## RW 2051 Revision 3

# LSTT SLEEVING

## SCOPE

**This Quality Assurance Specification establishes the quality standard for a heat-shrinkable polyolefin 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 RK6209 Revn 6 | | |
| 1 | CRF P1097<br>CRF T1020<br>CR-98-DM0028 | 30 May 1996<br>27 August 1997<br>06 February 1998 | L. Abrams<br>C. Woosnam<br>L. Abrams |
| 2 | CR02-DM-0157 | 05 August 1998 | L. Abrams |
| 3 | Via DMTEC | 27 February 2014 | C. Diss |

## 2. REQUIREMENTS

### 2.1 Composition, Appearance and Colour

The sleeving shall be homogeneous and essentially free from pinholes, flaws, bubbles, cracks, seams, defects and inclusions. The colour shall be as specified in the contract or order.

### 2.2 Dimensions

| Size | Inside Diameter as supplied (min) mm | Inside Diameter after recovery (max) mm | Wall Thickness after recovery mm |
|---|---|---|---|
| 1.6 | 1.6 | 0.8 | 0.50 ± 0.12 |
| 2.4 | 2.4 | 1.2 | 0.55 ± 0.12 |
| 3.2 | 3.2 | 1.6 | 0.55 ± 0.12 |
| 4.8 | 4.8 | 2.4 | 0.55 ± 0.12 |
| 6.4 | 6.4 | 3.2 | 0.65 ± 0.12 |
| 9.5 | 9.5 | 4.8 | 0.65 ± 0.15 |
| 12.7 | 12.7 | 6.4 | 0.65 ± 0.15 |
| 19.0 | 19.0 | 9.5 | 0.80 ± 0.15 |
| 25.4 | 25.4 | 12.7 | 0.95 ± 0.18 |
| 32.0 | 32.0 | 16.0 | 1.05 ± 0.20 |
| 38.0 | 38.0 | 19.0 | 1.05 ± 0.20 |
| 52.0 | 52.0 | 26.0 | 1.14 ± 0.18 |

**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 125 ± 5°C for 6 ± 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 ± 2°C and at 50 ± 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 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.

### 3.3 Tensile Strength and Ultimate Elongation

The test method shall be as specified in ISO 37.
For sleeving of recovered bore greater than 6mm, five Type 2 dumb-bell specimens shall be tested. For sleeving 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 ± 10mm per minute.
The test shall be carried out at a temperature of 23 ± 2°C.

### 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 ± 1mm per minute.
The test shall be carried out at a temperature of 23 ± 2°C.

### 3.5 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.

### 3.6 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.

**TEST METHODS (Cont'd)**

**3.7 Recovery at 80 °C**

Measure the internal diameter of the sleeving in both the expanded and fully recovered state. Immerse one 60mm long specimen of expanded sleeving completely in water for the time and temperature as specified in Table 1. Remove the sleeving and quench immediately in cold water. Cut the sleeving into 3 pieces each 20mm in length and measure the partially recovered internal diameter. Calculate the average.

Determine the percentage recovery from the formula:

(ID Expanded - ID Partially Recovered) / (ID Expanded - ID Fully Recovered) x 100%.

**3.8 Low Temperature Flexibility**

The test method shall be as specified in Procedure C of ASTM D2671.
For sleeving of recovered bore 6mm or less, apply the test to whole sections of recovered sleeving. For sleeving of recovered bore greater than 6mm, apply the test to strips 6mm wide, cut from the recovered sleeving, with their lengths parallel to the extruded axis. Mandrel diameter shall be 20 x specimen thickness ± 10%. For tubular specimens the thickness is the outside diameter. The specimens and mandrel shall be conditioned as specified in Table 1.

**3.9 Flammability Test**

The test method shall be as specified in MVSS 302.

**3.10 Electric Strength**

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

**3.11 Copper Contact Corrosion**

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, allowed to cool naturally to room temperature and tested for Ultimate Elongation according to Clause 3.3.

**3.12 Copper Mirror Corrosion**

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

**3.13 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 ± 2°C for 1h ± 15m. 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 (Cont'd)**

**3.14 Clarity Stability (Clear Product Only)**

A specimen of sleeving approximately 100mm in length shall be conditioned in a fan assisted air circulating oven as specified in Table 1. After conditioning, the specimen shall be removed from the oven.slit the longitudinally and pressed flat. Place the flattened sleeving over printed text of 8-point Helvetica medium type and checked for legibility of print using normal reading vision.

**4. RELATED STANDARDS & issue**

| | |
|---|---|
| ASTM D882-00 | Standard Test Methods for Tensile Properties of Thin Plastic Sheeting |
| 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 188: 1998 | Rubber, vulcanized - Accelerated Ageing or Heat Resistance Tests. |
| ISO 1817: 1999 | 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) |

**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, and Longitudinal Change 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, batch number and maximum storage temperature. Additional information shall be supplied as specified in the contract or order.

**TABLE 1 Test Requirements**

| Test | Test Method | Test Requirements |
|---|---|---|
| Visual | - | As per Clause 2.1 |
| Dimensions | ASTM D2671 | As per Clause 2.2 |
| Longitudinal Change | ASTM D2671 | +1 to -10% |
| Tensile Strength | ISO 37 | 15 MPa minimum |
| Ultimate Elongation | ISO 37 | 300% minimum |
| Secant Modulus at 2% Strain | ASTM D882 | 70 MPa maximum |
| Heat Shock<br>(4h ± 15m at 150 ± 5°C) | ASTM D2671 | No dripping, cracking or flowing |
| Heat Ageing<br>(168 ± 2h at 125 ± 3°C)<br>- Tensile Strength<br>- Ultimate Elongation | ISO 188<br><br>ISO 37 | <br><br>15 MPa minimum<br>300% minimum |
| Recovery at 80°C<br>(30 ± 5 seconds at 80 ± 2°C) | | 50% minimum |
| Low Temperature Flexibility<br>(4h ± 15m at -45 ± 2°C) | ASTM D2671 | No cracking |
| Flammability Test<br>Burning Rate | MVSS 302 | <br>100mm/minute maximum |
| Electric Strength | IEC 243-1 | 15 MV/m minimum |
| Copper Contact Corrosion<br>(24 ± 2h on copper mandrel at 90-95% RH, 23 ± 2°C, followed by 168 ± 2h on mandrel at 150 ± 3°C)<br>-Ultimate Elongation | ASTM D2671<br><br><br><br>ISO 37 | No corrosion of mandrel<br><br><br><br>200% minimum |
| Copper Mirror Corrosion<br>(16h ± 30 m at 150 ± 3°C) | | No corrosion of mirrors |

**TABLE 1 Test Requirements (Cont'd)**

| | | |
|---|---|---|
| Clarity Stability<br>(Clear Product Only) | | Printing must be legible beneath sleeving, discolouration of sleeving acceptable providing print is legible |
| Fluid Resistance<br>(24 ± 2h immersion at 23 ± 2°C)<br>• Gasoline Fuel to ISO 1817 Test liquid B<br>• Lubricating Oil to O-148<br>• Hydraulic Fluid to SAE J1703<br>• Diesel Fuel to BS 2869 Class A1<br>• Water<br>• Battery Acid to BS 2031<br>• Antifreeze (Ethylene Glycol) / Water 50/50 v/v<br>- Tensile Strength<br>- Ultimate Elongation | ISO 1817<br><br>ISO 37 | <br><br>8 MPa minimum<br>200% minimum |