BS 7870-1:2011

BSI Standards Publication

LV and MV polymeric insulated cables for use by distribution and generation utilities

Part 1: General

(Implementation of HD 603, 605, 620, 626 and 627)

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Publishing and copyright information

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Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 16, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 7870 is published by BSI and came into effect on 31 December 2011. It was prepared by Subcommittee GEL/20/16, *Medium/High voltage cables*, under the authority of Technical Committee GEL/20, *Electric cables*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

This part of BS 7870 supersedes BS 7870-1:1996, which is withdrawn.

Relationship with other publications

BS 7870 implements the nationally applicable elements of Harmonization Documents HD 603, 605, 620, 626 and 627, published by the European Committee for Electrotechnical Standardization (CENELEC), in accordance with the decision of the CENELEC Technical Board.

BS 7870 applies to cables for fixed installations having a rated voltage U_0/U up to and including 19/33 kV. Table 1 lists the parts and sections which have been published.

Table 1 **Parts and sections of BS 7870**

Part and section	Title
Part 1	General
Part 2	Methods of test
Part 3	Specification for distribution cables of rated voltage 0.6/1 kV
3.10	PVC insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors
3.11	XLPE insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors
3.12	XLPE insulated combined neutral and earth copper wire concentric cables with copper or aluminium conductors, having low emission of smoke and corrosive gases when affected by fire
3.20	PVC insulated split concentric cables with copper or aluminium conductors
3.21	XLPE insulated split concentric cables with copper or aluminium conductors
3.22	XLPE insulated split concentric cables with copper or aluminium conductors, having low emission of smoke and corrosive gases when affected by fire
3.40	XLPE insulated copper wire waveform concentric cables with solid aluminium conductors
3.50	XLPE insulated, copper wire waveform or helical concentric cables with solid aluminium conductors, having low emission of smoke and corrosive gases when affected by fire
Part 4	Specification for distribution cables with extruded insulation of rated voltages of 11 kV to 33 kV
4.10	Single-core 11 kV to 33 kV cables
4.11	Single-core 33 kV lead sheathed cables
4.20	Three-core 11 kV cables
Part 5	Polymeric insulated aerial bundled conductors (ABC) of rated voltage 0.6/1 kV for overhead distribution
Part 8	Specification for multicore and multipair cables for installation above and below ground
8.1	Single wire armoured and PVC sheathed multicore cable with copper conductors
8.2	Single wire armoured and PVC sheathed multipair cable with copper conductors
8.3	Single wire armoured and PVC sheathed multicore cable with copper conductors, having reduced fire propagation performance
8.4	Single wire or double steel tape armoured and PVC sheathed multipair cable with copper conductors, having reduced fire propagation performance
8.5	Single wire armoured and unarmoured multicore cables with copper conductors and non-halogenated sheath
8.6	Single wire or double steel tape armoured and non-halogenated sheathed multipair cable with copper conductors

BS 7870-1:2011 is to be read in conjunction with the appropriate parts and sections of BS 7870. Some parts and sections of BS 7870 have been revised and others have been made obsolescent or withdrawn, as indicated in the following list. The publication date and status are shown in bold.

BS 7870-2:**2011**

BS 7870-3.10:**2001**

BS 7870-3.11:**2011**

BS 7870-3.12:**2011**

BS 7870-3.20:**2001**

BS 7870-3.21:**2011**

BS 7870-3.22:**2011 (new section)**

BS 7870-3.40:**2011**

BS 7870-3.50:**2011**

BS 7870-4.10:**2011**

BS 7870-4.11:**2011**

BS 7870-4.12:2001 **(withdrawn)**

BS 7870-4-13:2001 **(withdrawn)**

BS 7870-4.20:**2011**

BS 7870-5:**2011**

BS 7870-6.1:1999 **(obsolescent)**

BS 7870-6.2:1999 **(obsolescent)**

BS 7870-6.3:1999 **(obsolescent)**

BS 7870-7.1:2003 **(obsolescent)**

BS 7870-7.2:2003 **(obsolescent)**

BS 7870-8.1:**2003**

BS 7870-8.2:**2003**

BS 7870-8.3:**2003**

BS 7870-8.4:**2003**

BS 7870-8.5:**2003**

BS 7870-8.6:**2003**

Information about this document

This is a full revision of the standard, and brings the standard up to date in accordance with current practice in the industry.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

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

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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1 Scope

This British Standard gives generic definitions and specifies the frequency of sample tests applicable to the BS 7870 series.

NOTE Guidance on the selection and use of the cables specified in BS 7870 is given in Annex A. Requirements for insulation and oversheath materials are specified in Annex B.

2 Normative references

The following referenced documents 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.

