



**RW 2031 Revision 3**

**ZH-100 SLEEVING**

**SCOPE**

**This Quality Assurance Specification establishes the quality standard for a sleeving for applications where Low Fire Hazard characteristics are critical.**

**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
1	Initial	9 January 1999	-
2	CR-99-DM-0186	09 July 1999	C. Diss
3	Via DMTEC	27 <sup>th</sup> February 2014	C.Diss

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

The sleeving shall be fabricated from irradiated, thermally-stabilised polyolefin compound containing no halogens or cadmium in the formulation. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks or inclusions that could effect the performance.

The sleeving shall be White, Yellow, Black, Blue, Red or Green unless otherwise specified and in the recovered form shall be a reasonable match with IEC 304.

**2.2 Dimensions**

Size	Inside Diameter as supplied (min) mm	Inside Diameter after recovery (max) mm	Wall Thickness after recovery mm
1/8	3.2	1.6	0.50 ± 0.10
3/16	4.8	2.4	0.50 ± 0.10
1/4	6.4	3.2	0.65 ± 0.15
3/8	9.5	4.8	0.65 ± 0.15
1/2	12.7	6.4	0.65 ± 0.15
3/4	19.0	9.5	0.75 ± 0.15
1	25.4	12.7	0.90 ± 0.15
1-1/2	38.0	19.0	1.00 ± 0.20
2	51.0	25.4	1.15 ± 0.25

**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  $4 \pm 1$  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.

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#### 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 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  $100 \pm 10\text{mm}$  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 at 2% Strain

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  $10 \pm 1\text{mm}$  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 Heat Shock

The test method shall be as specified in ASTM D2671. For sleeving of recovered bore 6mm or less, apply the test to cut lengths of that 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  $10 \times$  specimen thickness  $\pm 10\%$ . For tubular specimens the thickness is the outside diameter. The specimens shall be conditioned as specified in Table 1.

**TEST METHODS (Cont'd)****3.7 Heat Ageing**

The test method shall be as specified in ISO 188.

For sleeving of recovered bore 6mm or less, apply the test to cut lengths of that 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 10 x specimen thickness  $\pm$  10%. For tubular specimens the thickness is the outside diameter. The specimens shall be conditioned as specified in Table 1.

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**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 10 x 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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**3.9 Flammability**

The test method shall be as specified in ASTM D876.

The test shall be carried out on size 1/2".

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**3.10 Electric Strength**

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

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**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 Tensile Strength and Ultimate Elongation according to Clause 3.3.

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**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.

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**3.13 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.

**TEST METHODS (Cont'd)****3.14 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.

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**3.15 Oxygen Index at Ambient Temperature**

The test method shall be as specified in ISO 4589-2.  
Type IV test specimens shall be prepared using a 3mm thick sheet moulded from the material from which the sleeving is fabricated. The sheet shall be crosslinked to the same degree as the sleeving.

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**3.16 Oxygen Index at Elevated Temperature**

The test method shall be as specified in ISO 4589-3  
Type IV test specimens shall be prepared using a 3mm thick sheet moulded from the material from which the sleeving is fabricated. The sheet shall be crosslinked to the same degree as the sleeving. The test piece shall be wire supported.

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**3.17 Smoke Index**

The test method shall be as specified in IEC 60684-2 Clause 43.

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**3.18 Toxicity Index**

The test method shall be as specified in IEC 60684-2 Clause 44.

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**3.19 Acid Gas Generation**

The test method shall be as specified in IEC 60754-2.

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**3.20 Fungus Resistance**

The test method shall be as specified in IEC 68-2-10, 28 days exposure.

**4. RELATED STANDARDS & issue**

ASTM D876: 1995	Standard Test Methods for Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation
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 68-2-10: 1988	Environmental testing - Part 2: Tests. Test J and guidance : Mould growth
IEC 60243-1: 1998	Electrical strength of insulating materials - Test methods - Part 1: Tests at power frequencies
IEC 60684-2: 1997	Flexible Insulating Sleeving- Part 2: Methods of test
IEC 60754-2: 1991	Test on gases evolved during combustion of electric cables - Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity
ISO 37: 1994	Rubber, vulcanized or thermoplastic - Determination of Tensile Stress-Strain Properties
ISO 62: 1980	Determination of Water Absorption
ISO 188: 1998	Rubber, vulcanized or thermoplastic - Accelerated Ageing and 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
ISO 4589-2: 1996	Plastics - Determination of burning behaviour by oxygen index - Part 2: Ambient-temperature test
ISO 4589-3: 1996	Plastics - Determination of burning behaviour by oxygen index - Part 3: Elevated-temperature test

**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, Secant Modulus at 2% Strain, Heat Shock and Electric Strength.

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
Longitudinal Change	ASTM D2671	+ 5 to - 10%
Tensile Strength	ISO 37	7 MPa minimum
Ultimate Elongation	ISO 37	200 % minimum
Secant Modulus at 2% Strain	ASTM D882	130 MPa maximum
Specific Gravity	ISO 1183	1.6 maximum
Heat Shock (4h ± 15m at 175 ± 3°C)	ASTM D2671	No dripping, cracking or flowing
Heat Ageing (168h ± 2h at 135 ± 3°C)	ISO 188	No cracking
Low Temperature Flexibility (4h ± 15m at -30 ± 2°C)	ASTM D2671	No cracking
Flammability	ASTM D876	Duration of burning 30 s maximum
Electric Strength	IEC 243-1	15 MV/m minimum
Water Absorption (24 ± 2h immersion at 23 ± 2°C)	ISO 62	1.0 % maximum
Copper Contact Corrosion (24 ± 2h on copper mandrel at 90-95% RH, 23 ± 2°C, followed by 168 ± 2h on mandrel at 135 ± 3°C)	ASTM D2671	No corrosion of mandrel
- Tensile Strength	ISO 37	7 MPa minimum
- Ultimate Elongation		200% minimum



TABLE 1 Test Requirements (Cont'd)

Test	Test Method	Test Requirements
Copper Mirror Corrosion (16h ± 30m at 150 ± 3°C)	ASTM D2671	No corrosion of mirrors
Fluid Resistance (24 ± 2h immersion at 40 ± 2°C) • Gasoline Fuel to ISO 1817 Test Liquid B - Tensile Strength - Ultimate Elongation	ISO 1817  ISO 37	4 MPa minimum 100% minimum
Fluid Resistance (24 ± 2h immersion at 50 ± 2°C) • Hydraulic Fluid (Silicone based) to S1714 - Tensile Strength - Ultimate Elongation	ISO 1817  ISO 37	4 MPa minimum 100% minimum
Fluid Resistance (24 ± 2h immersion at 70 ± 3°C) • Hydraulic fluid. (Phosphate Ester-based) to ISO 1817 Test liquid 103 - Tensile Strength - Ultimate Elongation	ISO 1817  ISO 37	4 MPa minimum 100% minimum
Oxygen Index at Ambient Temperature	ISO 4589-2	32 minimum
Oxygen Index at Elevated Temperature	ISO 4589-3	250°C minimum
Acid Gas Generation -pH Index -Electrolytic Conductivity	IEC 60754-2	4.3 - 10.5 10 µS/mm maximum
Smoke Index	IEC 60684-2	20 maximum
Toxicity Index	IEC 60684-2	5 maximum per 100 grams
Fungus Resistance	IEC 68-2-10	2 maximum

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