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BRITISH STANDARD

BS 7919:2001
Incorporating Amendments Nos. 1 and 2

Electric cables — Flexible cables rated up to 450/750 V, for use with appliances and equipment intended for industrial and similar environments

ICS 29.060.20

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BSI
British Standards

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/1, Wiring cables, below 1 kV, upon which the following bodies were represented:

Association of Consulting Engineers

Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)

British Approvals Service for Cables

British Cables Association

British Plastics Federation

British Retail Consortium

Chartered Institution of Building Services Engineers

Department of Trade and Industry (Consumer Safety Unit, CA Division)

Electrical Installation Equipment Manufacturers Association

Electricity Association

Energy Industries Council

Engineering Industries Association

ERA Technology Ltd.

Institution of Incorporated Engineers

Lift and Escalator Industry Association

London Underground Ltd.

Transmission and Distribution Association (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on
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Amd. No.	Date	Comments
13777	2 October 2002	Addition of supersession detail to foreword (also see paragraph 2 of foreword)
14202	25 February 2004	See foreword

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Foreword

This British Standard has been prepared by Subcommittee GEL/20/1. It specifies requirements for flexible cables for industrial and similar environments. It incorporates cables specified in HD 21.12 and HD 21.13, and in HD 22.10, HD 22.11, HD 22.12, HD 22.13, HD 22.15 and HD 22.16.

BS 7919 complements BS 6500:2000 which specifies requirements for flexible cords for domestic and similar environments.

Together with BS 6500:2000, BS 6004:2000 and BS 6007:2000, it supersedes BS 6141:1991 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1. Tags indicating changes to text carry the number of the amendment. For example, text altered by amendment no. 1 is indicated by A1 A1.

Amendment No. 2:2004 implements the changes to the identification of cores by colours, in accordance with HD 308 S2. The principal identification colours are now:

Single phase – Green-and-yellow (Earth); blue (Neutral); brown (Live).

Three phase – Green-and-yellow (Earth); blue (Neutral); brown, black, grey (Live).

Users should ensure that any interconnection between cables with these new colours and those with the pre-existing ones is carried out safely. BS 7671, as amended in parallel with this standard, gives some guidance in this respect, but does not cover all installation conditions or cable uses.

The provisions introduced by amendment No. 2:2004 are effective from 1st April 2004. The version of this standard incorporating amendment No. 1:2002 remains current until 31st March 2006.

The following cable types have been transferred from other standards:

H07RN-F types (previously in BS 6500:1994, Table 8 and in BS 6007:1993, Table 4 and Table 4A);

H05RR-F types having conductor sizes larger than 2.5 mm^2 (previously in BS 6007:1993, Table 3);

H05VV-F types having conductor sizes larger than 2.5 mm^2 (previously in BS 6500:1994, Table 16).

A national type of low temperature 300/500 V PVC cable has also been included.

The following national type has been superseded by the H07BN4-F harmonized type:

450/750 V rubber insulated, HOFR sheathed flexible cable (previously in BS 6007:1993, Table 5).

Annex C, Annex D, Annex E, Annex F, Annex G, Annex I and Annex K are normative. Annex A and Annex B are informative. Annex H and Annex J are spare.

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.

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WARNING. This British Standard calls for the use of substances and/or 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.

Certification. Attention is drawn to the certification services (see page 69) of the British Approvals Service for Cables (BASEC)[1]. These services include licensing manufacturers to use BASEC certification marks as independent assurance that cables or cords have been designed and manufactured to appropriate British Standards. BASEC is a subscriber to an agreement in CENELEC whereby cables or cords coming within harmonized code designations and manufactured under a BASEC licence can carry marks acceptable to other signatory countries (CENELEC "Common Marking").

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 to vi, pages 1 to 69 and a back cover.

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1 Scope

This British Standard specifies requirements for the construction, dimensions and mechanical and electrical properties of insulated flexible cables for operation at voltages up to and including 450 V a.c. to earth and 750 V a.c. between conductors, intended for use with appliances and equipment in industrial or similar environments for ordinary or heavy duty.

The types of cables included in this standard are as follows:

Table 10	Ordinary duty rubber insulated and sheathed flexible cable, 3-core and 4-core. (H05RR-F)	300/500 V;
Table 11	Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, 3-core and 4-core. (H05BB-F)	300/500 V;
Table 12	Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core. (H07BB-F)	450/750 V;
Table 13	Ordinary duty heat resisting 110 °C EVA or equivalent synthetic elastomer insulated and sheathed flexible cable, parallel twin, circular twin, 3-core, 4-core and 5-core. (H05GG-F, H05GGH2-F)	300/500 V;
Table 14	Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core. (H07RN-F)	450/750 V;
Table 15	Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core. (H07RN-F)	450/750 V;
Table 16	Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core. (H07BN4-F)	450/750 V;
Table 17	Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core. (H07BN4-F)	450/750 V;
Table 18	Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, single-core, circular twin, 3-core, 4-core and 5-core. (H07ZZ-F)	450/750 V;
Table 19	Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, 6-core, 12-core, 18-core, 24-core and 36-core. (H07ZZ-F)	450/750 V;
Table 20	Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core. (H07RN8-F)	450/750 V;
Table 21	Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core. (H07RN8-F)	450/750 V;
Table 22	Ordinary duty heat resisting 180 °C silicone rubber insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H05SS-F, H05SST-F)	300/500 V;
Table 23	Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and thermoplastic polyurethane sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H05BQ-F)	300/500 V;
Table 24	Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and thermoplastic polyurethane sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H07BQ-F)	450/750 V;
Table 40	Ordinary duty PVC insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H05VV-F)	300/500 V;
Table 41	Ordinary duty 90 °C insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H05V2V2-F)	300/500 V;
Table 42	Ordinary duty PVC insulated and oil resisting PVC sheathed flexible cable, circular twin, 3-core, 4-core and 5-core. (H05VV5-F)	300/500 V;
Table 43	Ordinary duty PVC insulated and oil resisting PVC sheathed flexible cable, 6-core, 7-core, 12-core, 18-core, 27-core, 36-core, 48-core and 60-core. (H05VV5-F)	300/500 V;
Table 44	Ordinary duty low temperature PVC insulated and sheathed flexible cable, parallel twin, circular twin, 3-core, 4-core and 5-core. (National type)	300/500 V.