BS 7870-2, *LV and MV polymeric insulated cables for use by distribution and generation utilities – Part 2: Test methods*

BS EN 60811-1-1, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 1-1: General application – Measurement of thickness and overall dimensions – Test for determining the mechanical properties*

BS EN 60811-1-2, *Common test methods for insulating and sheathing materials of electric and optical cables – Part 1-2: General application – Thermal ageing methods*

BS EN 60811-1-3, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 1-3: General application – Methods for determining the density – Water absorption tests – Shrinkage test*

BS EN 60811-1-4, *Insulating and sheathing materials of electric cables – Common test methods – Part 1-4: General application – Tests at low temperature*

BS EN 60811-2-1, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, hot set and mineral oil immersion tests*

BS EN 60811-3-1, *Insulating and sheathing materials of electric cables – Common test methods – Part 3: Methods specific to PVC compounds – Section 3.1: Pressure test at high temperature – Tests for resistance to cracking*

BS EN 60811-3-2, *Insulating and sheathing materials of electric cables – Common test methods – Part 3: Methods specific to PVC compounds – Section 2: Loss of mass test – Thermal stability test*

BS EN 60811-4-1, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 4-1: Methods specific to polyethylene and polypropylene compounds – Resistance to environmental stress cracking – Measurement of the melt flow index – Carbon black and/or mineral filler content measurement in polyethylene by direct combustion – Measurement of carbon black content by thermogravimetric analysis (TGA) – Assessment of carbon black dispersion in polyethylene using a microscope*

IEC 60050-461, *International Electrotechnical Vocabulary – Part 461: Electric cables*

3 Terms and definitions

For the purposes of this British Standard the terms and definitions given in IEC 60050-461 and the following apply.

3.1 rated voltage
reference voltage for which the cable is designed

NOTE This is expressed as a combination of the values U_0 , U and U_m.

3.2 rated voltage U_0
nominal power-frequency voltage between any conductor and armour or earth, for which the cable is suitable

3.3 rated voltage *U*
nominal power-frequency voltage between phase conductors, for which the cable is suitable

3.4 maximum voltage U_m
maximum sustained power-frequency voltage between phase conductors, for which the cable is suitable

3.5 type of compound
category in which a compound is placed according to its properties, determined by specified tests

NOTE The type designation is not directly related to the composition of the compound.

3.6 cross-linked polyethylene (XLPE)
thermosetting material formed by the cross-linking of thermoplastic polyethylene compound, either by chemical or by irradiation methods

3.7 ethylene propylene rubber (EPR)
cross-linked compound in which the elastomer is ethylene propylene, ethylene propylene diene monomer (EPDM) or an equivalent synthetic elastomer

3.8 thermoplastic polyvinyl chloride compound (PVC)
thermoplastic material comprising a combination of materials of which the characteristic constituent is polyvinyl chloride and/or one of its copolymers

3.9 thermoplastic polyethylene compound (PE)
thermoplastic material comprising a combination of materials of which the characteristic constituent is polyethylene and/or one of its copolymers

3.10 polyolefin (PO)
thermoplastic or cross-linked material in which the characteristic constituent is a copolymer of ethylene, such as ethylene vinyl acetate (EVA), ethylene ethyl acrylate (EEA) or ethylene methyl acrylate EMA

3.11 nominal value
value by which a quantity is designated and which is often used in tables

NOTE Usually, in BS 7870, nominal values give rise to values to be checked by measurements taking into account specified tolerances.

3.12 approximate value
value which is only indicative

NOTE In BS 7870, values described as "approximate" do not constitute requirements to be checked by measurement.

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

NOTE Tests classified as routine or sample may be required as part of any Type Approval Scheme.

3.14 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

NOTE Tests classified as routine or sample may be required as part of any Type Approval Scheme.

3.15 type tests
tests made before supplying a particular type of cable on a general commercial basis, to determine whether the cable has satisfactory performance characteristics to be suitable for the intended application

NOTE Type tests are of such a nature that, after they have been performed, they need not be repeated unless changes are made in the cable materials or design or manufacturing process which might change the performance characteristics.

3.16 triplex formation
cable formation produced by laying up three complete single-core cables

3.17 cable manufacturer
organization that has the capability to both produce and control the conformity of cable made to this standard

NOTE See the particular parts and sections of this standard for information on marking the cable with the manufacturer's name and indentifier.

4 Frequency of sample tests

4.1 Conductor examination and check of dimensions

Conductor examination, measurement of the thickness of insulation and oversheath, and measurement of the overall diameter shall be made on one length from each manufacturing series of the same type and nominal cross-section of cable, but shall be limited to not more than 10% of the number of lengths in any particular contract.

