



# Technical Specification TS 43-91

Issue 6 2016

Stay strands and stay fittings for overhead lines

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Issue 5 published, 2004.

### Amendments since publication

Issue	Date	Amendment
Issue 6	December, 2016	<p>Major revision of Issue 1 to reflect changes made to the standards referenced and to take into account modifications in practice that have been introduced in the light of on-going operating experience.</p> <p>This issue includes the following principal technical changes.</p> <p>Foreword: Expanded to provide more detail of the role of the document and purpose of this revision.</p> <p>Clause 2: References updated, deleted or added as relevant.</p> <p>Clause 3: Term and definition for “design tests” added.</p> <p>Table 1 (Issue 5, Table 4.1): Entries with “kgf” units deleted (only “kN” units retained).</p> <p>Clause 4.1.2: Two references updated: “BS EN 10025” to “BS EN 10025-1” and “BS EN 1461” to “BS EN ISO 1461”.</p> <p>Clause 4.2.3: Screw in anchor categories revised to improve clarity:</p> <ul style="list-style-type: none"><li>(i) Original clause renamed “4.2.3 Manually installed screw-in anchor” with text restricted to the information related to this type of anchor.</li><li>(ii) New clause added “4.2.4 Power installed screw-in anchor” containing the remaining text of information related to this type of anchor. Text added to emphasise that the rating is dependent on the required torque being achieved during installation.</li></ul> <p>Clause 4.2.5 (Issue 5, Clause 4.2.4):</p> <ul style="list-style-type: none"><li>(i) Renamed ‘Load lock anchor’. Reference to ‘Toggle type’ retained for continuity with previous issues of TS 43-91.</li><li>(ii) Recommendations added to ensure satisfactory installation practice for Platypus Anchors Limited type B6 load lock anchors.</li></ul>