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A guide to the use of the cables specified in this standard is given in Annex A. Guidance to manufacturers on procedures for routine testing is given in Annex B. Test methods are given in Annex C, Annex D, Annex E, Annex F, Annex G, Annex I and Annex K.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publications referred to applies.

[A2] *Text deleted* [A2]

BS 4727-2-08, *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms — Part 2: Terms particular to power engineering — Group 08: Electric cables.*

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

BS 7655-1.1, *Specification for insulating and sheathing materials for cables — Part 1: Cross-linked elastomeric insulating compounds — Section 1.1: Harmonized types.*

BS 7655-2.1, *Specification for insulating and sheathing materials for cables — Part 2: Cross-linked elastomeric sheathing compounds — Section 2.1: Harmonized types.*

BS 7655-3.1, *Specification for insulating and sheathing materials for cables — Part 3: PVC insulating compounds — Section 3.1: Harmonized types.*

BS 7655-4.1, *Specification for insulating and sheathing materials for cables — Part 4: PVC sheathing compounds — Section 4.1: Harmonized types.*

BS 7655-4.2, *Specification for insulating and sheathing materials for cables — Part 4: PVC sheathing compounds — Section 4.2: General application.*

BS 7655-5.1, *Specification for insulating and sheathing materials for cables — Part 5: Cross-linked insulating compounds having low emission of corrosive gases, and suitable for use in cables having low emission of smoke when affected by fire — Section 5.1: Harmonized cross-linked types.*

BS 7655-8.1, *Specification for insulating and sheathing materials for cables — Part 8: Cross-linked sheathing compounds having low emission of corrosive gases, and suitable for use in cables having low emission of smoke when affected by fire — Section 8.1: Harmonized types.*

BS 7655-12.1, *Specification for insulating and sheathing materials for cables — Part 12: Miscellaneous sheathing compounds — Section 12.1: Harmonized thermoplastic polyurethane sheathing compound.*

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 premixed flame.*

[A2] BS EN 50266-2-4, *Common test methods for cables under fire conditions — Test for vertical flame spread of vertically-mounted bunched wires or cables — Part 2-4: Procedures — Category C.* [A2]

BS EN 50267-2-2:1999, *Common test methods for cables under fire conditions — Tests on gases evolved during combustion of materials from cables — Part 2-2: Procedures — Determination of degree of acidity of gases for materials by measuring pH and conductivity.*

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

[A2] BS EN 50334 [A2], *Marking by inscription for the identification of cores of electric cables.*

BS EN 60719:1993, *Calculation for the lower and upper limits for the average outer dimensions of cables with circular copper conductor and rated voltages up to and including 450/750 V.*

BS EN 60811-1-1:1995, *Insulating and sheathing materials of electric cables — Common test methods — Part 1: General application — Section 1.1: Measurement of thickness and overall dimensions — Tests for determining the mechanical properties.*

BS EN 60811-1-2, *Insulating and sheathing materials of electric cables — Common test methods — Part 1: General application — Section 1.2: Thermal ageing methods.*

[A2] *Footnote deleted* [A2]

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BS EN 60811-4-1, *Insulating and sheathing materials of electric cables — Common test methods — Part 4: Methods specific to polyethylene and polypropylene compounds — Section 4.1: Resistance to environmental stress cracking — Wrapping test after thermal ageing in air — Measurement of the flow index — Carbon black and/or mineral content measurement in PE.*

PD 2379, *Register of colours of manufacturers' identification threads for electric cables and cords.*

3 Terms and definitions

For the purposes of this British Standard the terms and definitions given in BS 4727-2:Group 08 and the following apply.

3.1
rated voltage U_0
nominal power-frequency voltage between conductor(s) and earth, for which the cable is suitable

3.2
rated voltage U
nominal power-frequency voltage between phase conductors for which the cable is suitable

3.3
nominal value
value by which a quantity is designated and which is often used in tables

NOTE In this standard, nominal values usually give rise to values to be checked by measurement taking into account specified tolerances.

3.4
approximate value
value which is only indicative

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

3.5
type tests (symbol T)
tests required to be made before supplying a type of cable covered by this standard on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application

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

3.6
sample tests (symbol S)
tests made on samples of completed cable, or components taken from a completed cable adequate to verify that the finished product meets the design specifications

3.7
routine tests (symbol R)
tests made on all production lengths of cable to demonstrate their integrity

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4 Voltage designation

Cables shall be designated by the rated voltages U_0 and U, expressed in the form U_0/U.

In an a.c. system, the rated voltage of a cable shall be at least equal to the nominal voltage of the system for which it is intended and this applies both to the value U_0 and to the value U.

In a d.c. system, the nominal voltage between conductors shall be not higher than 1.5 times the rated voltage U of the cable and the nominal voltage between any conductor and earth shall be not higher than 1.5 times the rated voltage U_0 of the cable.

The rated voltages recognized for the purposes of this standard shall be 300/500 V and 450/750 V.

NOTE The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10 %. A cable can be used at 10 % higher voltage than its rated voltage if the latter is at least equal to the nominal voltage of the system.

5 General

5.1 Construction

The construction of the cables shall be as given in the appropriate construction table (Table 10 to Table 24 or Table 40, Table 41, Table 42, Table 43 and Table 44).

Conformity shall be checked by examination.

5.2 Core identification

5.2.1 *General*

Each core shall be identified by its colour or number as indicated in the appropriate construction table.

5.2.2 *Core colours*

The colour shall be either throughout the whole of the insulation or on its surface. Alternatively, for cables having an optional proofed tape, that tape shall be coloured.

The colours of the cores according to the number of cores in the cable and also the sequence of the colours shall be as given in the appropriate construction table.

Where indicated in the construction table, cables shall be colour coded using the pilot and marker system. In each layer, two adjacent cores shall be distinctively coloured, with all other cores the same colour as each other. For cables including a protective earth conductor, one core coloured green-and-yellow shall replace one of the two distinctively coloured cores in the outer layer only.

On the core marked with the bi-colour combination green-and-yellow, the distribution of these colours shall be such that for every 15 mm length of core, one of these colours shall cover at least 30 % and not more than 70 % of the surface of the core, while the other colour covers the remainder of the surface.

Conformity shall be checked by measurement.