4.2 Other sample tests

Other sample tests shall be carried out on samples taken according to quality control procedures agreed between the manufacturer and the purchaser.

Annex A (informative) Guide to selection and use of cables

A.1 Object

The object of this annex is to provide general recommendations for the selection (taking into account the cable system), storage, transportation and installation of the cables specified in BS 7870-3 and BS 7870-4.

Specific guidance is given in the relevant sections of BS 7870-3 and BS 7870-4.

In case of doubt as to the suitability of a cable for a particular use, further specific information should be obtained from the cable manufacturer.

A.2 Recommendations for selection of cables

A.2.1 General

The cables specified in BS 7870-3 and BS 7870-4 are designed to be installed in air (indoors and/or outdoors), or may be buried directly in free draining soil or in ducts or in special backfills.

Cables specified in BS 7870-3 and BS 7870-4 are not specifically designed for use:

a) as self supporting cables;

b) as submarine cables;

c) where subsidence is likely, unless special precautions are taken to minimize damage;

d) where any exposure to excessive heat is involved.

A.2.2 System categories

In accordance with IEC 60183, three categories of voltage systems are considered.

a) *Category A*. This category comprises those systems in which any phase conductor that comes in contact with earth or an earth conductor is disconnected from the system within 1 min.

b) *Category B*. This category comprises those systems which under fault conditions, are operated for a short time with one phase earthed. This period, according to IEC 60183, should not exceed 1 h. For cables specified in BS 7870-3 and BS 7870-4, a longer period, not exceeding 8 h on any occasion, can be tolerated. The total duration of earth faults in any year should not exceed 125 h.

c) *Category C*. This category comprises all systems which do not fall into category A or category B.

NOTE 1 It should be realised that in a system where an earth fault is not automatically and promptly eliminated, the extra stresses on the insulation of cables during the earth fault reduce the life of the cables to a certain degree. If the system is expected to be operated fairly often with a permanent earth fault, it might be advisable to classify the system into category C.

NOTE 2 Where applicable, the particular sections of BS 7870-3 and BS 7870-4 give the intended system category for the cables.

A.2.3 Power frequency range

These cables are intended to be used in the power frequency range of 49 Hz to 61 Hz.

A.2.4 Construction

A.2.4.1 **Concentric conductor** (for cables specified in BS 7870-3)

For cables having a concentric conductor, that conductor may be used as a neutral, PE (protective earth) or PEN (protective neutral/earth) conductor or as a screen.

A.2.4.2 **Metallic layer** (for cables specified in BS 7870-4)

The metallic layer of cables specified in BS 7870-4 may be used as an electrical screen.

A.2.5 Current rating

Reference should be made to the manufacturer's information to obtain the current ratings of the selected cable cross-sections for standard installation conditions.

If cables in accordance with BS 7870-3 and BS 7870-4 are exposed to localised heat, solar radiation or high temperature ambient conditions, or are installed where there is a possibility of higher than normal soil thermal resistivity, the current carrying capacity will be reduced.

NOTE In the UK the thermal resistivity of the soil is typically considered to be 1.2 °C·m/W.

Due to the relatively high conductor temperature, there is a risk of drying out the surrounding soil causing an increase in thermal resistivity which in turn would lead to the cable temperature rising to a higher value than anticipated. For cable laid directly in the ground, a suitable de-rating factor should be applied or a lower maximum sustained conductor operating temperature should be assumed to take into account the possible effects of soil drying out.

It should be noted that published de-rating tables for multiple circuits assume that the cables are of the same size, construction and voltage and are equally loaded. Where there are circuits of differing ratings, construction or voltage, more complex de-rating should be considered.

A.2.6 Operating conditions

In addition to the current rating, due regard should be given to:

a) the ability of the cable to withstand the worst anticipated fault conditions of the system;

b) the earth loop impedance;

c) the operating characteristics of the connected equipment;

d) the voltage drop requirements during normal load or motor starting conditions.

A.3 Recommendation for storage and transport

NOTE For detailed recommendations on the storage and handling of cables on wooden drums see BS 8512.

A.3.1 Sealing and drumming

A.3.1.1 Clearance

The distance between the outer layer of the cable in the filled drum and the ground or protection lagging should be sufficient to avoid damage to the cable.

A.3.1.2 Drum barrel diameter

The particular sections of BS 7870-3 and BS 7870-4 give recommendations for drum barrel diameters according to the design of the cables.

A.3.1.3 Cable sealing

The cable ends should be sealed to prevent ingress of moisture during transport and storage.

The possibility of damage to moisture seals during storage and transport should be borne in mind. Where such a damage might have occurred, the seals should be inspected and remade if necessary.

A.3.1.4 Drum condition

Cable drums should be regularly inspected during storage to assess their physical condition.