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	<p>New Clause 4.2.6 added detailing requirements for rock anchors.</p> <p>Table 2 (Issue 5, Table 4.2):</p> <ul style="list-style-type: none"> <li>(i) Note 2: “Light duty strap” re-named “Standard duty strap”, “maximum load limit” re-named “overall assembly strength” and limit increased from 28 kN to 101 kN, to align with Clause 4.2.16.1.</li> <li>(ii) Note added (Note 3): Overall assembly strength on a double stay strap to be restricted to 202 kN, to align with Clause 4.2.16.3.</li> <li>(iii) Note added (Note 7): SMFL for stay rods with barrels / turnbuckles is dependent on a minimum 1.5 x the rod diameter of thread inside each end of the barrel / turnbuckle.</li> </ul> <p>Clause 4.2.14 (Issue 5, Clause 4. 2.12): Requirement that “stays supporting high voltage (HV) lines should be bonded” made mandatory by amending to “stays supporting high voltage (HV) lines shall be bonded”.</p> <p>Clause 4.2.16 (Issue 5, Clause 4. 2.14):</p> <ul style="list-style-type: none"> <li>i) Requirement added that stay straps to be in accordance with the requirements of Clause 8.2.</li> <li>ii) “Light Duty stay strap” re-named “Standard Duty stay strap” to reflect increased rating. Maximum load that can be applied increased from 28 kN to 101 kN and restriction on use with 7/4.00 (grade 1150) deleted. Text added to require: use of an ‘anti-split bolt’, pole to be drilled to incorporate anti-split bolts and a square curved washer conforming to ENA TS 43-96 Figure 3 to be placed between the nut and the pole.</li> <li>(iii) New Double Stay strap type added, for double stay installations. Maximum load not to exceed 202 kN, for use with all the stays in Table 2 except 2 x 19/3.55 mm (grade 700) stays.</li> </ul> <p>Clause 5.1:</p> <ul style="list-style-type: none"> <li>(i) Requirement for adjustable stay rods to be “...manufactured from heavy gauge steel tube to BS 1387, Table 3 ...” updated to be “...manufactured from medium series steel tube to BS EN 10255, Table 2...”. Footnote added that BS EN 10255, Table A.1 provides cross-references of nominal diameters to actual diameters, for information.</li> <li>(ii) Requirement that “Threads shall be to BS 3643...” updated to “Threads shall be to BS 3643-1...”.</li> <li>(iii) Reference to BS 1387 updated to BS EN 10255.</li> </ul> <p>Clause 6.1.1: Requirement for the concrete mix to be in accordance with “CP116” updated to “ BS 8500-2 and conformity control to be in accordance with BS EN 206 added”.</p> <p>Clause 6.1.2:</p> <ul style="list-style-type: none"> <li>(i) Requirement that the cement for ordinary conditions to be “...Ordinary Portland Cement to BS EN 197- Part 1...” updated to be “...standard strength CEM 1 Portland cement to BS EN 197-1...”.</li> <li>(ii) Requirement that blocks for use in soil with high acid content to be “...sulphate resisting to BS 4027...” updated to be “...CEM I sulphate resisting Portland cement to BS EN 197-1...”.</li> </ul> <p>Clause 6.1.3:</p> <ul style="list-style-type: none"> <li>(i) Requirement that the aggregate to be in accordance with “BS 882” updated to “BS EN 12620”.</li> <li>(ii) Requirement that the coarse aggregate “...must pass through a 12 mm<sup>2</sup> mesh measure in the clear...” updated to “...shall meet the requirements of BS EN 12620 aggregate size 4/10...”. Requirement added that recycled aggregate shall comply with BS 8500-2.</li> </ul> <p>Clause 6.1.5: Requirement added “The test method and acceptance criteria shall be as per the type tests specified in Clause 6.1.4”.</p>