When a green-and-yellow bi-colour combination is used the core marked with it shall be laid up in the outer layer.

NOTE 1 In cases of dispute regarding the green/yellow combination and where appropriate to the method of colour marking of the insulation, a suitable test method for checking conformity is given in BS 6469-99.1:1992, Clause **8**.

NOTE 2 It is understood that the colours green and yellow when they are combined as specified are recognized as identifying exclusively the core intended for use as an earth connection or similar protection. The colour blue is for the identification of the core intended to be connected to the neutral but, if there is no neutral, blue may be used to identify any core except for the earthing or protective conductor.

5.2.3 *Core numbering*

Where cables of more than 5-cores are identified by marking by inscription this shall be in accordance with BS EN 50334.

5.2.4 *Clarity and durability of colours and numbers*

The colours or numbers shall be clearly identifiable and durable.

Conformity shall be checked by trying to remove the colour or inscribed number of the cores by rubbing the core lightly 10 times with a piece of cotton wool or cloth soaked in water.

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5.3 Cable markings

5.3.1 *General*

Designated harmonized codes for cables are given in the appropriate construction tables and, except where explicitly shown as national types, these cables shall be permitted to bear the CENELEC Common Marking in accordance with **5.3.3**.

5.3.2 *Indication of origin*

All cables shall be provided with an indication of origin consisting of either an identification thread or threads or the continuous marking of the manufacturer's name or trademark.

If coloured threads are used, the colours shall conform to those registered in PD 2379, where applicable. The colours shall be easy to recognize or shall become recognizable by cleaning with petrol or other suitable solvent, if necessary.

The marking of the manufacturer's name or trademark, if used, shall be by one of the following alternative methods:

a) printed tape within the cable;

b) printing, indenting or embossing on the insulation of at least the blue core;

c) printing, indenting or embossing on the sheath, if any.

Each specified mark shall be legible and shall be regarded as continuous if the distance between the end of the mark and the beginning of the next identical mark does not exceed the following:

1) 550 mm if the marking is on the outer sheath of the cable;

2) 275 mm if the marking is:

i) on the insulation of an unsheathed cable;

ii) on the insulation of a sheathed cable;

iii) on a tape within a sheathed cable.

Conformity shall be checked by measurement.

NOTE A "specified mark" is a mandatory mark covered by this standard, or the optional CENELEC Common Marking as specified in **5.3.3**.

5.3.3 *CENELEC "Common Marking"*

It shall be permitted for cables for which a harmonized code designation is given in the appropriate construction table to carry an indication that it has been manufactured under a licence issued by one of the approvals organizations subscribing to the CENELEC agreement on the use of a commonly agreed marking for cables. If it does carry such an indication this shall be one of the following.

a) The mark of the approvals organization, followed by the Common Marking ◁ HAR ▷ applied by one of the three methods specified in **5.3.2**.

b) An identification thread extending throughout the length of the cable indicating the approvals organization. The base colour shall be yellow and this shall be serially dyed or printed in red and black. The lengths of the coloured sections shall conform to the dimensions laid down by CENELEC for that approvals organization (see PD 2379).

Neither of these indications shall be used for a cable shown in the construction tables as a national type or national size.

The name CENELEC, in full or abbreviated, shall not be marked on, or in, the cable.

5.3.4 *Identification mark*

〈A2〉 Harmonized cables shall be marked with the CENELEC harmonized code designation, as given in the applicable construction table. The marking shall be on the sheath, except for cables to Table 10, Table 22 and Table 40 to Table 44 where it shall be on the sheath or on the insulation of one core.

The marking shall be continuous as specified in **5.3.2**.

Conformity shall be checked by measurement. 〈A2〉

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5.3.5 *Durability*

Any marking by printing shall be durable.

Conformity shall be checked by rubbing the marking lightly 10 times with a piece of cotton wool or cloth soaked in water.

5.4 Cable testing

5.4.1 *Schedule of tests*

The tests to be performed on cables specified in this standard shall be as specified in Table 2 and Table 5, which refer to the relevant clauses of the standard specifying the requirements and test methods as well as the category of each test which applies, i.e. T, S or R (as defined in Clause **3**).

NOTE Table 2 and Table 5 also indicate which tests relate to completed cables, and which relate to components.

5.4.2 *Test conditions*

5.4.2.1 *Ambient temperature*

Tests shall be performed at an ambient temperature of (20 ± 15) °C unless otherwise specified in the details for a particular test.

5.4.2.2 *Frequency and waveform of power frequency test voltages*

Unless otherwise specified for a particular test, the frequency of the alternating test voltages shall be in the range of 49 Hz to 61 Hz. The waveform shall be substantially sinusoidal.

6 Flexible cables with thermosetting insulation

6.1 Conductors

The conductors shall be tinned or plain annealed copper conforming to BS 6360.

The class of conductor shall be as given in the appropriate construction table.

The d.c. resistance of the conductors shall be as specified in **6.8.2**.

Plain conductors shall conform to the solderability requirements specified in **6.9.9**. A separator tape shall be applied around the conductor where specified in the appropriate construction table. Any separator tape used in type H07ZZ-F cables (specified in Table 18 and Table 19), shall conform to the corrosive and acid gas emission requirements specified in **6.10.4**.

NOTE The construction tables indicate those cables in which an optional separator tape may be applied around the conductor.

6.2 Insulation

6.2.1 *Type of insulation*

The insulation shall be one of the following types as specified in the appropriate construction table:

a) type EI 2, EI 3, EI 4, EI 6 or EI 7 conforming to BS 7655-1.1;

b) type EI 8 conforming to BS 7655-5.1.

6.2.2 *Application*

The insulation shall be applied closely by extrusion to the conductor or separator.

It shall be possible to remove the insulation easily, without damage to the insulation itself, to the conductor or to the tin coating, if any.

Conformity shall be checked by examination and by a manual test.

6.2.3 *Thickness*

The radial thickness of the insulation, when determined by taking the average of a number of measurements in accordance with **K.1**, shall be not less than the value given in the appropriate construction table and the smallest of the measured values shall not fall below the value by more than 10 % + 0.1 mm.

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6.2.4 *Additional tape*

Where specified in the appropriate construction table, it shall be permissible for a tape to be applied over the insulation. Where tapes are used, it shall be possible to remove the tape from a completed cable without damage to the insulation.

