



## Technical Specification 09-21

Issue 2 2013

Cross-linked polymeric insulated triplex cables for  
a rated voltage of 6 530/11 000 V ( $U_m = 12\ 000\ V$ )

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First published, December, 1990

### Amendments since publication

| Issue   | Date          | Amendment  |
|---------|---------------|--|
| Issue 2 | January, 2013 | <p>Minor revision of Issue 1 to: (i) reflect changes in the British Standards referred to, (ii) add information from BS 7870 and (iii) amend clauses where changes to requirements in the updated Standards affect the requirements given in the document.</p> <p>References throughout the document to BS 6622 updated to ensure that the correct clause is referenced.</p> <p>4 Conductors:</p> <p>References to BS 6360 amended to BS EN 60228 and BS 801 amended to BS EN 50307 here and throughout the document.</p> <p>4.1.1 Phase conductors:</p> <p>Sentence added to clarify the specification nominal sizes and allowance for other sizes.</p> <p>4.3 Insulation:</p> <p>Additional requirement to check compliance of insulation concentricity.</p> <p>4.5 Oversheath:</p> <p>Original requirement for oversheath to be black amended to allow other colours, subject to agreement with purchaser and suitability for the duty.</p> <p>4.6 Cable markings:</p> <p>Requirements revised to align with BS 6622:2007 and BS 7870-4.10:2011. No significant technical difference.</p> |

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|  |  | <p>5.2.1 Spark test on oversheath:<br/>Requirements updated to reference the test methods in the later Standard BS EN 62230 using the test voltages specified in BS 5099.</p> <p>5.2.4 Partial discharge:<br/>Test voltage requirement increased to 12.5 kV to bring TS 09-21 into line with BS 6622:2007.</p> <p>5.2.5 Voltage test:<br/>Test voltage requirement increased to 25.5 kV and duration increased to 15 minutes to bring TS 09-21 into line with BS 6622:2007.</p> <p>5.2.6 Cable markings:<br/>New clause with requirement to check the conformity of the cable markings.</p> <p>5.2.7 Extruded insulation screen cutting test:<br/>Minor amendment to wording.</p> <p>5.3.1 General requirements b) Electrical and physical tests:<br/>The table of numbers of samples to test revised to bring TS 09-21 into line with BS 6622:2007.</p> <p>5.3.2 Conductor material and construction:<br/>New clause with requirement to check the conformity of the conductor material and construction to bring TS 09-21 into line with BS 7870-4.10:2011 &amp; BS 6622:2007.</p> <p>5.3.3 Conductor screen:<br/>New clause with requirement to check the application of the conductor screen to bring TS 09-21 into line with BS 7870-4.10:2011 &amp; BS 6622:2007.</p> <p>5.3.4.2 Concentricity of insulation:<br/>New clause with requirement to check the concentricity of the insulation to bring TS 09-21 into line with BS 6622:2007.</p> <p>5.3.6 Hot set test on insulation:<br/>Test requirements updated to reference the hot set test methods in BS 7870-4.10:2011.</p> <p>5.3.7 Circularity of insulated core:<br/>New clause with requirement to check the circularity of the insulated core to bring TS 09-21 into line with BS 7870-4.10:2011 &amp; BS 6622:2007.</p> <p>5.3.8 Strippability test of extruded insulation screen:<br/>Requirement of forces to remove the strip amended to be not less than 8 N and not more than 45 N to bring TS 09-21 into line with BS 6622:2007 &amp; BS 7870-4.10:2011.</p> <p>5.3.11 Measurement of aluminium foil thickness:<br/>Additional text to require checks for conformity of the foil thickness.</p> <p>5.4.1.2 Tests on insulation:<br/>Reference to test procedure amended to be BS 7870-1 but with no requirement for the insulation test.</p> <p>5.4.1.3 Tests on oversheath:<br/>Reference to test procedure amended to be BS 7655-10.1.</p> <p>(Cont).</p> |
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|  |  | <p>5.4.1.4 Compatibility test, Table 3 - Compatibility test requirements:<br/>Amendments in the table data to bring TS 09-21 into line with BS 6622:2007 &amp; BS 7870-4.10:2011.</p> <ul style="list-style-type: none"><li>(i) Additional requirement for oversheath minimum tensile strength to be checked.</li><li>(ii) Insulation screen strippability forces amended to be not less than 8 N and not more than 45 N.</li><li>(iii) Addition of values for both XLPE and EPR of the insulation maximum variation of tensile strength and elongation at break.</li></ul> <p>5.4.4 Shrinkage test of oversheath:<br/>Amendments to test procedure and requirements to bring TS 09-21 into line with BS 7870-4.10:2011.</p> <ul style="list-style-type: none"><li>(i) Reference to test procedure amended from Clause 6.6 to BS EN 60811-1-3 and Clause 6.6 deleted.</li><li>(ii) Test sequence amended to be 5 cycles of 5 hour duration at 80 °C.</li><li>(iii) Value of allowed shrinkage amended to not exceed 3%.</li></ul> <p>6.1.2 Procedure:<br/>Reference to test procedure amended to be BS EN 60811-1-1 and amendment to the text to align with the revised reference.</p> <p>6.4 Water penetration test:</p> <ul style="list-style-type: none"><li>(i) Figure 1 removed and replaced by reference to an updated version in BS 7870-2 (Figure 2.4.9.1).</li><li>(ii) The test temperature amended to 20 ±10 °C to align to BS 7870-2.</li><li>(iii) Water head amended to 1 000 mm to align with BS 7870-2.</li></ul> <p>6.8 Swell height of water blocking tape (previously numbered 6.9):<br/>Figure 2 removed and replaced by reference to an updated version in BS 7870-2 (Figure 2.5.9).</p> |
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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 09-21”.

