



RW 2053 Revision 2

RNF-3000 SLEEVING

SCOPE

This Quality Assurance Specification establishes the quality standard for two types of heat-shrinkable, electrically-insulating, semi-flexible, flame-retarded polyolefin sleeving.

Type 1: Flame retarded and coloured

Type 2: Clear

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 RK 6150 Revision 3 | | |
| 1 | CRF T1020 CR98-DM-0027 | 28 August 1997 16 February 1998 | C. Woosnam L. Abrams |
| 2 | Via DMTEC | 27 February 2014 | C. Diss |

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

The sleeving shall be homogeneous and free from pinholes, bubbles, cracks 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 |
|---------|---|--|-------------------------------------|
| 1.5/0.5 | 1.5 | 0.5 | 0.45 ± 0.10 |
| 3/1 | 3.0 | 1.0 | 0.55 ± 0.10 |
| 6/2 | 6.0 | 2.0 | 0.65 ± 0.10 |
| 9/3 | 9.0 | 3.0 | 0.75 ± 0.12 |
| 12/4 | 12.0 | 4.0 | 0.75 ± 0.12 |
| 18/6 | 18.0 | 6.0 | 0.85 ± 0.12 |
| 24/8 | 24.0 | 8.0 | 1.00 ± 0.18 |
| 39/13 | 39.0 | 13.0 | 1.15 ± 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** 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 ± 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.

3. 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.

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 ± 10 mm per minute.

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

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 ± 1 mm per minute.

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

3.5 Specific Gravity

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

3.6 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.

3.7 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 Ultimate Elongation according to clause 3.3.

TEST METHODS (Cont'd)**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 $15 \times$ 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.

3.9 Flammability

The test method shall be as specified in ASTM D876.

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 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 ± 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.

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.

TEST METHODS (Cont'd)**3.15 Fungus Resistance**

The test method shall be as specified in ISO 846.

The specimens shall be conditioned for 56 days, and tested for Tensile Strength and Ultimate Elongation according to Clause 3.3.

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 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 846: 1997 | Plastics - Evaluation of the action of microorganisms. |
| 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, Secant Modulus at 2% Strain and Specific Gravity.

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 | 0 to -10% |
| Tensile Strength | ISO 37 | 10 MPa minimum |
| Ultimate Elongation | ISO 37 | 250% minimum |
| Secant Modulus at 2% strain | ASTM D882 | 100 MPa maximum |
| Specific Gravity | ISO 1183 | |
| Type 1 Sleeving: | | 1.35 maximum |
| Type 2 Sleeving: | | 1.0 maximum |
| Heat Shock (4h ± 15m at 250 ± 5°C) | ASTM D2671 | No dripping, cracking or flowing |
| Heat Ageing (168 ± 2h at 175 ± 3°C) | ISO 188 | |
| - Ultimate Elongation | ISO 37 | 150% minimum |
| Low Temperature Flexibility (4h ± 15m at -55 ± 2°C) | ASTM D2671 | No cracking |
| Flammability (Type 1 Sleeving only) | ASTM D876 | Duration of burning 15s maximum |
| Electric Strength | IEC 243 | 20 MV/m minimum |
| Copper Contact Corrosion (24 ± 2h on copper mandrel at 90-95% RH, 23 ± 2°C, followed by 168 ± 2h on mandrel at 160 ± 3°C) | ASTM D2671 | No corrosion of mandrel |
| - Ultimate Elongation | ISO 37 | 200% minimum |
| Copper Mirror Corrosion (16h ± 30m at 175 ± 3°C) | ASTM D2671 | No corrosion of mirrors |

TABLE 1 Test Requirements (Cont'd)

| Test | Test Method | Test Requirements |
|--|-------------|-------------------|
| Water Absorption (24 ± 2h immersion at 23 ± 2°C) | ISO 62 | 0.5% maximum |
| Fluid Resistance (24 ± 2h immersion 23 ± 2°C) | ISO 1817 | |
| <ul style="list-style-type: none"> • Gasoline Fuel to ISO 1817 Test Liquid B • Hydraulic Fluid (Phosphate Ester based) to ISO 1817 Test Liquid 103 • Lubricating Oil. (Ester based) to ISO 1817 Test Liquid 101 | | |
| - Tensile Strength | ISO 37 | 5 MPa minimum |
| - Ultimate Elongation | | 200% minimum |
| Fungus Resistance | ISO 846 | |
| - Tensile Strength | ISO 37 | 10 MPa minimum |
| - Ultimate Elongation | | 250% minimum |

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