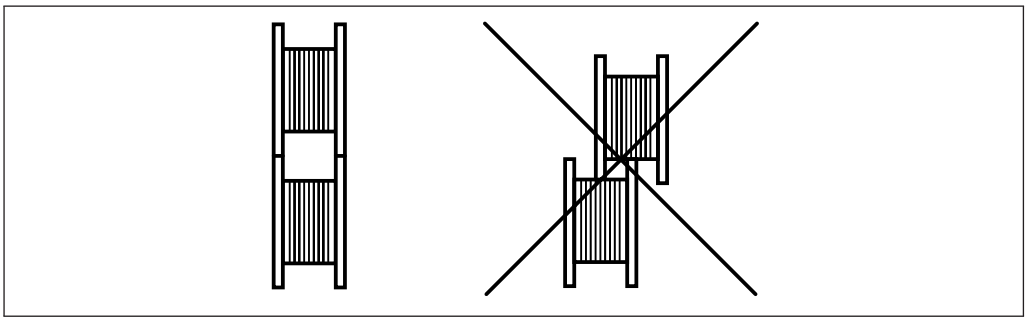
Care should be taken to avoid damage to the cables caused by nails and staples used either in drum manufacturing or when applying battens.

Battens, where applied, should not be removed from drums until the cable is about to be installed.

Cable drums should be stored so that the drum flanges do not contact cable on another drum. See Figure A.1.

Cable drums should be stored with the drum axis horizontal.

Figure A.1 **Drum storage – View from the top**

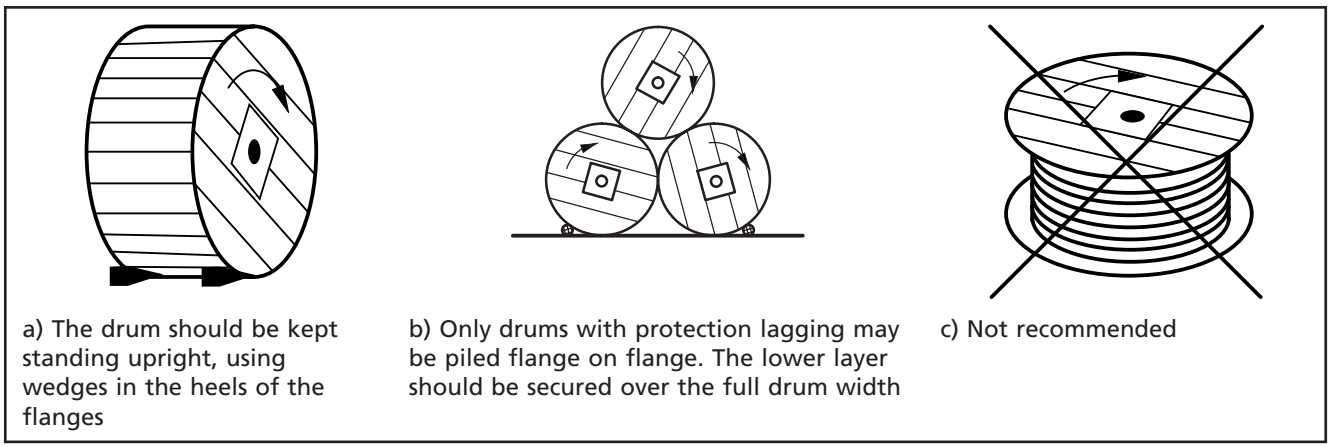


A.3.2 Transport

A.3.2.1 Drum axis position

Cable drums should be transported with the drum axis horizontal and any drum movement should be avoided. See Figure A.2.

Figure A.2 **Drum axis position**



a) The drum should be kept standing upright, using wedges in the heels of the flanges

b) Only drums with protection lagging may be piled flange on flange. The lower layer should be secured over the full drum width

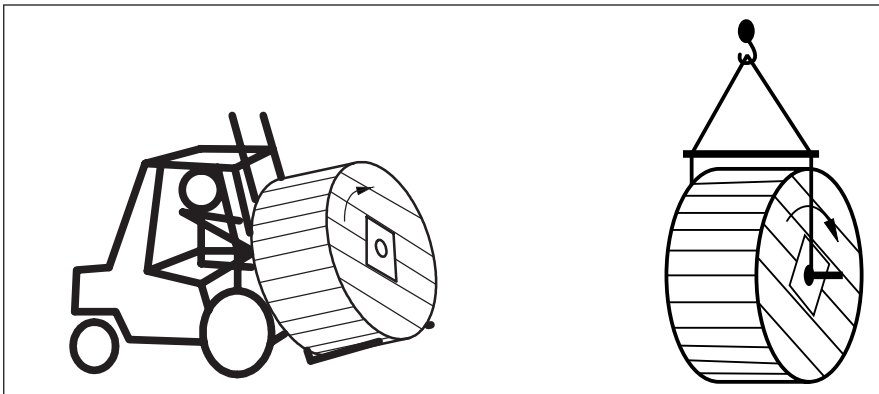
c) Not recommended

A.3.2.2 Loading and unloading

For loading and unloading of cable drums, suitable lifting and hoisting equipment should be used. See Figure A.3.

