



# Engineering Recommendation G81 Part 5

## Issue 2 2016

Framework for new industrial and commercial  
underground connections  
Part 5 Materials specification

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**Operations Directorate  
Energy Networks Association  
6th Floor, Dean Bradley House  
52 Horseferry Rd  
London  
SW1P 2AF**

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First published, 2004; Amendment 1, 2008

Revised, 2016

### Amendments since publication

Issue	Date	Amendment
1	2004	First issue
1 + A1	2008	Amendment 1: Reference to ENA Technical Specification 41-26 removed. Reference to Electricity Safety Quality and Continuity Regulations 2002 changed to refer to document amended in 2006.
2	2016	Minor revision to reflect changes in the Ofgem Competition in Connections regime and updating of reference publications and legislation. This issue includes the following principal technical changes. Clause 1: Scope amended to generally cover HV underground connections up to and including 20 kV to account for changes in ER G88. Scope extended to cover provision of cables feeding from a grid/primary substation to an IDNO network, where it is agreed under the Competition in Connections regime. Clause 3: Added definitions of IDNO. Amended term “ER” to include “EREC”. Clause 4: Changed ‘Building Regulations 2010’ to ‘Building Regulations (applicable to the location)’ to reflect different Building Regulations apply for different locations of the UK. Added explanatory footnote.

		<p>Clause 6.1:</p> <p>Reworded such that protection of buried assets is a mandatory requirement.</p> <p>Aligned this clause with ENA ER G87/1 including inserting appropriate cross-references in place of requirements.</p> <p>Changed requirement for cables to be low smoke zero halogen.</p> <p>Deleted sentence relating to harmonisation of phase colours.</p> <p>Added new paragraph and requirements for conformity assessment to ENA TS and various Assessment Panels.</p> <p>Clarified “fire resistance” as meeting the relevant requirements defined in the Building Regulations and Fire Safety Regulations...”.</p> <p>Added requirement for meter cabinets to conform to BS 8567.</p> <p>Added requirement for CTs and VTs to meet relevant Balancing &amp; Settlement Code Metering Codes of Practice.</p> <p>Added requirement for equipment to allow commissioning of CTs and VTs up to the test terminal block in accordance with the relevant Balancing &amp; Settlement Code of Practice.</p> <p>Deleted “to meet HSE requirements”.</p> <p>Rephrased so BSCP 520 relates to unmetered supplies.</p> <p>Clause 6.2:</p> <p>Added new requirement that options that exist within relevant Standards publications, which are not specified in this document or DLH Appendices, are agreed with the Host DLH.</p> <p>Added requirement for Applicants to be responsible for ensuring that materials are checked prior to installation and for test results to be obtained and reviewed.</p> <p>Added requirement for plant to be unloaded and stored in a way that avoids safety risks and risk of theft.</p> <p>General:</p> <p>Reference to CDM Regulations changed from “2007” to “2015”.</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 Engineering Recommendation (EREC) 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 “EREC G81 Part 5”.

This EREC replaces and supersedes ER G81 Part 5 2008 (as amended).

This document is a “qualifying standard”, being listed in Appendix 2 of The Distribution Code, and has been revised under the governance of The Distribution Code Review Panel and in association with the Ofgem Electricity Connections Steering Group.

EREC G81 is a suite of engineering documents that sets out a national framework to facilitate competition in new connections. EREC G81 Parts 4-6 are associated with commercial and industrial connections and associated new HV and HV/LV distribution substations, where the requirements are documented as follows:

- Part 4 – Design and planning.
- Part 5 – Materials specification (this document).
- Part 6 – Installation and records.

Since ER G81 was last amended in 2008 the contestability of connection work has been extended to include jointing of metered and unmetered supplies to existing low voltage mains cables and high voltage cables<sup>1</sup>. In addition, a significant number of references in the documents have been superseded and new references relevant to EREC G81 have been published. These changes and resultant changes to requirements are captured in this revision. The opportunity has been taken to align the document with the current ENA engineering document template and ER G0 governing the rules for structure, drafting and presentation of ENA engineering documents.

This document is intended to be used by Independent Connection Providers (ICPs) and Independent Distribution Network Operators (IDNOs) that undertake new connections under the Ofgem Competition in Connections regime.

Where the term “shall” or “must” is used in this document it means the requirement is mandatory. 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 requirement.

