



Technical Specification 09-11

Issue 2 2013

Low voltage heat-shrinkable material
components for use up to and including
600/1 000 V

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First published, 1975; Amendment 1, 1993

Amendments since publication

Issue	Date	Amendment
Issue 2	April, 2013	<p>Major revision of Issue 1 to align with BS EN 60684 and BS EN 62329, where appropriate, and changes in other reference BS and IEC Standards. Converted into the new ENA Technical Specification (TS) template and updated in accordance with Engineering Recommendation G0 Issue 1 2012 <i>Rules for structure, drafting and presentation of ENA engineering documents</i>.</p> <p>This issue includes the following principal technical changes:</p> <p>Clause 1 Scope: Expanded scope to cover other low voltage equipment, where applicable.</p> <p>Clause 4 General: The following new clauses added to generally align with requirements in ENA TS 09-13 and EN 60684-2 for heat-shrinkable tubing components and BS EN 62329-2 for heat-shrinkable moulded shapes:</p> <ul style="list-style-type: none">• Clause 4.5 Storage.• Clause 4.6 Dimensions.• Clause 4.7 Colour and transparency.• Clause 4.8 Material composition. <p>Added requirement to generally comply with EN 50393.</p>

		<p>Clause 4.1 Test requirements:</p> <ul style="list-style-type: none">• Added requirement for tests to be carried out generally in accordance with EN 60684-2 for heat-shrinkable tubing components and BS EN 62329-2 for heat-shrinkable moulded shapes.• Changed temperature and time period for recovering test specimens to align with ENA TS 09-13. Changed from “200 °C ±5 °C for a time period of 10 min” to “...unless stated otherwise in EN 60684-2 or BS EN 62329-2 (as applicable)...150 °C ±5 °C for a time period of 20 min”.• Added requirement for composite materials used as cable accessories to be tested in accordance with EN 50393. <p>Clause 4.2: Added new clause relating to service requirements.</p> <p>Clause 4.3 Identification: Aligned with ENA TS 09-13 including requirement for clear and permanent marking in a prominent position. Deleted requirement for specific size and spacing of markings.</p> <p>Clause 4.4: Packaging and labelling: Changed title to include “labelling”. Requirements aligned with Clauses 10 and 11 of BS EN 60684-1 for tubing and Clauses 10 and 11 of BS EN 62329-1 for moulded shapes including:</p> <ul style="list-style-type: none">• Labelling of packages and tubing supplied in reels.• Protection against ingress of moisture and mechanical damage.• Provision of safety data sheets, if requested by purchaser. <p>Clause 5.1 Tubing:</p> <ul style="list-style-type: none">• Deleted reference to “Polyolefin BEB Type 1”.• Scope widened to include other equivalent insulating material in accordance with BS EN 60684-3.• Changed statement on immersion in bitumen compound to a NOTE.• Maximum storage temperature changed from 50 °C to +45 °C. <p>Clause 5.2 Moulded shapes:</p> <ul style="list-style-type: none">• Delete reference to “Polyolefin BEB Type 2”.• Scope widened to include other equivalent insulating material in accordance with BS EN 62329-101.• Changed statement on immersion in bitumen compound to a NOTE.• Maximum storage temperature changed from 50 °C to +40 °C. <p>Clause 6.1 Test A – Visual examination: Reference to BS 6746C changed to IEC 60304. Specific dimensions for coating deleted and replaced by functional requirement for an effective seal.</p> <p>Clause 6.2 Test B – Dimensions and longitudinal change: Revision of test requirements to align with Clause 3 of EN 60684-2 for tubing. Error of determination changed from 0.025 mm to 0.01 mm. Text relating to determination of longitudinal shrinkage deleted and replaced by cross reference to Clause 9 of EN 60684-2.</p>
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	<p>Clause 6.3 Test C – Tensile strength and elongation at break: Revision of test requirements to align with Clause 19 of EN 60684-2 for tubing and Clause 10 of BS EN 62329-2 for moulded shapes. “unexpanded” replaced with “fully-recovered”.</p> <p>Clause 6.4 Test D – Heat shock:</p> <ul style="list-style-type: none">• Reference to BS 903, Part A2, type 2 requirements deleted.• Test requirements aligned with Clause 6 of EN 60684-2 for tubing and Clause 7 of BS EN 62329-2 for moulded shapes. Requirement for annealing deleted.• Temperature and time period for recovering test specimens aligned with BS EN 60684-3 and Table B.1, whichever is more onerous. <p>Deleted Test F — Hot modulus (to align with ENA TS 09-13).</p> <p>Clause 6.5 Test G — Electric strength: Reference to BS 903, Part C4 requirements deleted. Test requirements aligned with Clause 21 of EN 60684-2 for tubing and Clause 12 of BS EN 62329-2 for moulded shapes (generally in accordance with BS EN 60243-1).