Drums should not be dropped.

Figure A.3 **Lifting of cable drums**



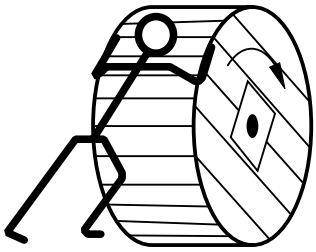
NOTE 1 Drums may be lifted either by fork-lift truck or by crane.

NOTE 2 When using a crane, the unloader should use a spreader bar unless advised otherwise by the manufacturer.

A.3.2.3 Rolling of cable drums

Cable drums should be rolled only for short distances over flat solid ground in the direction indicated on the flange. See Figure A.4.

Figure A.4 **Rolling of cable drums**



A.3.2.4 Fastening of cable ends to the drum

Cable ends should be firmly attached to the drum during transport and storage.

A.3.2.5 Cable coils

Short cable lengths may be coiled, and the coils transported and stored horizontally.

The coil diameter should not fall below the minimum permissible bending radius for the cable. The values are given in the particular sections of BS 7870-3 and BS 7870-4.

The cable coils should be protected against mechanical stress, shocks and solar radiation.

A.4 Recommendations for cable installation

A.4.1 Design of cable systems

The electrical, mechanical and chemical properties of the cable, as specified in the particular section of BS 7870-3 and BS 7870-4, should be taken into account when planning a cable system.

The cable route, laying method, climatic conditions and service conditions (operating conditions and installation data) should be taken into account when selecting the type of cable.

A.4.2 Installation and operating conditions

The following installation and operating conditions, as applicable, should be taken into account when selecting cables:

a) operating conditions:

- ambient temperature;
- number of cables and the installation configuration (e.g. flat or trefoil formation);
- the presence of any source of external heat;
- thermal resistivity of the soil;
- solar radiation;
- possible effects of cables on each other;
- mechanical stress (pressure, tension, shear, vibration);
- presence of chemicals (solvents or corrosive substances);
- leakage or stray currents and corrosion;

b) movement of soil;

c) the method of burying and backfilling. This should be selected according to the type of cable to avoid mechanical damage.

NOTE The thermal resistivity of the backfill used can significantly impact on the current rating of the cable. For more information, see BS IEC 60287.

A.4.3 Types of installation

Cables may be either directly buried in soil or pulled into ducts or pipes, or installed on walls and ceilings using cable racks or trays.

A.4.4 Preparation of cable route

The cable route should be suitable for the selected installation procedure with a sufficient number of cable rollers, special attention being paid to the required minimum bending radius of the cable (see **A.4.6**).

The pulling force should be continuously monitored during the pull-in procedure and should not exceed the permissible values (see **A.4.12**).

Where a cable is to be laid in a trench, the walls of the trench should be compact and smooth so that stones and hard gravel do not damage the cable surface during pulling operations.

A.4.5 Unwinding and rewinding

Unwinding and rewinding should be done as shown in Figure A.5.