This document replaces and supersedes Technical Specification 09-21 Issue 1 1990.

This Specification defines the technical requirements for a triplex 11 kV cable type having cross-linked polymeric insulation, specifically designed for use on distribution systems. It describes a design in which moisture is kept out of the insulation by a metallic layer rather than solely by polymeric or thermoplastic materials.

As in a paper insulated cable, the metallic moisture barrier also forms the safety screen required by legislation.

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

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



## 1 Scope

This Specification covers the construction and dimensions of a triplex cable design, which comprise three single-core cables laid up around a lead-sheathed stranded copper earth conductor. Each core has a compacted circular, stranded aluminium conductor and extruded cross-linked insulation complying with BS 6622. A water blocking layer and a metallic screen consisting of aluminium foil, bonded to a polyethylene oversheath are applied over each core.

Test requirements and test methods are included, which are intended to demonstrate the suitability of the cable components for operating at a sustained maximum conductor temperature of 90 °C.

The cable is designed to be suitable for the ratings given in Table 2 and a maximum phase conductor short-circuit temperature of 250 °C.

Cables conforming to this Specification are suitable for laying direct in ground, in ducts or in air, but not self-supporting.

## 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

BS 5099:2004, *Electric cables. Voltage levels for spark testing*

BS 6480:1988, *Specification for impregnated paper-insulated lead or lead alloy sheathed electric cables of rated voltages up to and including 33 000 V*

BS 6622:2007, *Electric cables. Armoured cables with thermosetting insulation for rated voltages from 3.8/6.6 kV to 19/33 kV. Requirements and test methods*

BS 7655-10-1:2000, *Specification for insulating and sheathing materials for cables. Polyethylene sheathing compounds. Thermoplastic medium density polyethylene (MDPE) sheathing compound*

BS 7870-1:2011, *LV and MV polymeric insulated cables for use by distribution and generation utilities. General*

BS 7870-2:2011, *LV and MV polymeric insulated cables for use by distribution and generation utilities. Methods of test*

BS 7870-4.10:2011, *LV and MV polymeric insulated cables for use by distribution and generation utilities. Specification for distribution cables with extruded insulation of rated voltages of 11 kV to 33 kV. Single-core 11 kV to 33 kV cables*

BS EN 50307:2002, *Lead and lead alloys. Lead and lead alloy sheaths and sleeves of electric cables*<sup>1</sup>

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<sup>1</sup> Identical to EN 50307:2002

BS EN 60228:2005, *Conductors of insulated cables* <sup>2</sup>

BS EN 60811-1-1:1995, *Insulating and sheathing materials of electric cables. Common test methods. General application. Measurement of thickness and overall dimensions. Tests for determining the mechanical properties. Section 1: Measurement of thickness and overall dimensions — Tests for determining the mechanical properties* <sup>3</sup>

BS EN 60811-1-3:1995, *Insulating and sheathing materials of electric cables. Common test methods. General application. Methods for determining the density. Water absorption tests. Shrinkage test. Section 3: Methods for determining the density — Water absorption tests — Shrinking test* <sup>4</sup>

BS EN 62230:2007, *Electric cables. Spark-test method* <sup>5</sup>

### 3 Terms and definitions

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

#### 3.1

##### **cross-linked polyethylene (XLPE)**

thermosetting material formed by the cross-linking of thermoplastic polythene compounds

#### 3.2

##### **ethylene propylene rubber compound (EPR)**

thermosetting material comprising a cross-linked compound in which the elastomer is ethylene propylene

#### 3.3

##### **nominal value**

value by which a quantity is designated and usually gives rise to values to be checked by measurements taking into account the specified tolerances

#### 3.4

##### **routine tests**

tests performed by the manufacturer on each manufactured length of cable to check whether the whole length of each meets the specified requirements

#### 3.5

##### **sample tests**

tests performed by the manufacturer on samples of completed cable, or components taken from a completed cable, at a specified frequency, to determine whether the finished product meets the specified requirements

#### 3.6

##### **Triplex formation**

Cable formation produced by laying up three complete single-core cables

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<sup>2</sup> Identical to EN 60228:2005 and IEC 60228:2004

<sup>3</sup> Identical to EN 60811-1-1:1995 and IEC 60811-1-1:1993

<sup>4</sup> Identical to EN 60811-1-3:1995 and IEC 60811-1-3:1993

<sup>5</sup> Identical to EN 66230:2007 and IEC 66230:2006