</p> <p>Clause 6.6 Test H — Secant modulus at 2% elongation: Test requirements aligned with Clause 19.4 of EN 60684-2 for tubing and Clause 11 of BS EN 62329-2 for moulded shapes.</p> <p>Clause 6.7 Test J — Flame retardance: Test requirements aligned with Clause 26 of EN 60684-2 for tubing and Clause 16 of BS EN 62329-2 for moulded shapes. Requirement for the method of test to be determined for particular types of grades of tubing and moulded shapes.</p> <p>Clause 6.8 Test K — Water absorption: Test requirements aligned with Clause 40 of EN 60684-2 and Clause 24 of BS EN 62329-2 (generally in accordance with Method 1 of ISO 62). Tolerance of measurement changed from 0.1 per cent to 0.1 mg. Amended formula to align with BS EN Standards for water absorption.</p> <p>Clause 6.9 Test L — Low temperature flexibility:</p> <ul style="list-style-type: none">• Test requirements aligned with Clause 14 of EN 60684-2 for tubing and Clause 8 of BS EN 62329-2 for moulded shapes.• Changed temperature and time period for recovering test specimens to align with BS EN 60684-3 or Table B.1 (for tubing) and BS EN 62329-3 or Table B.2 (for moulded shapes), whichever is more onerous.• Separation time changed from 2s to not more than 2 s. <p>Clause 6.10 Test M — Stiffness: Changed requirement for test to be carried out only if specifically requested by the purchaser (as not a standard test in EN 60684-2 or BS EN 62329-2).</p> <p>Clause 6.11 Test N — Heat ageing: Test requirements aligned with Clause 39 of EN 60684-2 for tubing and Clause 23 of BS EN 62329-2 for moulded shapes.</p> <p>Clause 6.12 Test O — Corrosion resistance: Test requirements aligned with Clause 32 of EN 60684-2. Test specimens changed from six to five. Added requirement to test with lead and solder dipped tubes to align with ENA TS 09-13. Added requirement for adhesion of the heat-shrinkable material to the tube/moulding to be cause for rejection to align with ENA TS 09-13.</p>
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		<p>Clause 6.13 Test P — Resistance to selected fluids: Test requirements aligned generally in accordance with Clause 36 of EN 60684-2 for tubing and Clause 20 of BS EN 62329-2 for moulded shapes. References changed to Table B.3 for tubing and Table B.4 for moulded shapes.</p> <p>Clause 6.14 Test T Weather resistance: Added new Clause 6.14.1 with general requirements. Test requirements aligned with ENA TS 09-13. Test requirements for tubing and moulded shapes harmonised. Added tolerances for atmospheric conditions as ENA TS 09-13.</p> <p>Clause 6.15 Test U — Fungus resistance: New clause added to align with requirements in ENA TS 09-13 and BS EN 60068-2-10.</p> <p>Clause 6.16 Test V — Volume resistivity: New clause added to align with requirements in ENA TS 09-13 and Clause 23 of EN 60684-2 for tubing and Clause 15 of BS EN 62329-2 for moulded shapes.</p> <p>Clause 7.1 Test Q — Adhesive peel strength: Test requirements aligned with Clause 57 of EN 60684-2. Added “mean” before “average”. Reworded “Fifteen specimens...” to “Sufficient specimens...”. Cooling temperature tolerance changed from +3 °C to +2 °C.</p> <p>Clause 7.3 Test S — Flow at elevated temperature: Test requirements deleted and replace by those in ENA TS 09-13 for sealants.</p> <p>Annex B Type approval and quality assurance:</p> <p>Table B.1 and Table B.2 amendments:-</p> <ul style="list-style-type: none">• Amended type approval requirement for Test A Colour to include basic colours in IEC 60304.• Amended type approval requirement for Test A Identification to include manufacturer’s/supplier’s name/mark and legibility.• Amended type approval requirement for Test B Dimensions to conform to BS EN 60684-3.• Amended low temperature flexibility test to be at -40 °C.• Amended type approval requirements for Test B Concentricity to include the expanded and recovered states.• Amended type approval requirements for Test J Flame Retardance.• Amended type approval requirements Test S Flow at Elevated Temperature to include “No leakage of air”.• Added requirements for new Test U Fungus Resistance and Test V Volume Resistivity.• Corrected secant modulus requirement for moulded shapes to “Max.” not “Min.”. <p>Table B.3 and Table B.4 amendments:-</p> <ul style="list-style-type: none">• Aligned selected fluids with those in ENA TS 09-13.• Values of tensile strength converted to MPa.• Replaced “room temperature” with “23 °C”.• Added warning note regarding use of creosote. <p>Immersion temperature of water changed from 65 °C to 85 °C to align with ENA TS 09-13.</p>
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		Details of all other technical, general and editorial amendments are included in the associated Document Amendment Summary for this Issue (available on request from the Operations Directorate of ENA).
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Foreword