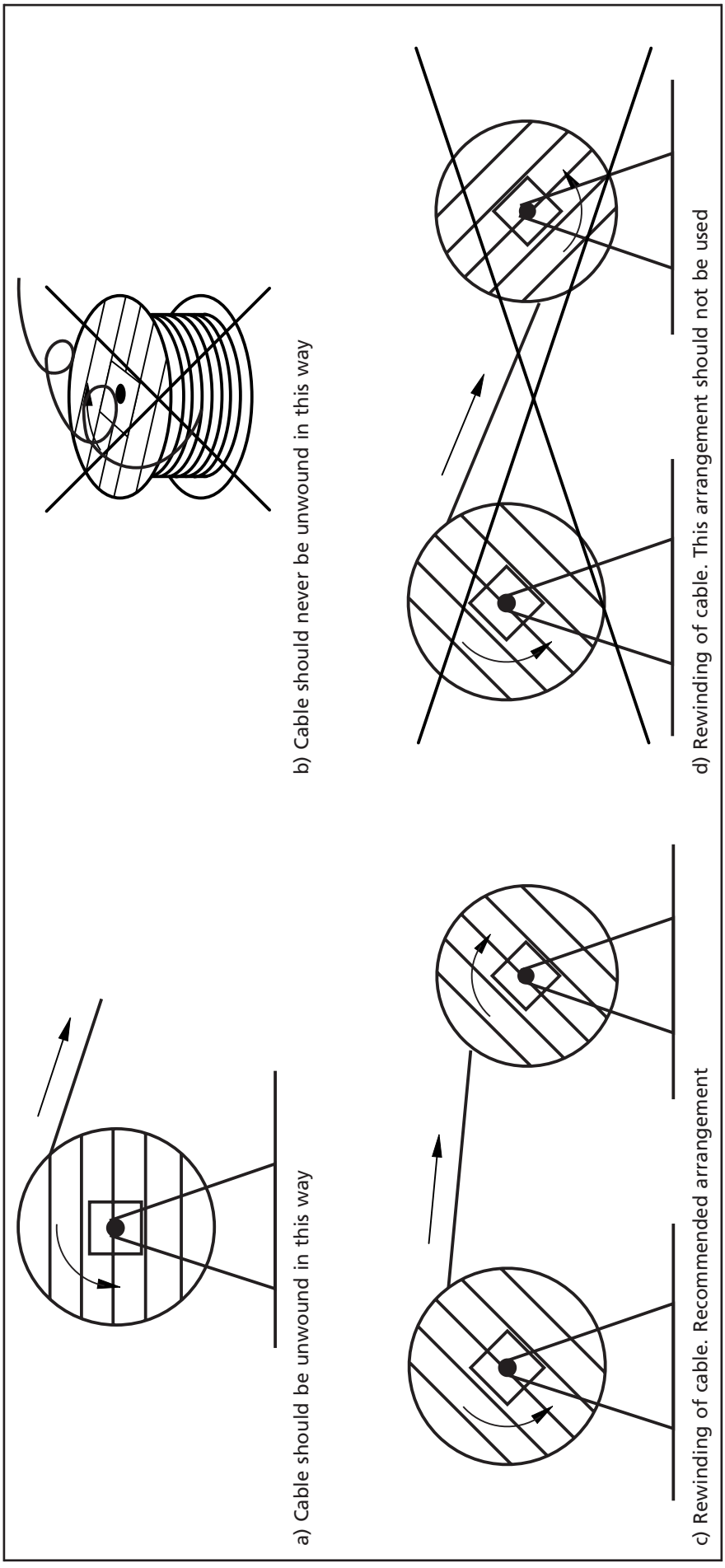


Figure A.5 **Unwinding and rewinding of cables**

A.4.6 Bending radii during installation

The permissible bending radii during installation are given in the particular sections of BS 7870-3 and BS 7870-4.

Reduction of bending radii below the permissible bending radii (up to 50% in the case of cables to BS 7870-3) may be considered provided that the following are all applicable:

- there is a single bend, for example at a termination;
- the cable is at a temperature of not less than 30 °C or is heated up to 30 °C;
- the cable is bent by means of a template or preformed rollers.

A.4.7 Prevention of moisture ingress

Care should be exercised during installation to avoid any damage to cable coverings. The protective caps should not be removed from the ends of the cable until immediately prior to termination or jointing. When the caps have been removed, the unprotected ends of the cable should not be exposed to moisture.

The possibility of damage to moisture seals during installation should be borne in mind. Where such damage might have occurred, the seals should be inspected and remade if necessary.

A.4.8 Protection of cables

Cables should be protected against mechanical damage occurring after installation.

Cables conforming to BS 7870-4, when directly buried, may be protected by an additional structural layer (slabs, tiles, etc.).

A.4.9 Installation of cables in ducts or pipes

The inner diameter of ducts and pipes should be large enough to allow for free movement and replacement of the cables. If cables are to be installed in ducts or pipes, reference should be made to the cable manufacturer for the duct or pipe size suitable for the current rating of the cable.

Single-core cables of a three-phase system installed in steel pipes or through steel constructions, should pass through the same pipe or construction.

To protect the pipes against mechanical shock, it is recommended that a sand bedding should be used.

The minimum bending radius for the cable should be taken into account when installing pipes.

In the case of electrical systems having more than one cable per phase, it is essential to check the current sharing between the cables of the same phase to avoid overloading a single cable.

For cables to BS 7870-3, if a sand bedding is used, it is recommended that the pipe should be protected against the ingress of sand.

A.4.10 Lowest temperature of cable prior to and during installation

The lowest temperature of the cables prior to and during installation is given in the particular sections of BS 7870-3 and BS 7870-4.

This temperature applies to the cable itself and not to the surroundings.

When cables are at a lower temperature than that permitted, they may be warmed up to the lowest permissible temperature. This operation can take one or two days.