If there are queries about this document please discuss them with the Host Distribution Licence Holder (DLH) in whose area it is proposed that work is to be undertaken. In the event that it is not possible to resolve the question with the Host DLH, please seek advice from the Connections Policy Team, Ofgem, 9 Millbank, London SW1P 3GE.

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<sup>1</sup> See Ofgem decision letter dated 8 May 2012 [1].

## 1 Scope

This document sets out the materials specification requirements for new low voltage and high voltage (generally up to and including 20 kV) underground electricity networks and associated distribution substations for industrial and commercial connections undertaken under the Ofgem Competition in Connections regime. It is one of the following suite of documents governing this work.

- Adoption Agreement<sup>2</sup>.
- Design and planning framework (EREC G81 Part 4).
- Materials specifications framework (EREC G81 Part 5).
- Installation and records framework (EREC G81 Part 6).
- Underground unmetered connections framework.

This document must be read in conjunction with these documents as some issues, for example equipment ratings, are dependent both on the way equipment is specified, designed or installed.

NOTE: This suite of documents applies only to new installations and is not to be applied retrospectively.

This document sets out and makes reference to materials specification requirements which have to be met for a Host DLH to adopt contested HV and LV networks and associated new HV and HV/LV distribution substations supplying industrial and commercial connections generally up to and including 20 kV. This includes industrial and commercial connections on both 'greenfield' and 'brownfield' sites.

This document supplements but does not amend, abridge or override any statutory legislation referred to within this document.

This suite of documents principally applies to connections of industrial and commercial developments although some relevant design aspects associated with multi-occupied premises, e.g. blocks of offices or shops, have been summarised from ER G87.

This suite of documents does not include any requirements in respect of generator or traction supply connections. These are subject to separate consideration.

Where it is agreed that cables feeding from a grid/primary substation to an IDNO network are to be installed under the Competition in Connections regime then they shall meet the relevant materials specifications within this document and/or the Host DLH Appendix [EREC G81 Part 5].

## 2 Normative references

The following referenced documents, in whole or part, are indispensable for the application of this document and must be complied with unless otherwise agreed in writing with the Host DLH. The latest editions of these documents including all addenda and revisions shall apply unless otherwise agreed with the Host DLH.

NOTE: It is not appropriate to cross-reference all relevant requirements from the following publications in this document. Where a publication is not specifically cross-referenced in the main clauses of this document then all relevant requirements are deemed to apply.

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<sup>2</sup> Also known as "Agreement to Adopt".

## **Standards publications**

BS 31, *Specification steel conduit and fittings for electrical wiring*

NOTE: This Standard is current, obsolescent (see BS 4568-1, BS EN 60423 and BS EN 61386-1).

BS 4568-1, *Specification for steel conduit and fittings with metric threads of ISO form for electrical installations. Steel conduit, bends and couplers*

BS 4607-1, *Non-metallic conduits and fittings for electrical installations. Specification for fittings and components of insulating material*

BS 4568-1, *Specification for steel conduit and fittings with metric threads of ISO form for electrical installations. Steel conduit, bends and couplers*

BS 6946, *Specification for metal channel cable support systems for electrical installations*

BS 7654, *Specification for single-phase street lighting cut-out assemblies for low-voltage public electricity distribution systems. 25 A rating for highway power supplies and street furniture*

NOTE: To be read with BS EN 60947-1 (as amended).

BS 7657, *Specification for cut-out assemblies up to 100 A rating, for power supply to buildings*

NOTE: To be read with BS EN 60947-1 (as amended).

BS 7671, *Requirements for electrical installations (IET Wiring Regulations. Seventeenth Edition)*

BS 7870-3.40, *LV and MV polymeric insulated cables for use by distribution and generation utilities. Specification for distribution cables of rated voltage 0,6/1 kV. XLPE insulated, copper wire waveform concentric cables with solid aluminium conductors*

BS 7870-4.10, *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 7870-4.20, *LV and MV polymeric insulated cables for use by distribution and generation utilities. Specification for distribution cables with extruded insulation for rated voltages of 11 kV to 33 kV. Three-core 11 kV cables\*\**

BS 7888-4.1, HD 629.1 S2, *Test requirements on accessories for use on power cables of rated voltage from 3,6/6(7,2) kV up to 20,8/36(42) kV. Cables with extruded insulation*