Any tape used in type H07ZZ-F cables (specified in Table 18 and Table 19), shall conform to the corrosive and acid gas emission requirements specified in **6.10.4**.

6.3 Core identification

Each core shall be identified by its colour or number in accordance with **5.2** and the specific requirements given in appropriate construction table.

6.4 Fillers and binders

The use of fillers and binders shall be in accordance with the appropriate construction table.

NOTE Where applicable, the construction tables indicate whether:

— a centre filler is permitted;

— the outer sheath is required to fill the outer interstices;

— separate fillers are permitted to fill the interstices;

— a binder tape is permitted over the assembly of cores, and fillers if any.

Where separate fillers are permitted, they shall be of elastomeric compound, natural textiles, synthetic textiles or similar material.

Any fillers or binder tapes used in type H07ZZ-F cables (specified in Table 18 and Table 19) shall conform to the corrosive and acid gas emission requirements specified in **6.10.4**.

It shall be possible to remove the sheath, fillers and binder tape without damage to the cores.

6.5 *Spare*

6.6 Sheath

6.6.1 *Type of sheath*

The sheath shall be one of the following types as specified in the appropriate construction table:

a) type EM 2, EM 3, EM 4, EM 6, EM 7 or EM 9 conforming to BS 7655-2.1;

b) type EM 8 or EM 10 conforming to BS 7655-8.1;

c) type TMPU conforming to BS 7655-12.1.

6.6.2 *Application*

6.6.2.1 *General*

The sheath shall be extruded and shall consist of either a single layer or two layers as specified for each type of cable in the appropriate construction table.

6.6.2.2 *Sheath in a single homogeneous layer*

The sheath shall be extruded in a single homogeneous layer, and shall be capable of being removed without damage to the cores. Where taped cores are employed, some transfer of proofing from the tapes shall be permissible.

6.6.2.3 *Sheath in two separate homogeneous layers*

6.6.2.3.1 *Inner layer*

The inner layer of the sheath shall be applied as specified in **6.6.2.2**.

NOTE 1 A proofed tape or equivalent separator may be applied over the inner layer.

NOTE 2 The thickness of the tape or separator, if any, may be included, for a value not exceeding 0.5 mm, in the measurement of the thickness of inner layer provided that it adheres to the latter.

6.6.2.3.2 *Outer layer*

The outer layer of the sheath shall be applied over the inner layer or over the tape. It shall be applied as a homogeneous layer.

If the outer layer is bonded to the inner layer, it shall be visibly distinguishable from the inner layer. If it is not bonded, it shall be easily separable from the inner layer.

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6.6.3 ***Thickness***

6.6.3.1 *Sheath in a single homogeneous layer*

The radial thickness of the sheath, when determined by taking the average of a number of measurements in accordance with **K.2** or **K.3** as applicable, shall be not less than the value given in the appropriate construction table and the smallest of the measured values shall not fall below the value by more than 15 % + 0.1 mm.

6.6.3.2 *Sheath in two homogeneous layers*

The radial thickness of each layer of the sheath, when determined by taking the average of a number of measurements in accordance with **K.4**, shall be not less than the value given in the appropriate construction table and the smallest of the measured values shall not fall below the value by more than 15 % + 0.1 mm. If the outer layer is bonded to the inner layer, then the measurement shall be made with a measuring microscope.

The radial thickness of the two separate homogeneous layers of sheath combined, when determined by taking the average of a number of measurements in accordance with **K.4**, shall be not less than the values given in the appropriate construction table for the inner layer and outer layer added together, and the smallest of the measured values shall not fall below this total value by more than 15 % + 0.1 mm.

6.6.4 ***Colour***

6.6.4.1 *General*

The colour of the sheath shall be as specified in the appropriate construction table.

6.6.4.2 *Black sheaths*

Where the appropriate construction table specifies that the cable shall have a black sheath, or where a black sheath is applied to a cable where colour is not specified, the colour shall be throughout the whole of the sheath, or the whole of the outer layer in a two layer construction.

6.6.4.3 *Non-black sheaths*

For all non-black sheaths, the colour shall be throughout the whole of the sheath (or the whole of the outer layer in a two layer construction) or on its surface. Where surface colouring is applied, the surface colour shall be of essentially the same material as the underlying material and shall be applied as part of the extrusion process. The surface colour shall not be separable from the underlying material and shall be durable.

6.7 *Spare*

6.8 Electrical tests

6.8.1 ***General***

The electrical tests to be performed on flexible cables with thermosetting insulation shall be as specified in Table 1.

The tests shall be performed in accordance with the test schedule given in Table 2.

6.8.2 ***Conductor resistance***

The d.c. resistance of each conductor shall be measured in accordance with BS 6360 on a sample of completed cable not less than 1 m in length. The resistance of each conductor of all cables shall not exceed the relevant value specified in BS 6360.

6.8.3 ***Voltage test on completed cable***

When the cable is tested in accordance with **C.2**, no breakdown of the insulation shall occur.

6.8.4 ***Voltage test on cores***

When the cores are tested in accordance with **C.3**, no breakdown of the insulation shall occur.

6.8.5 ***Absence of faults in the insulation***

When the cable is tested in accordance with **C.6**, no breakdown of the insulation shall occur.

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6.8.6 *Surface resistance of sheath*

This test shall be carried out on cables with sheaths made of compounds EM 2, EM 3, EM 4, EM 6, EM 7 and TMPU.

The surface resistance when tested in accordance with **C.7** shall be not less than $1 \times 10^9\ \Omega$.

6.8.7 *Long term resistance to d.c.*

For cables specified in Table 18 and Table 19, the insulation shall not break down nor shall the exterior of the insulation show damage when the cable is tested in accordance with **C.5**. Discoloration of the insulation shall be ignored.

6.8.8 *Insulation resistance*

For cables specified in Table 18 and Table 19, when the cable is tested in accordance with **C.4**, the insulation resistance of each core shall be not less than the minimum value specified in the appropriate construction table.

6.9 Non-electrical tests

6.9.1 *General*

The non-electrical tests and long term water immersion tests to be performed on flexible cables with thermosetting insulation shall be as specified in Table 1.

These tests shall be performed in accordance with the test schedule given in Table 2.

