

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

Part 8: Specification for multicore and multipair cables for installation above and below ground —

Section 8.6: Single wire or double steel tape armoured and non-halogenated sheathed multipair cable with copper conductors

(Implementation of part of HD 627)

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Committees responsible for this British Standard

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British Approval Service for Cables

British Cables Association

British Plastics Association

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Foreword

This section of BS 7870 has been prepared by Subcommittee GEL/20/16, under the direction of Technical Committee GEL/20.

BS 7870 implements the nationally applicable parts of Harmonization Documents HD 603, HD 604, HD 605, HD 620, HD 622, HD 626 and HD 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, and is published as a series of separate parts and sections, as listed in the table in the foreword of BS 7870-1.

BS 7870-8.6 implements HD 627:Part 7A2 and is to be read in conjunction with BS 7870-1 and BS 7870-2.

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.

WARNING This British Standard calls for procedures that may 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.

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 does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 23 and a back cover.

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1 Scope

This section of BS 7870 specifies requirements for the construction, dimensions and mechanical and physical properties of multipair cables with halogen-free insulation and sheaths, having reduced fire propagation performance and low emission of smoke when affected by fire.

It specifies requirements for multipair cables (up to 200-pair) with copper conductors, a collective screen and armouring consisting of a single layer of steel wires or a double layer of steel tapes.

It specifies requirements for both Type 1 and Type 2 cables, which are defined as follows:

- Type 1: cable designed for the installation and operating conditions prevailing in a conventional fossil fuelled power station or equivalent location;
- Type 2: cable designed for the installation and operating conditions prevailing in a PWR power station, but excluding location in or around the containment area.

The requirements specified in this section of BS 7870 are applicable to both Type 1 and Type 2 cables unless otherwise indicated.

This section of BS 7870 is applicable to cables for use in and around power stations and other installations having similar cable densities.

NOTE A “guide to use” is given in Annex A.

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 6360, *Specification for conductors in insulated cables and cords*.

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

BS 7870-2:1999, *LV and MV polymeric insulated cables for use by distribution and generation utilities — Part 2: Methods of test*.

BS EN 50265-2-1:1999, *Common test methods for cables under fire conditions — Test for resistance to vertical flame propagation for a single insulated conductor or cable — Part 2-1: Procedures — 1 kW pre-mixed flame*.

BS EN 50265-2-2:1999, *Common test methods for cables under fire conditions — Test for resistance to vertical flame propagation for a single insulated conductor or cable — Part 2-2: Procedures — Diffusion flame*.

BS EN 50267-2-1, *Common test methods for cables under fire conditions — Tests on gases evolved during combustion of materials from cables — Part 2-1: Procedures — Determination of amount of halogen gas*.

BS EN 50268-2:2000, *Common test methods for cables under fire conditions — Measurement of smoke density of cables burning under defined conditions — Part 2: Procedure*.

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

BS EN 60811-1-2:1995, *Insulating and sheathing materials of electric cables — Common test methods — Part 1-2: General application — Thermal ageing methods*.

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

BS EN 60811-1-4:1995, *Insulating and sheathing materials for electric cables — Common test methods — Part 1-4: General application — Test at low temperatures*.

BS EN 60811-2-1:1995, *Insulating and sheathing materials for electric cables — Common test methods — Part 2-1: Methods specific to elastomeric compounds — Ozone resistance, hot set and mineral oil immersion tests*.

BS EN 60811-3-1:1995, *Insulating and sheathing materials for electric cables — Common test methods — Part 3-1: Methods specific to PVC compounds — Pressure test at high temperature — Tests for resistance to cracking.*

BS EN 60811-4-1:1995, *Insulating and sheathing materials for electric cables. Common test methods — Part 4-1: Methods specific to polythene and polypropylene compounds — Resistance to environmental stress cracking — Wrapping test after thermal ageing in air — Measurement of flow index — Carbon black and/or mineral content measurement in PE.*

BS EN 60811-4-2:2000, *Insulating and sheathing materials of electric cables — Common test methods — Methods specific to polyethylene and polypropylene compounds — Tensile strength and elongation at break after pre-conditioning — Wrapping test after thermal ageing in air — Measurement of mass increase — Long-term stability test — Test method for copper-catalysed oxidative degradation.*

BS EN ISO 4589-3, *Plastics — Determination of burning behaviour by oxygen index — Part 3: Elevated temperature test.*

IEC 60189-1:1986, *Low-frequency cables and wires with PVC insulation and PVC sheath — Part 1: General test and measuring methods.*

IEC 60189-2:1986, *Low-frequency cables and wires with PVC insulation and PVC sheath — Part 2: Cables in pairs, triples, quads and quintuples for inside installation.*

ASTM D5964-96:2001, *Standard practice for rubber IRM 902 and IRM 903 replacement oils for ASTM No. 2 and ASTM No. 3 oils.*

3 Rated voltage

The rated voltage of cables in this standard is 100 V a.c. or 150 V d.c.