This Technical Specification (TS) is published by the Energy Networks Association (ENA) and comes into effect from date of publication. It has been prepared under the authority of the ENA Engineering Policy and Standards Manager and has been approved for publication by the ENA Electricity Networks and Futures Group (ENFG). The approved abbreviated title of this engineering document is "ENA TS 09-11".

This document cancels and replaces ENA TS 09-11 Issue 1.

The purpose of this Specification is to specify the properties and test requirements of a range of heat-shrinkable insulating materials for use up to and including 600/1 000 V on low voltage distribution systems. Heat-shrinkable components are supplied in an expanded state and are installed by being heated to an appropriate temperature to activate the heat-shrink mechanism. Recovery ('shrinking') takes place on to a substrate having dimensions within a specified application range.

Issue 1 of the Specification was prepared in consultation with the Electric Cable Makers' Confederation essentially as a performance Specification in order that a range of heat-shrinkable components and sealants could be used, provided that relevant test requirements could be met and long term performance could be shown to be satisfactory. Subsequently, BS EN 60684 and BS EN 62329 have been published, which specify requirements and methods for test for heat-shrinkable components used for electrical purposes.

This revision incorporates relevant requirements from BS EN 60684-1, BS EN 60684-3 and EN 60684-2:2011, for heat-shrinkable tubing, and BS EN 62329, for heat-shrinkable moulded components, where these requirements are compatible with the original performance requirements.

NOTE: In this document the terms 'extruded' and 'tubing' are interchangeable.

The intention is generally to align requirements in ENA TS 09-11 with relevant Standards without any significant reduction in performance required in the previous issue.

It should be noted that black is the recommended colour for low voltage heat shrinkable materials. However, other colours may be suitable for use subject to meeting weather resistance and other remaining requirements.

Test requirements for heat-shrinkable materials and sealants forming part of complete products (i.e. cable joints and terminations) are not included in this Specification. Complete joints incorporating screens and insulation are subject to other test requirements for cable accessories (see 2).

Users are recommended to consult the manufacturers about heat-shrinkable materials not included in this Specification as the development of new materials, composite materials and new techniques is a continuing process and new materials brought into use may not be adequately covered by the current issue of this specification.

In the context of this document the term "tubing" and "sleeving" are interchangeable and have the same meaning.

Annex C of this Technical Specification includes “Self Certification Conformance Declaration” sheets to enable manufacturers/suppliers to declare conformance or otherwise, clause by clause, with relevant parts of this Specification.

Where the term “shall” is used in this document it expresses a requirement. The term “may” is used to express permission.

NOTE: Commentary, explanation and general informative material is presented in smaller type, and does not constitute a normative element.

1 Scope

This Specification specifies the properties and test requirements for heat-shrinkable tubing and moulded shapes manufactured from insulating materials for use on electrical systems not exceeding 600/1 000 V ($U_m = 1.2$ kV) AC or 1.5 kV DC.