NOTE In some tests, the preparation and presentation of the test sample can have a critical effect on the result of the tests so it is essential that test samples are always prepared carefully.

Test samples shall be examined for damage before testing. Test samples which have been damaged during preparation shall not be tested.

In the case of sheath in two layers, each of the two layers shall be tested separately using the test methods applicable to the compound of which the layer is made. Each layer shall conform to the requirements specified for the particular compound of which it is made. If the two layers are bonded and separation with low mechanical deformation and/or without damaging the surface is not possible, test samples of each compound shall be prepared by cutting or grinding, care being taken to avoid undue heating.

6.9.2 *Mean overall dimensions*

The mean overall diameter of circular cables and the mean overall dimensions of flat cables shall be within the limits specified in the appropriate construction table, with the exception of national types and sizes for which the lower limit given in the construction tables shall be taken as an indicative value and not a requirement for conformity to this standard.

Conformity shall be checked by the method described in BS EN 60811-1-1:1995, **8.3**.

One sample of cable shall be taken from each of three places separated by at least 1 m. For circular cable the mean of the six values obtained shall be taken as the mean overall diameter. For flat cables, the mean of each set of three values, for the major and minor axis, respectively, shall be taken as the relevant overall dimension.

6.9.3 *Ovality of circular cables*

The difference between any two values of the overall diameter of circular sheathed cables at the same cross-section shall not exceed 15 % of the upper limit for the mean overall diameter given in the appropriate construction table.

Conformity shall be checked by the method described in BS EN 60811-1-1:1995, **8.3**.

One sample of cable shall be taken from each of three places separated by at least 1 m.

Two measurements shall be taken at the same cross-section of the cable, covering the maximum and minimum values.

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6.9.4 *Spare*

6.9.5 ***Two pulley flexing test***

When tested in accordance with Annex D, the cables shall conform to the following requirements.

During the test with 30 000 cycles, i.e. 60 000 single movements, there shall be:

— no interruption of the current;

— no short-circuit between the conductors;

— no short-circuit between the cable and the pulley wheels (the flexing apparatus).

After the required number of cycles the sheath of the cable shall be removed. The cores shall then be subjected to the voltage test specified in **C.3**. No breakdown of the insulation shall occur.

6.9.6 *Spare*

6.9.7 *Spare*

6.9.8 *Spare*

6.9.9 ***Solderability test***

To assess any possible interaction between the insulation and any plain conductor, the cable shall be subjected to the solderability test specified in Annex F.

After testing in accordance with **F.2**, those conductors which are not blackened shall be considered to have passed the test. When cables which failed the test described in **F.2** are subjected to the test procedure described in **F.3, F.4** and **F.5**, the part of the plain conductor which has been immersed in the solder bath shall be adequately tinned.

6.9.10 ***Compatibility***

For cables specified in Table 16, Table 17, Table 18, Table 19, Table 23 and Table 24, after a sample of completed cable has been aged in accordance with **G.2**, the insulation and sheath shall conform to the requirements given in Table 3. In addition, at the end of the test period in the oven, the blotting paper shall be free of stains.

6.10 Tests under fire conditions

6.10.1 ***Flame propagation of a single cable***

Cables specified in Table 14 to Table 22 inclusive shall be tested in accordance with BS EN 50265-2-1. The test shall be carried out on a sample of the completed cable. After the test the cable shall conform to the performance [A2] recommendations given [A2] in BS EN 50265-2-1:1999, Annex A.

6.10.2 ***Flame propagation of bunched cables***

[A2] Cables specified in Table 18 and Table 19 shall be tested in accordance with BS EN 50266-2-4. After the test, the cable shall conform to the performance recommendations given in BS EN 50266-2-4:2001, Annex B. [A2]

6.10.3 ***Smoke emission***

For cables specified in Table 18 and Table 19, when a sample of the completed cable is tested in accordance with BS EN 50268-2, the values for light transmittance shall not fall below 60 % at any time during the test.

The samples of cable shall be tested as a flat horizontal unit. The number of samples of cable shall be determined in accordance with BS EN 50268-2 using the values of mean overall diameter given in Table 18 and Table 19.

6.10.4 ***Corrosive and acid gas emission***

For cables specified in Table 18 and Table 19, when the non-metallic components of the cables are tested in accordance with BS EN 50267-2-2 the pH and conductivity of the solution shall conform to the requirements recommended in BS EN 50267-2-2:1999, Annex A.

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6.11 Long term water immersion tests

6.11.1 *Long term voltage tests in water*

Cables specified in Table 20 and Table 21 shall be tested in accordance with **I.1**, and shall conform to the requirements specified in **I.1**.

6.11.2 *Mechanical properties of sheath after immersion in water*

Cables specified in Table 20 and Table 21 shall be tested in accordance with **I.2** and shall conform to the requirements specified in **I.2**.

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Table 1 — List of tests applicable to the flexible cables specified in Clause 6

Clause number	Test	Cable specified in table														
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Electrical tests															
6.8.2	Conductor resistance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.8.3	Voltage test on completed cable at 2 000 V	X	X	—	X	—	—	—	—	—	—	—	—	X	X	—
6.8.3	Voltage test on completed cable at 2 500 V	—	—	X	—	X	X	X	X	X	X	X	X	—	—	X
6.8.4	Voltage test on cores at 2 500 V	—	—	X	—	X	X	X	X	X	X	X	X	—	—	X
6.8.4	Voltage test on cores at 2 000 V	X	X	—	X	—	—	—	—	—	—	—	—	X	—	—
6.8.4	Voltage test on cores at 1 500 V	—	—	—	X	—	—	—	—	—	—	—	—	X	X	—
6.8.5	Absence of faults in the insulation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.8.6	Surface resistance of sheath	X	X	X	X	X	X	X	X	—	—	X	X	—	X	X
6.8.7	Long term resistance to d.c.	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
6.8.8	Insulation resistance at 70 °C	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
	Constructional and dimensional tests															
5.1	Check on construction	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.2.3	Measurement of insulation thickness	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.6.3	Measurement of sheath thickness	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.9.2	Measurement of overall dimensions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.9.3	Measurement of ovality	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Mechanical strength of completed cables															
6.9.5	Two pulley flexing test[a]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Other tests															
6.9.9	Solderability test	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.9.10	Compatibility test	—	—	—	—	—	—	X	X	X	X	—	—	—	X	X
6.10.1	Flame propagation of a single cable	—	—	—	—	X	X	X	X	X	X	X	X	X	—	—
6.10.2	Flame propagation of bunched cables	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
6.10.3	Smoke emission	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
6.10.4	Corrosive and acid gas emission	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
6.11	Long term water immersion tests	—	—	—	—	—	—	—	—	—	—	X	X	—	—	—

[a] Not applicable to cables having conductors of cross-sectional area greater than 4 mm^2 or cables having more than 18-cores laid up in more than two concentric layers.

