <li>- HTAT to Aluminium</li> </ul> </li> </ul>	ISO 1817          ISO 37	7 MPa minimum 300% minimum      70 N/25 mm minimum

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