The scope of this document applies primarily to heat-shrinkable components and adhesives/sealants used in LV applications with electric cables and accessories. However, the requirements and test methods may be applied to applications in other low voltage equipment, where applicable.

Certain performance characteristics required for specific applications may not be covered by this specification. Prominent among these is the behaviour of components in fire conditions.

NOTE: Requirements such as fire performance are specific to the product application, location etc and are therefore better dealt with in specifications directly relevant to the application.

2 Normative references

The following referenced documents, in whole or part, are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

ASTM G154 – 06, *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials*

BS ISO 37:2011, *Rubber, vulcanized or thermoplastic. Determination of tensile stress-strain properties*

BS 903-A13:1990, ISO 1432:1988, *Physical testing of rubber. Method of determination of stiffness at low temperature (Gehman Test)*

BS 1858:2002, *Electric cables. Accessories. Bitumen-based filling compounds*

BS 5467: 1997+A3:2008, *Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V*

BS 6004:2012, *Electric cables. PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting*

BS 7870, *LV and MV polymeric insulated cables for use by distribution and generation utilities*

BS EN 50525-1:2011, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U_0/U). General requirements*

BS EN 50525-2-41:2011, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U₀/U). Cables for general applications. Single core cables with crosslinked silicone rubber insulation*

BS EN 50525-2-42:2011, *Electric cables. Low voltage energy cables of rated voltages up to and including 450/750 V (U₀/U). Cables for general applications. Single core non-sheathed cables with crosslinked EVA insulation*

BS EN 60243-1:1998, IEC 60243-1:1998, *Methods of test for electric strength of solid insulating materials. Tests at power frequencies*

BS EN 60684-1:2003, *Flexible insulating sleeving. Definitions and general requirements*

BS EN 60684-3 (specific parts), *Flexible insulating sleeving. Specifications for individual types of sleeving*

BS EN 62329-1:2006, *Heat shrinkable moulded shapes. Definitions and general requirements*

BS EN 62329-2:2006, *Heat shrinkable moulded shapes. Methods of test*

BS EN 62329-3-101:2010 (specific parts), *Heat-shrinkable moulded shapes. Specification requirements for shape dimensions, material requirements and compatibility performance*

EN 50393, *Test methods and requirements for accessories for use on distribution cables of rated voltage 0,6/1,0 (1,2) kV*

EN 60684-2:2011, *Flexible insulating sleeving – Part 2: Methods of test¹⁾*

CENELEC HD 603 S1, *Distribution cables of rated voltage 0,6-1 kV*

CENELEC HD 605 S2, *Electric cables – Additional test methods*

CENELEC HD 626 S1, *Overhead distribution cables of rated voltage U₀/U(U_m): 0,6/1 (1,2) kV*

IEC 60304:1982, *Standard colours for insulation for low-frequency cables and wires*

Other publications

[N1] ENA TS 09-9, *Polymeric insulated, combined neutral/earth (CNE) cables with solid aluminium phase conductors and concentric aluminium wire waveform neutral/earth conductor*

¹⁾ At the time of publication, current work was in hand to revise BS EN 60684-2 in line with EN 60684-2:2011. On this basis, reference has been made to the latest publication EN 60683-2:2011. It is expected that the revision of BS EN 60684-2, when published, will be identical to EN 60683-2:2011.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

accessory

essential component of a cable system other than the cable itself, which is required for it to function

NOTE: Particular examples are joints and terminations.

3.2

air-circulating oven

electrically-heated automatic temperature-controlled oven, in which the air is circulated internally by mechanical means

3.3

batch

quantity of material or components processed at one time

3.4

concentricity

ratio of minimum to maximum wall thickness expressed in per cent

3.5

expanded

as-supplied state, which can be recovered

3.6

fully-recovered

final state after heat-shrinking without constraint

3.7

recovered

final state after heat shrinking with constraint

3.8

routine test

test carried out on each batch

3.9

sample test

test made by the manufacturer on samples of accessory components, at a specified frequency, so as to verify that the finished product meets the specified requirements

3.10

moulded plaque

sample of material moulded in sheet form for preparation of test pieces