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Table 2 — Schedule of tests

Test	Requirement given in clause	Test method	Test category
Tests on components			
Conductor construction	**6.1**	BS 6360	S
Insulation:			
material	**6.2.1**	BS 7655-1.1 or BS 7655-5.1	T
application	**6.2.2**	Visual examination and a manual test	S
thickness	**6.2.3**	**K.1**	S
Core identification:			
colour	**6.3**	Visual examination	S
number	**6.3**	BS EN 50334	S
clarity and durability of colours and numbers	**5.2.4**	**5.2.4**	S
Fillers and binders	**6.4**	Visual examination	S
Sheath:			
physical properties	**6.6.1**	BS 7655-2.1, BS 7655-8.1 or BS 7655-12.1	T
application	**6.6.2**	Visual examination	S
thickness	**6.6.3**	**K.2**, **K.3** or **K.4**	S
Tests on completed cables			
Cable markings	**5.3**	Visual examination and measurement	R
Durability of marking	**5.3.5**	**5.3.5**	S
Conductor resistance	**6.8.2**	BS 6360	S
Voltage test on completed cable	**6.8.3**	**C.2**	S
Voltage test on cores	**6.8.4**	**C.3**	T
Absence of faults in the insulation	**6.8.5**	**C.6**	R
Surface resistance of sheath	**6.8.6**	**C.7**	T
Long term resistance to d.c	**6.8.7**	**C.5**	T
Insulation resistance	**6.8.8**	**C.4**	S
Mean overall dimensions	**6.9.2**	BS EN 60811-1-1:1995, **8.3**	S
Ovality	**6.9.3**	BS EN 60811-1-1:1995, **8.3**	S
Two pulley flexing test	**6.9.5**	Annex D	T
Solderability test	**6.9.9**	Annex F	T
Compatibility test	**6.9.10**	Annex G	T
Flame propagation of a single cable	**6.10.1**	BS EN 50265-2-1	T[a]
Flame propagation of bunched cables	**6.10.2**	A2 BS EN 50266-2-4 A2	T
Smoke emission	**6.10.3**	BS EN 50268-2	T
Corrosive and acid gas emission	**6.10.4**	BS EN 50267-2-2	T
Long term water immersion tests	**6.11**	Annex I	T

NOTE Tests classified as sample (S) or routine (R) may be required as part of a type approval scheme.

[a] For cables specified in Table 18 and Table 19 this test is category S.

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Table 3 — Compatibility requirements for the cables specified in Clause 6

Component	Parameter	Requirement for material type						
		EI 6	EI 7	EI 8	EM 7	EM 8	EM 10	TMPU
Insulation	Minimum tensile strength (N/mm^2)	5.0	5.0	—	—	—	—	—
	Minimum percentage elongation at break	—	—	125	—	—	—	—
	Maximum percentage variation[a] of tensile strength	±30	±30	−30[b]	—	—	—	—
	Maximum percentage variation[a] of elongation at break	±30	±30	±30	—	—	—	—
Sheath	Minimum tensile strength (N/mm^2)	—	—	—	—	—	—	—
	Minimum percentage elongation at break	—	—	—	—	100	100	300
	Maximum percentage variation[a] of tensile strength	—	—	—	±30	−30[b]	−30[b]	±30
	Maximum percentage variation[a] of elongation at break	—	—	—	±40	±30	±30	±30

[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] No limit for the positive tolerance.

7 Flexible cables with thermoplastic insulation

7.1 Conductors

The conductors shall be tinned or plain annealed copper conforming to BS 6360.

The class of the conductor shall be as given in the appropriate construction table.

The d.c. resistance of the conductors shall be as specified in **7.8.2**.

7.2 Insulation

7.2.1 *Type of insulation*

The insulation shall be type TI 2, TI 3 or TI 4 conforming to BS 7655-3.1, as specified in the appropriate construction table.

7.2.2 *Application*

The insulation shall be applied closely by extrusion to the conductor. It shall be possible to remove the insulation easily, without damage to the insulation itself or to the conductor or to the tin coating, if any.

Conformity shall be checked by examination and by a manual test.

7.2.3 *Thickness*

The radial thickness of the insulation, when determined by taking the average of a number of measurements in accordance with **K.1**, shall be not less than the value given in the appropriate construction table and the smallest of the measured values shall not fall below the value by more than 10 % + 0.1 mm.

7.3 Core identification

Each core shall be identified by its colour or number in accordance with **5.2** and the specific requirements given in the appropriate construction table.

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7.4 Fillers and binders

The use of fillers and binders shall be in accordance with the appropriate construction table.

NOTE Where applicable the construction tables indicate whether:

— a centre filler is permitted;
— the outer sheath is required fill the outer interstices;
— separate fillers are permitted to fill the interstices;
— a binder tape is permitted over the assembly of cores and fillers, if any.

Where separate fillers are permitted, they shall be of thermoplastic compound, natural textiles, synthetic textiles or similar material.

It shall be possible to remove the outer sheath, fillers and binder tape without damage to the cores.

7.5 *Spare*

7.6 Sheath

7.6.1 *Type of sheath*

The sheath shall be one of the following types as specified in the appropriate construction table:

a) type TM 2, TM 3 or TM 5 conforming to BS 7655-4.1;

b) type 10 conforming to BS 7655-4.2.

7.6.2 *Application*

The sheath shall be extruded in an homogeneous layer, and shall be capable of being removed without damage to the cores.

7.6.3 *Thickness*

The radial thickness of the sheath, when determined by taking the average of a number of measurements in accordance with **K.2** or **K.3**, as appropriate, shall be not less than the value given in the appropriate construction table and the smallest of the measured values shall not fall below the value by more than 15 % + 0.1 mm.