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	<p>Clause 6.3: Reference to ENA TS 43-88 Part 1 and ENA TS 43-88 Part 2 updated to ENA TS 43-88.</p> <p>Clause 7.1.1:</p> <ul style="list-style-type: none"> <li>(i) Requirement that insulator marking to be in accordance with “BS EN 60383-1” updated to “BS EN 60383-1, Clause 5”.</li> <li>(ii) Requirement that composite string insulators to be marked in accordance with “BS EN 61466-1” updated to “BS EN 61466-1, Clause 6”.</li> </ul> <p>Clause 7.1.2: Requirement that ceramic or glass used in the manufacture of insulators to comply with “IEC 60672” updated to “BS EN 60672-1”.</p> <p>Clause 7.2</p> <ul style="list-style-type: none"> <li>(i) Requirement that “The holes in the insulator shall be smoothly radiused...” amended to “The edges of the holes in the insulator shall have a smooth rounded profile...” for clarity.</li> <li>(ii) Requirement that composite stay insulators to be in accordance with “IEC 61109 and BS EN 61466” updated to “BS EN 61109 and BS EN 61466-1”.</li> </ul> <p>Clause 7.3: Requirement that composite stay insulators to be in accordance with “IEC 61109 and BS EN 61466” updated to “BS EN 61109 and BS EN 61466-1”.</p> <p>Clause 7.4.1:</p> <ul style="list-style-type: none"> <li>(i) Requirement that tests to be performed to “...BS EN 60383-1 for insulator units and stay insulators, EN 60383-2 for insulator strings, and IEC 61109 for composite string insulators...” updated to “...BS EN 60383-1, Section 4 for insulator units and stay insulators, BS EN 60383-2, Section 2 for insulator strings, and BS EN 61109 for composite string insulators...”.</li> <li>(ii) Requirement that design, type, sample, and routine tests to be in accordance with “...BS EN 60383 and IEC 61109...” updated to “...BS EN 60383-1, BS EN 60383-2 and BS EN 61109...”.</li> </ul> <p>Clause 7.4.2:</p> <ul style="list-style-type: none"> <li>(i) Requirement that tests to be performed to “...BS EN 60383-1 for insulator units and stay insulators and IEC 61109 for composite string insulators ...” updated to “...BS EN 60383-1, Section 5 for insulator units and stay insulators and BS EN 61109 for composite string insulators ...”.</li> <li>(ii) Requirement that design, type, sample, and routine tests to be in accordance with “...BS EN 60383 and IEC 61109...” updated to “...BS EN 60383-1, BS EN 60383-2 and BS EN 61109...”.</li> </ul> <p>Clause 8.2:</p> <ul style="list-style-type: none"> <li>i) “Light Duty” stay strap renamed “Standard Duty” to align with Clause 4.2.16.1. Specified minimum failure load increased from 70 kN to 110 kN.</li> <li>ii) Double Stay Duty strap added to align with Clause 4.2.16.3. Specified minimum failure load to be 220 kN.</li> </ul> <p>Clause 8.3: Note added to clarify that the reference numbers in Table 8.1 (renumbered Table 8) are in accordance with the current UK industry preferred practice for distinguishing between a fitting with a hex. bolt, nut and a fitting with a clevis pin, washer and split pin.</p> <p>Clause 9.2: New Clause defining the commonly used types of factory formed stay fittings.</p> <p>Clause 9.4: (Issue 5, Clause 9.3)</p> <ul style="list-style-type: none"> <li>(i) Title amended to “Sample tests” since routine tests are not included.</li> <li>(ii) Requirement added “The test method and acceptance criteria shall be as per the type tests specified in Clause 9.3”.</li> </ul>
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		<p>Clause 9.5: New Clause to capture requirements for marking of factory formed stay fittings. Table included showing required colour coding.</p> <p>Figure 4: (Issue 5, Figure 5.1): Note added that the SMFL dependent on a minimum 1.5 x the rod diameter of thread inside each end of barrel/turnbuckle, to align with the Note in Table 2.</p> <p>Figure 6 (Issue 5, Figure 6.1): Requirement added "STEEL REINFORCING MESH TO BS 4449".</p> <p>Figure 8 (Issue 5, Figure 6.3): Diameter of hole in stay block drawing increased from 26 mm to 28 mm.</p> <p>Figure 10 (Issue 5, Figure 8.1): Note added that thimbles supplied in the open condition shall have a gap of 25 mm, to align with Clause 8.1.</p> <p>Figure 13: New Figure added to show details of the double stay strap - see clauses 4.2.16.3 &amp; 8.2.</p> <p>Appendix A: (renumbered Annex A): Tables 1 to 5 deleted and replaced by a single Self-Certification Conformance Declaration table.</p> <p>Bibliography added: 1 reference included of a background document that is not required as a normative reference for the document.</p> <p>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).</p>
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## Foreword