BS 7888-4.2, HD 629.2 S2, *Test requirements on accessories for use on power cables of rated voltage from 3,6/6(7,2) kV up to 20,8/36(42) kV. Cables with impregnated paper insulation*

BS 7933-1, HD 631.1 S2, *Electric cables. Accessories. Material characterisation. Fingerprinting and type tests for resinous compounds*

BS 8567, *Specification for outdoor electricity meter cupboards*

BS EN 50085, *Cable trunking systems and cable ducting systems for electrical installations.*

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



NOTE: This Standard relates to complete LV cable joints and has replaced BS 7888-1, BS 7888-2 and BS 7888-3.

BS EN 60255, *Measuring relays and protection equipment*

BS EN 60269-1, BS 88-1, *Low-voltage fuses. General requirements.*

BS EN 60423, *Conduit systems for cable management. Outside diameters of conduits for electrical installations and threads for conduits and fittings*

BS EN 60598-1, *Luminaires. General requirements and tests*

BS EN 60688, *Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals*

BS EN 60898, *Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations*

BS EN 60947-1, *Low-voltage switchgear and controlgear. General rules*

NOTE: See also ER C81, ER C79 and BS HD 60269-2, BS 88-2 for link boxes.

BS EN 61386-1, *Conduit systems for cable management. General requirements*

BS EN 61508, *Functional safety of electrical/electronic/programmable electronic safety-related systems*

BS EN 61869, *Instrument transformers*

NOTE: BS EN 61869 is identical to IEC 61869, which replaces the IEC 60044 series of Standards for current transformers and voltage transformers.

BS HD 60269-2, BS 88-2, *Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J*

NOTE: BS 88-5 fuses are now referred to as BS HD 60269-2, BS 88-2 fuse system I gU fuse-links with wedge tightening contacts.

BS HD 60269-3, BS 88-3, *Low-voltage fuses. Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications). Examples of standardized systems of fuses A to F*

NOTE: BS 1361 fuses are now referred to as BS 88-3 fuse system C.

CENELEC HD 620 S2, *Distribution cables with extruded insulation for rated voltages from 3,6/6 (7,2) kV up to and including 20,8/36 (42) kV\*\**

NOTE: BS 7870-4.10 is the UK implementation of HD 620 Parts 100 and 110.

\*\*NOTE: HV cables (complying with appropriate selection of options from the documents) may be selected from the listed ENA TS, CENELEC HD or IEC documents.

### **Energy Network Association publications<sup>3</sup>**

ENA TS 09-2, *Specification for the supply, delivery & installation of power cables with operating voltages in the range of 33 kV to 400 kV and associated auxiliary cables<sup>4</sup>*

ENA TS 09-06, *Auxiliary multicore and multipair cables*

ENA TS 09-07, *PVC and XLPE insulated concentric service cables with stranded copper or solid aluminium phase conductors and copper concentric neutral conductors*

ENA TS 09-9, *Low voltage 3-phase polymeric insulated copper wire concentric cables with solid aluminium phase conductors*

ENA TS 09-12, *Impregnated paper insulated corrugated aluminium sheathed 6 350/11 000 volts cable<sup>\*\*</sup>*

ENA TS 09-16, *Tests on power cables with XLPE insulation and metallic sheath and their accessories, for rated voltages of 66 kV ( $U_m = 72.5$  kV), 110 kV ( $U_m = 123$  kV) and 132 kV ( $U_m = 145$  kV)<sup>4</sup>*

ENA TS 09-17, *Single core cables for use in substations having extruded insulation and rated voltages of 6 350/11 000 and 19 000/33 000 volts<sup>\*\*</sup>*

NOTE: Single core cables to ENA TS 09-17 may also be used in outside substations, where agreed with the Host DLH.