A.4.11 Cable fixing

Single-core cables may be installed separately or installed together in bundles.

A system of bundled cables may be treated as a multicore cable. In case of separate laying of single-core cables, cleats made of plastic or cleats consisting of non-magnetic metals should be used. Steel cleats may be used if the magnetic circuit is not around a single-core cable alone.

Cleats should be tightened in such a way as to avoid damage to the cables caused by heat expansion.

A.4.12 Pulling force

Cables may be pulled either into ducts or direct into the soil by using appropriate pulling devices to ensure that the pulling force is evenly distributed on the cable conductors. The maximum recommended pulling force varies according to the device used, and the configuration of cables being pulled. The recommended maximum pulling forces are as follows.

a) *Pulling head*

The maximum pulling force, P, in newtons, should be as given by the following equation:

$$P = S\sigma$$

where:

S is the cross-sectional area of the conductors, in square millimetres (mm^2);

σ is the permissible tensile stress of the conductors, in newtons per square millimetre (N/mm^2),

as given in the particular sections of BS 7870-3 and BS 7870-4.

This maximum pulling force takes into account the permitted elongation of 0.2% for the conductor.

NOTE The maximum pulling force (P) is calculated from the total of the nominal conductor cross-sectional areas. The nominal cross-sectional area of the screens, concentric conductors, armour and auxiliary cores should not be considered in this calculation.

b) *Pulling grip via conductor*

The pulling force may be transmitted via a frictional connection between the pulling grip and the conductor of the cable (for example, for the pulling in of cables which have thermoplastic insulation and sheath and no metallic covering).

The pulling force recommended for the pulling head [see item a)], may be applied for the pulling grip.

NOTE After pulling, unless the cable is ready for jointing or terminating, the protective caps should be remade.

c) *Pulling grip via outer sheath*

The pulling force can also be applied by a frictional device acting on the outer sheath.

In this case, the maximum pulling force, *P*, in newtons, should be as given by the following equation:

$$P = 3D^2$$

where:

D is the outer cable diameter, in millimetres (mm).

NOTE The pulling grip should be of a suitable diameter and length to transfer the force to the conductor. The length of cable in contact with the frictional device should be removed before installation.

d) *Simultaneous pulling*

For three pre-assembled single-core cables, the total pulling force should not exceed 3 times the maximum permissible value for a single-core cable and for 3 parallel-arranged cables the total pulling force should not exceed twice the maximum permissible value for a single-core cable.

Special care should be taken with sharp route turns.

NOTE Care should be taken to ensure the pulling load is equally shared between the three cables.

A.4.13 Compound filling

Joints and terminations might require compound filling to seal against wet or hazardous environments. When hot pouring is used, care should be taken at the time of pouring, that the temperature of the filling compound does not exceed 150 °C.

A.4.14 Testing after installation

Testing after installation should be carried out in accordance with the particular sections of BS 7870-3 and BS 7870-4.

It should be noted that repeated over voltage testing can lead to premature failure of the cable.

A.5 Environment

Cables can be harmed by exposure to corrosive products or solvents, especially petroleum based vapours.

The sheathing compounds used on these cables do not provide any protection against damage by rodents, termites, etc.

Loaded cables can have high surface temperatures, and might require protection against accidental contact.

A.6 Incineration of scrap cable

Incineration of scrap cable should only be undertaken by a licensed contractor. For further information the Environment Agency should be contacted.

Annex B (normative) Insulation and oversheath materials

The insulation and oversheath materials of the cables specified in the particular sections of BS 7870 shall be tested in accordance with Table B.1 and Table B.2, respectively, and shall conform to the requirements specified in Table B.1 or Table B.2, as applicable. Tolerances on temperature values shall be as specified in BS 7870-2, **1.5.2**.

Table B.1 **Requirements for insulation materials**

Parameter	Test method	Compound type	
		DIX 3 XLPE insulation	DIE 5 EPR insulation
Mechanical properties			
Before ageing	BS EN 60811-1-1, **9.1**		
Minimum tensile strength (MPa)		12.5	4.2
Minimum elongation at break (%)		200	200
After ageing in air oven	BS EN 60811-1-2, **8.1**		
Temperature (°C)		135	135
Duration (h)		168	168
Maximum variation of tensile strength (%) [A)]		25	30
Maximum variation of elongation at break (%) [A)]		25	30
After ageing in air bomb at 0.55 MPa	BS EN 60811-1-2, **8.2**		
Temperature (°C)		—	127
Duration (h)		—	40
Maximum variation in tensile strength (%) [A)]		—	30
Maximum variation in elongation at break (%) [A)]		—	30
Physical and chemical properties			
Hot set test	BS EN 60811-2-1, Clause **9**		
Temperature (°C)		200	250
Duration (min)		15	15
Mechanical stress (MPa)		0.2	0.2
Maximum elongation under load (%)		175	175
Maximum residual elongation (%)		15	15
Water absorption	BS EN 60811-1-3, **9.2**		
Temperature (°C)		85	100
Duration (h)		336	24
Maximum mass variation (mg/cm^2)		1	3
Insulation resistance constant, K_i [B)]	BS 7870-2, **3.3.1**		
Minimum value:			
At 20 °C (MΩ·km)		—	3 670
At 90 °C (MΩ·km)		10	3.67
Ozone resistance test	BS EN 60811-2-1, Clause **8**		
Exposure time (h)		—	30
Concentration of ozone (ppm)			250 to 300