4 Conductors

Conductors shall be of plain copper wire or tinned copper wire consisting of a single strand of 0.8 mm nominal diameter, conforming to the requirements of BS 6360.

Conformity shall be checked by visual examination as specified in **17.2**.

5 Insulation

The insulation for Type 1 cables shall be an extruded layer of PE compound conforming to the requirements given in Table 8. The insulation for Type 2 cables shall be an extruded layer of an aromatic based compound conforming to the requirements of this specification and meeting the requirements of BS EN 50265-2-2 in the core stage.

The insulation shall be applied so that it fits closely on the conductor and it shall be possible to remove it without damage to the insulation itself or to the conductor.

The insulation shall be applied by a suitable extrusion process, cross-linked where required, and shall form a compact and homogenous body.

Conformity shall be checked by the test methods specified in **17.3**.

6 Identification of cores

6.1 Cores

With the exception of 2-pair cables, the insulation of cores shall be colour coded in accordance with the code given in IEC 60189-2 and in Table 1 using cabling elements 1 to 20 inclusive, in sequence.

The cores of 2-pair cables shall be laid up as a quad in the sequence white, red, blue, orange.

Table 1 — Colour codes

Cabling element	Colour of insulation	
	Wire a	Wire b
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey
11	Black	Blue
12	Black	Orange
13	Black	Green
14	Black	Brown
15	Black	Grey
16	Yellow	Blue
17	Yellow	Orange
18	Yellow	Green
19	Yellow	Brown
20	Yellow	Grey

Conformity shall be checked by visual examination as specified in 17.5.1.

6.2 Pairs, quads and units

The cores of 2-pair cables shall be colour coded as detailed in 6.1 and shall be laid up in quad formation and bound overall with non-hygroscopic tape binder as detailed below. 5-pair and 10-pair cables shall consist of cabling elements colour coded 1 to 5 and 1 to 10 respectively as detailed in Table 1, and shall be laid up to form a compact and symmetrical cable. The laid-up group shall be bound overall with a non-hygroscopic tape binder as detailed below. Non-hygroscopic fillers shall be used if necessary for 2-pair, 5-pair and 10-pair constructions in order to form a compact and symmetrical cable.

20-pair to 200-pair cables shall be constructed from the required number of cabling units. Each cabling unit shall consist of 20 cabling elements, colour coded 1 to 20 as detailed above, laid up in concentric layers to form a compact and symmetrical unit.

The cabling unit shall be bound overall with non-hygroscopic tape binder of minimum thickness 0.023 mm and shall be applied with a minimum overlap of 25 %. The required number of cabling units, individually identified as detailed below, shall be laid up in concentric layers to form a compact and symmetrical cable and shall be bound overall with a double layer of clear non-hygroscopic tape, the layers being applied in opposite directions. Open spiral inter-layer tapes shall be applied if necessary. The cable construction shall consist of the required number of cabling units, using non-hygroscopic fillers where necessary, to form a compact and symmetrical cable.

The cabling units in cables having 40 pairs or more shall be individually identified by printed numbers of a contrasting colour to the natural base.

The printed numbers shall be applied direct on to the tape forming the unit binder or on a separate longitudinal tape applied under a clear unit binder tape. The numbers shall run from one upwards in units of one. The height of the figures shall be not less than 2 mm and shall be spaced such that ready identification of all units is possible in any 50 mm of cable. The figures shall be applied with an ink that is capable of withstanding the effect of wiping with a dry or wet cloth, and that will remain identifiable after the removal of the cable bedding and collective screen.

Conformity shall be checked by visual examination as specified in 17.5.2.

7 Assembly of cores, fillers and binders

Cable shall be twinned and where required formed into separate identifiable units, which shall then be laid up to form a compact and symmetrical cable using non-hygroscopic fillers and binders as required.