ENA TS 09-20, *Single core cables having cross linked polyethylene insulation and lead sheath for rated voltage 19 000/33 000 volts ( $U_m = 36 000$  volts)<sup>4</sup>*

ENA TS 09-22, *Protection of cable installations against the effects of fire*

ENA TS 12-11, *Dry cable terminations in HV switchgear for service at rated voltages 12, 24 and 36 kV*

ENA TS 12-23, *Polythene warning tape and polythene protection tape for buried electricity supply cable*

ENA TS 12-24, *Plastic ducts for buried electric cable*

ENA TS 35-1 Part 1, *Distribution transformers, Common clauses<sup>5</sup>*

ENA TS 35-1 Part 2, *Distribution transformers, Ground mounted transformers — not close-coupled<sup>5</sup>*

ENA TS 35-1 Part 3, *Distribution transformers, Ground mounted transformers — close-coupled<sup>5</sup>*

ENA TS 37-2, *Public electricity network distribution assemblies*

ENA TS 41-24, *Guidelines for the design, installation, testing and maintenance of main earthing systems in substations*

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<sup>3</sup> ENA documents can be obtained via the ENA web site: [www.energynetworks.org](http://www.energynetworks.org)

<sup>4</sup> Applicable to 66 kV and 33 kV cables installed under the Competition in Connections regime, where agreed with the Host DLH.

<sup>5</sup> Schedules that accompany each Part of ENA TS 35-1 may be applicable.

ENA TS 41-36, *Switchgear for service up to 36 kV (Cable and Overhead Conductor Connected)*

ENA TS 43-94, *Earth rods and their connectors*

**\*\*NOTE:** HV cables (complying with appropriate selection of options from the documents) may be selected from the listed ENA TS, CENELEC HD or IEC documents.

ENA TS 48-5, *Environmental test requirements for protection and control equipment and systems*

ENA TS 50-19, *Standard numbering for small wiring (for switchgear and transformers together with their associated relay panels)*

ER C55/4, *Insulated sheath power cable systems<sup>4</sup>*

ER C79, *Type tests for connectors and terminations for copper and aluminium conductors of insulated power cables*

ER C81/4, *Type approval tests for accessories for 600/1 000 volt cable systems*

ER C89, *Performance specification for terminations on polymeric insulated cables rated at 12 kV and 36 kV maximum system voltage*

ER C90/1, *Type approval tests for accessories for power cables with rated voltage from 3.6/6 kV up to and including 19/33 kV*

ER C92, *Performance specifications for pole top terminations on 6 350/11 000 volt paper insulated cables*

ER C93, *Type approval for mechanical connections to metallic sheaths of cables*

ER G12, *Requirements for the application of protective multiple earthing to low voltage networks*

ER G39, *Model code of practice covering electrical safety in the planning, installation commissioning and maintenance of public lighting and other street furniture*

ER P17 (all parts), *Current rating guide for distribution cables*

EREP 127, *Application of electrical, electronic, and programmable electronic systems in safety-related systems in the electricity industry*

### **National Joint Utilities Group (NJUG) publications**

Volume 1, *NJUG Guidelines on the Positioning and Colour Coding of Underground Utilities' Apparatus*

### **Balancing & Settlement Code**

Balancing & Settlement Code (BSC) Procedure BSCP 520 Unmetered Supplies Registered in Supplier Meter Registration Service (SMRS)

Balancing & Settlement Code Metering Codes of Practice<sup>6</sup>

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<sup>6</sup> See <https://www.elexon.co.uk/bsc-related-documents/related-documents/codes-of-practice/>

## **Ofgem agreed publications**

The Distribution Code

Standard Conditions of the Electricity Distribution Licence

## **3 Terms and definitions**

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

### **3.1**

#### **Applicant**

company wishing to undertake the contestable work

### **3.2**

#### **BS**

British Standard

### **3.3**

#### **BS EN**

European Standard adopted as a British Standard

### **3.4**

#### **BSI**

British Standards Institution

### **3.5**

#### **DLH**

Holder of an Electricity Distribution Licence as defined in the Electricity Act 1989 Standard conditions of the Electricity Distribution Licence

NOTE: Host DLH refers to the Distribution Licence Holder for the public electricity network concerned.

### **3.6**

#### **Distribution Service Area (DSA)**

service area of a DLH

### **3.7**

#### **ENA**

Energy Networks Association

### **3.8**

#### **ENA TS**

Energy Networks Association Technical Specification

### **3.9**

#### **Engineering Recommendation (ER or EREC)**

engineering document published by the ENA, whose title may be abbreviated to ER or EREC

NOTE: Engineering Recommendations published from 2012 onwards are generally referred to as ERECs.

### **3.10**

#### **EREP**

Engineering Report

### **3.11**

#### **Harmonised Document (HD)**

IEC Standard adopted as a European reference document