NOTE 1 MPa = 1 N/mm².

[A)] The variation is the difference between the respective values obtained prior to and after heat treatment expressed as a percentage of the former.

[B)] This test is not required for screened cables.

Table B.2 **Requirements for oversheath materials** *(1 of 2)*

Parameter	Test method	Compound type		
		DMV 23 PVC oversheath	DMP 5 PE oversheath	DMZ 4 PO oversheath
Mechanical properties				
Before ageing	BS EN 60811-1-1, **9.2**			
Minimum tensile strength (MPa)		12.5	12.5	10.0
Minimum elongation at break (%)		150	300	100
After ageing in air oven	BS EN 60811-1-2, **8.1**			
Temperature (°C)		100	110	100
Duration (h)		168	336	168
Minimum tensile strength (MPa)		12.5	12.5	10.0
Maximum variation of tensile strength (%) [A)]		25	—	40
Minimum elongation at break (%)		150	300	100
Maximum variation of elongation at break (%) [A)]		25	—	40
Physical and chemical properties				
Water immersion test	BS 7870-2, **2.2.12**			
Temperature (°C)		—	—	70
Duration (h)		—	—	168
Maximum variation of tensile strength (%)		—	—	30
Maximum variation of elongation at break (%)		—	—	30
Insulation resistance constant, K_i	BS 7870-2, **3.3.4**			
Minimum value:				
At 20 °C (MΩ·km)		—	—	0.003 5
Properties after exposure to UV (non-black oversheaths only)	BS 7870-2, **2.4.20**			
Duration (h)		—	500	—
Minimum elongation at break (%)		—	300	—
Difference between elongation at break before and after exposure (%)		—	30	—
Carbon black content (black oversheaths only)	BS EN 60811-4-1, Clause **11**			
Content (%)		—	2.5 ±0.5	—
Loss of mass	BS EN 60811-3-2, **8.2**			
Duration (h)		168	—	—
Temperature (°C)		100	—	
Maximum loss of mass (mg/cm²)		1.5	—	—

Table B.2 **Requirements for oversheath materials** *(2 of 2)*

Parameter	Test method	Compound type		
		DMV 23 PVC oversheath	DMP 5 PE oversheath	DMZ 4 PO oversheath
Pressure test at high temperature	BS EN 60811-3-1, **8.2**			
Duration (h)		4 or 6 [B)]	6	4 or 6 [B)]
Temperature (°C)		90	115	80
Maximum depth of indentation (%)		50	50	50
Elongation test at low temperature	BS EN 60811-1-4, **8.4**			
Temperature (°C)		–15	—	–15
Minimum elongation (%)		20	—	30
Impact test at low temperature	BS EN 60811-1-4, **8.5**			
Temperature (°C)		–15	—	–15
Bending test at low temperature	BS EN 60811-1-4, **8.2**			
Temperature (°C)		–15	—	—
Heat shock test	BS EN 60811-3-1, **9.2**			
Duration (h)		1	—	—
Temperature (°C)		150	—	—
Tear resistance test	BS 7870-2, **2.2.2.2**			
Temperature (°C)		—	—	20 ±5
Minimum resistance (N/mm^2)				5

NOTE 1 MPa = 1 N/mm^2.

[A)] The variation is the difference between the respective values obtained prior to and after heat treatment expressed as a percentage of the former.

[B)] Dependent on the cable diameter, as given in BS EN 60811-3-1, **8.1.5**.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 8512, *Electric cables – Code of practice for the storage, handling, installation and disposal of cables on wooden drums*

BS IEC 60287, *Electric cables – Calculation of the current rating*

HD 603 S1, *Distribution cables of rated voltage 0.6/1 kV*

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

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*

HD 626 S1, *Overhead distribution cables of rated voltage $U_o/U(U_m)$: 0.6/1(1.2) kV*

HD 627 S1, *Multicore and multipair cable for installation above and below ground*

IEC 60183, *Guide to the selection of high voltage cables*

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