7.6.4 *Colour*

Where the sheath is coloured, the colour shall be throughout the whole of the sheath or on its surface. Where surface colouring is applied, the surface colour shall be of essentially the same material as the underlying material and shall be applied as part of the extrusion process. The surface colour shall not be separable from the underlying material and shall be durable.

7.7 *Spare*

7.8 Electrical tests

7.8.1 *General*

The electrical tests to be performed on flexible cables with thermoplastic insulation shall be as specified in Table 4.

These tests shall be performed in accordance with the test schedule given in Table 5.

7.8.2 *Conductor resistance*

The d.c. resistance of each conductor shall be measured in accordance with BS 6360 on a sample of completed cable not less than 1 m in length. The resistance of each conductor of all cables shall not exceed the relevant value given in BS 6360.

7.8.3 *Voltage test on completed cable*

When the cable is tested in accordance with **C.2**, no breakdown of the insulation shall occur.

7.8.4 *Voltage test on cores*

When the cores are tested in accordance with **C.3**, no breakdown of the insulation shall occur.

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7.8.5 *Absence of faults in the insulation*

When the cable is tested in accordance with **C.6**, no breakdown of the insulation shall occur.

7.8.6 *Insulation resistance*

When the cable is tested in accordance with **C.4**, the insulation resistance of each core shall be not less than the value specified in the appropriate construction table.

7.8.7 *Long term resistance of insulation to d.c.*

The insulation shall not break down nor shall the exterior of the insulation show damage when the cable is tested in accordance with **C.5**. Discoloration of the insulation shall be ignored.

7.9 Non-electrical tests

7.9.1 *General*

The non-electrical tests to be performed on flexible cables with thermoplastic insulation shall be as specified in Table 4.

These tests shall be performed in accordance with the test schedule given in Table 5.

NOTE In some tests, the preparation and presentation of the test sample can have a critical effect on the results of the tests, so it is essential that test samples are always prepared carefully.

Test samples shall be examined for damage before testing. Test samples which have been damaged during preparation shall not be tested.

7.9.2 *Mean overall dimensions*

The mean overall diameter of circular cables and the mean overall dimensions of flat cables shall be within the limits specified in the appropriate construction table, with the exception of national types and sizes for which the lower limit given in the construction tables shall be taken as an indicative value and not a requirement for conformity to this standard.

Conformity shall be checked by the method described in BS EN 60811-1-1:1995, **8.3**.

One sample of cable shall be taken from each of three places separated by at least 1 m. For circular cables, the mean of the six values obtained shall be taken as the mean overall diameter. For flat cables, the mean of each set of three values, for the major and minor axis respectively, shall be taken as the relevant overall dimension.

7.9.3 *Ovality of circular cables*

The difference between any two values of the overall diameter of circular sheath cables at the same cross-section shall not exceed 15 % of the upper limit for the mean overall diameter given in the appropriate construction table.

Conformity shall be checked by the method described in BS EN 60811-1-1:1995, **8.3**.

One sample shall be taken from each of three places separated by at least 1 m.

Two measurements shall be taken at the same cross-section of the cable, covering the maximum and minimum values.

7.9.4 *Two pulley flexing test*

When tested in accordance with Annex D the cables shall conform to the following requirements.

During the test with 30 000 cycles, i.e. 60 000 single movements, there shall be:

— no interruption of the current;

— no short circuit between the conductors;

— no short circuit between the cable and the pulley wheels (the flexing apparatus).

After the required number of cycles the sheath of the cable, if any, shall be removed. The cores shall then be subjected to the voltage test specified in **C.3**. The insulation shall not break down.

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7.9.5 *Spare*

7.9.6 *Spare*

7.9.7 *Spare*

7.9.8 ***Compatibility***

When a sample of completed cable specified in Table 40, Table 41, Table 42, Table 43 or Table 44 is aged in accordance with **G.2**, the insulation and sheath shall conform to the requirements specified in Table 6. In addition, at the end of the test period in the oven, the blotting paper shall be free of stains.

7.10 Flame propagation of a single cable

Cables shall be tested in accordance with BS EN 50265-2-1. The test shall be carried out on a sample of the completed cable. After the test, the cable shall conform to the performance A2 recommendations given A2 in BS EN 50265-2-1:1999, Annex A.

Table 4 — List of tests applicable to the flexible cables specified in Clause 7

Clause number	Test	Cable specified in table				
		40	41	42	44	43
	Electrical tests					
7.8.2	Conductor resistance	X	X	X	X	X
7.8.3	Voltage test on completed cable at 2 000 V	X	X	X	X	X
7.8.4	Voltage test on cores at 1 500 V	—	—	X	X	X
7.8.4	Voltage test on cores at 2 000 V	X	X	X	X	X
7.8.5	Absence of faults in the insulation	X	X	X	X	X
7.8.6	Insulation resistance at 70 °C	X	—	X	X	X
7.8.6	Insulation resistance at 90 °C	—	X	—	—	—
7.8.7	Long term resistance to d.c.	X	X	X	X	X
	Constructional and dimensional tests					
5.1	Check on construction	X	X	X	X	X
7.2.3	Measurement of insulation thickness	X	X	X	X	X
7.6.3	Measurement of sheath thickness	X	X	X	X	X
7.9.2	Measurement of overall dimensions	X	X	X	X	X
7.9.3	Measurement of ovality	X	X	X	X	X
	Mechanical strength of completed cables					
7.9.4	Two pulley flexing test[a]	X	X	X	X	X
	Other tests					
7.9.8	Compatibility test	X	X	X	X	X
7.10	Flame propagation of a single cable	X	X	X	X	X

[a] Not applicable to cables having conductors of cross-sectional areas greater than 2.5 mm^2 or cables having more than 18-cores laid up in more than two concentric layers.