Conformity shall be checked by visual examination as specified in 17.6.

8 Rip cord

A terylene rip cord shall be included to facilitate stripping.

9 Collective screen

2-pair cables with binding tape shall have a plain aluminium tape of minimum thickness 0.075 mm applied helically with a minimum 25 % overlap, in contact with which shall be a 1/0.8 mm tinned copper drain wire or stranded conductor of equivalent cross-sectional area.

5-pair and above cables shall have a collective aluminium screen with a backing which will ensure adhesion to the bedding. The laminated screen tape shall be applied longitudinally over the rip cord and drain wire, and shall be in electrical contact with the latter, which shall be a 1/0.8 mm diameter tinned copper wire. The laminated screen shall be a minimum thickness of 0.15 mm aluminium bonded to a suitable backing material.

Conformity shall be checked by measurement as specified in 17.8.

10 Bedding layer

The bedding layer shall be an extruded layer of compound type ZM 1 for Type 1 cables and type ZM 2 for Type 2 cables.

11 Armouring

Cables shall be armoured either with a single layer of galvanized steel wires, applied with a direction of lay opposite to that of the pairs, or (in the case of Type 1 cables, 20-pair to 200-pair) with a double layer of galvanized steel tape each 0.5 mm thick. The tapes shall be applied helically with the outer tape covering the gap between the turns of the inner tape. Type 2 cables shall only be armoured with galvanized wires.

Joints in the steel wire armour shall be brazed or welded and any surface irregularity shall be removed. Any joint in any wire shall be not less than 1 m from the nearest joint in any other armour wire in the complete cable.

Conformity shall be checked by visual examination as specified in 17.11.

12 Oversheath

The oversheath shall be an extruded layer of compound type ZM 1 for Type 1 cable and type ZM 2 for Type 2 cable.

13 Marking

13.1 External marking

The external surface of the cable shall be legibly marked with the following elements.

Element	Example of marking
a) Electric cable	ELECTRIC CABLE
b) Voltage designation	100 V
c) British Standard number ¹⁾ and cable type	BS 7870-8.6 Type 1 or BS 7870-8.6 Type 2
d) Manufacturer's identification	XYZ

The marking shall be by indenting or embossing on the oversheath.

For cables with tabulated²⁾ approximate overall diameters greater than 15 mm, elements a), b) and c) shall appear, in any sequence that is deemed neither to confuse nor to conflict, on two or more primary lines along the axis of the cable, approximately equally spaced around the circumference of the cable.

Element d) shall appear upon at least one line, which may be one of the primary lines or a secondary line.

For cables with tabulated²⁾ approximate overall diameters of 15 mm or less, the elements shall be arranged as for cables of greater than 15 mm diameter, except that the marking for elements a), b) and c) shall appear on one or more primary lines.

The distance between the end of one element of marking and the beginning of the next identical element shall be not greater than 550 mm for elements a), b) and c) and not greater than 1 100 mm for element d).

NOTE Identification of circuits by colour or printing may be provided if mutually agreed between supplier and user.

The letters and figures shall consist of upright block characters. The characters shall have a minimum height of 3 mm.

Conformity shall be checked by visual examination and measurement as specified in 16.6.

13.2 Identification of year of manufacture

A means of identifying the year of manufacture of the cable shall be provided throughout the length of the cable, either internally or by use of an identification thread or externally by marking on the surface of the cable.

If the identification is internal, the distance between the end of one mark and the beginning of the next mark shall be not greater than 550 mm.

If the identification is by marking on the external surface, the distance between the end of one element of marking and the beginning of the next identical element shall be not greater than 1 100 mm.

Conformity shall be checked by visual examination and measurement as specified in 16.6.

13.3 Mark of an approval organization

If the mark of an approval organization is used, it shall be provided throughout the length of the cable, either as an identification thread or by marking on the external surface of the cable, as specified by the approval organization.

If the mark is on the external surface of the cable, it shall be in the form of the symbol(s) specified by the approval organization, and the distance between the end of one element of marking and the beginning of the next identical element shall be not greater than 1 100 mm.

Conformity shall be checked by visual examination and measurement as specified in 16.6.

¹⁾ Marking BS 7870-8.6:2003 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

²⁾ See Table 2 and Table 3.