This Technical Specification (TS) is published by the Energy Networks Association (ENA) and comes into effect from the 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 43-91”.

This document replaces and supersedes Technical Specification 43-91 Issue 5 2004.

It specifies the types of stay strands and their associated fittings that are used in conjunction with wood poles for overhead line construction. It is recognised that materials and designs other than those described may be used and their use is not precluded provided they meet the performance requirements of this Specification. In addition, it must be demonstrated that any alternative materials will maintain their initial performance in service for a period at least equal to that of conventional materials.

Wood brace blocks for ‘H’ poles and foundation blocks are included with the specification for stay blocks.

The strength of materials and fittings in the arrangements shown meet the requirements for the designs of overhead lines on wood poles specified in ENA Technical Specifications TS 43-30, TS 43-40 and TS 43-50.

This revision of ENA TS 43-91 has been undertaken to reflect the revision of several of the standards called within its text. In general the approach of this revision has been to interpret revised standards such that existing practices, which have proven to provide satisfactory field performance, have been maintained, taking into account any modifications that have been introduced in the light of on-going operating experience.

Annex A of the document includes ‘Self Certification Conformance Declaration’ sheets to enable suppliers/manufacturers to declare conformance or otherwise, clause by clause, with the relevant parts of the document.

Where the term “shall” or “must” is used in this document it means the requirement is mandatory. The term “should” is used to express a recommendation. 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 describes typical stay assemblies which are suitable for use with overhead lines of wood pole construction and which range from low voltage services to lines having operating voltages up to 132 kV.

## 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 EN 197-1:2011, *Cement. Composition, specifications and conformity criteria for common cements*

BS EN 206:2013, *Concrete. Specification, performance, production and conformity*

BS EN 10025-2, *Hot rolled products of structural steels. Technical delivery conditions for non-alloy structural steels*

BS EN 10255:2004, *Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions*

BS EN 12620, *Aggregates for concrete*

BS EN 13411-1, *Terminations for steel wire ropes. Safety. Thimbles for steel wire rope slings*

BS EN 50341-1:2012, *Overhead electrical lines exceeding AC 1 kV. General requirements. Common specifications*

BS EN 60305, *Characteristics of string insulator units of the cap and pin type*

BS EN 60383-1, *Insulators for lines with a nominal voltage above 1000 V: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

BS EN 60383-2, *Insulators for overhead lines with a nominal voltage above 1000 V: Insulator strings and insulator sets for a.c. systems – Definitions, test methods and acceptance criteria*

BS EN 60672-1, *Ceramic and glass insulating materials. Definitions and classification*

BS EN 61109, *Insulators for overhead lines. Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1000 V. Definitions, test methods and acceptance criteria*

BS EN 61284:1998, *Overhead Lines - Requirements and tests for fittings*

BS EN 61466-1, *Composite string insulator units for overhead lines with a nominal voltage greater than 1000 V: Standard strength classes and end fittings*

BS EN ISO 1461, *Hot dipped galvanised coatings on fabricated iron or steel articles – Specifications and test methods*

BS 183, *Specification for general purpose galvanised steel wire strand*

BS 3288-2:2009, *Insulator and conductor fittings for overhead power lines. Specification for a range of insulator fittings*

BS 3643-1:2007, *ISO metric screw threads*

BS 4449, *Specification for carbon steel bars for the reinforcement of concrete*

BS 4978, *Specification for visual strength grading of softwood*

BS 8500-2:2015+A1:2016, *Concrete. Complementary British Standard to BS EN 206. Specification for constituent materials and concrete*

### **Other publications**

[N1] ENA TS 43-30, *Low voltage overhead lines on wood poles*

[N2] ENA TS 43-40, *Specification for single circuit overhead lines on wood poles for use at high voltage up to and including 33 kV*

[N3] ENA TS 43-50, *Specification for Single Circuit Overhead Lines on Wood Poles for use at 132kV*

[N4] ENA TS 43-88, *Selection and treatment of wood poles and associated timber for overhead lines*

[N5] ENA TS 43-90, *Anti climbing devices for H.V. Lines up to and including 400 kV*

[N6] ENA TS 43-96, *Fasteners and Washers for Wood Pole Overhead Lines*

[N7] ENA TS 43-125 Part 1, *Design guide and technical specification for overhead lines above 45 kV. Part 1 Design basis and electrical requirements*

## **3 Terms and definitions**

For the purposes of this document, the following terms and definitions apply. The terms used in this Specification are generally from BS EN 60383-1, BS EN 60383-2, BS EN 1284 or as defined below.

### **3.1**

#### **design tests**

tests to verify the suitability of the design, materials and method of manufacture (technical)

### **3.2**

#### **factory-formed helical fitting stay wire**

fitting formed from helically formed wires which provide the force necessary to grip the stay wire by self tightening

### **3.3**

#### **fitting**

generalised term for any item in this Specification

NOTE: The term fitting without qualification is used in this Specification only where the nature of the fitting is obvious from the text.

### **3.4**

#### **mechanical failure load**

maximum load which can be applied to a fitting, stay wire, or stay rod under specified test conditions