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Table 5 — Schedule of tests

Test	Requirement given in clause	Test method	Test category
Tests on components			
Conductor construction	**7.1**	BS 6360	S
Insulation:			
material	**7.2.1**	BS 7655-3.1	T
application	**7.2.2**	Visual examination and manual test	S
thickness	**7.2.3**	**K.1**	S
Core identification:			
colour	**7.3**	Visual examination	S
number	**7.3**	Visual examination	S
clarity and durability of colours and numbers	**5.2.4**	**5.2.4**	S
Fillers and binders	**7.4**	Visual examination	S
Sheath:			
physical properties	**7.6.1**	BS 7655-4.1 or BS 7655-4.2	T
application	**7.6.2**	Visual examination	S
thickness	**7.6.3**	**K.2** or **K.3**	S
Tests on completed cables			
Cable markings	**5.3**	Visual examination and measurement	R
Durability of marking	**5.3.5**	**5.3.5**	S
Conductor resistance	**7.8.2**	BS 6360	S
Voltage test on completed cable	**7.8.3**	**C.2**	S
Voltage test on cores	**7.8.4**	**C.3**	T
Absence of faults in the insulation	**7.8.5**	**C.6**	R
Insulation resistance	**7.8.6**	**C.4**	S
Long term resistance of insulation to d.c.	**7.8.7**	**C.5**	T
Mean overall dimensions	**7.9.2**	BS EN 60811-1-1:1995, **8.3**	S
Ovality	**7.9.3**	BS EN 60811-1-1:1995, **8.3**	S
Two pulley flexing test	**7.9.4**	Annex D	T
Compatibility test	**7.9.8**	Annex G	T
Flame propagation of a single cable	**7.10**	BS EN 50265-2-1	T

NOTE Tests classified as sample (S) and routine (R) may be required as part of a type approval scheme.

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Table 6 — Compatibility requirements for flexible cables specified in Clause 7

Component	Parameter	Requirement for material type						
		TI 2	TI 3	TI 4	TM 2	TM 3	TM 5	Type 10
Insulation	Minimum tensile strength (N/mm^2)	10.0	15.0	12.5	—	—	—	—
	Minimum percentage elongation at break	150	150	125	—	—	—	—
	Maximum percentage variation[a] of tensile strength	±20	±25	±20	—	—	—	—
	Maximum percentage variation[a] of elongation at break	±20	±25	±20	—	—	—	—
Sheath	Minimum tensile strength (N/mm^2)	—	—	—	10	10	10	10
	Minimum percentage elongation at break	—	—	—	150	150	150	150
	Maximum percentage variation[a] of tensile strength	—	—	—	±20	±25	±20	±20
	Maximum percentage variation[a] of elongation at break	—	—	—	±20	±25	±20	±20

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

Table 7 — *Spare*

Table 8 — *Spare*

Table 9 — *Spare*

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Table 10 — Ordinary duty rubber insulated and sheathed flexible cable, 3-core and 4-core, 300/500 V

Harmonized code designation: H05RR-F

NOTE Equivalent cables having conductor sizes smaller than 4 mm² are specified in BS 6500.

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 4;

Sheath — compound type EM 3.

An optional separator tape may be applied around each conductor.

Optional coloured proofed tape is permitted over the insulation.

3- or 4-cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section.

A binder tape is permitted over the assembly of cores.

A centre filler may be used.

Core identification and sequence:

3-core — green-and-yellow, blue and brown;

〉A2〈 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a]. 〉A2〈

Colour of sheath — Not specified, but if black is used the carbon black content shall be 2 % minimum when measured in accordance with BS EN 60811-4-1.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit	Upper limit
mm²	mm	mm	mm	mm
3 × 4	1.0	1.2	11.3	14.5
3 × 6	1.0	1.4	12.8	16.3
4 × 4	1.0	1.3	12.7	16.2
4 × 6	1.0	1.5	14.2	18.1

[a] 〉A2〈 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〉A2〈

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Table 11 — Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, 3-core and 4-core, 300/500 V

Harmonized code designation: H05BB-F

NOTE Equivalent cables having conductor sizes smaller than 4 mm² are specified in BS 6500.

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 6;

Sheath — compound type EM 6.

An optional separator tape may be applied around each conductor.

3- or 4-cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section.

A binder tape is permitted over the assembly of cores.

A centre filler may be used.

Core identification and sequence:

3-core — green-and-yellow, blue and brown;

〖A2〗 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a] 〈A2〉.

Colour of sheath — Not specified, but if black is used the carbon black content shall be 2 % minimum when measured in accordance with BS EN 60811-4-1.

〖A2〗 *Text deleted* 〈A2〉

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit	Upper limit
mm²	mm	mm	mm	mm
3 × 4	1.0	1.2	11.3	14.5
3 × 6	1.0	1.4	12.8	16.3
4 × 4	1.0	1.3	12.7	16.2
4 × 6	1.0	1.5	14.2	18.1

[a] 〖A2〗 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〈A2〉

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Table 12 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07BB-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 6;

Sheath — for specified thicknesses ≤2.4 mm: a single layer of compound type EM 6;

— for specified thicknesses >2.4 mm: either a single layer of compound type EM 6 or two separate layers of compound type EM 6.

An optional separator tape may be applied around each conductor.

2- to 5-cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

Core identification and sequence:

Single-core — green-and-yellow, light blue or other colours, except green, yellow or any other bi-colours;

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

〚A2〛 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey. 〈A2〉

Colour of sheath — Not specified but, if black is used, the carbon black content shall be 2 % minimum when measured in accordance with BS EN 60811-4-1.

〚A2〛 *Text deleted* 〈A2〉

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm²	mm	mm	mm	mm	mm	mm
1 × 1.5	0.8	1.4	—	—	5.7	7.1
1 × 1.5	0.9	1.4	—	—	6.3	7.9
1 × 4	1.0	1.5	—	—	7.2	9.0
1 × 6	1.0	1.6	—	—	7.9	9.8
1 × 10	1.2	1.8	—	—	9.5	11.9
1 × 16	1.2	1.9	—	—	10.8	13.4
1 × 25	1.4	2.0	—	—	12.7	15.8
1 × 35	1.4	2.2	—	—	14.3	17.9
1 × 50	1.6	2.4	—	—	16.5	20.6
1 × 70	1.6	2.6	1.0	1.6	18.6	23.3
1 × 95	1.8	2.8	1.1	1.7	20.8	26.0
1 × 120	1.8	3.0	1.2	1.8	22.8	28.6
1 × 150	2.0	3.2	1.3	1.9	25.2	31.4
1 × 185	2.2	3.4	1.4	2.0	27.6	34.4
1 × 240	2.4	3.5	1.4	2.1	30.6	38.3

[a] 〚A2〛 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〈A2〉

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Table 12 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
1 × 300	2.6	3.6	1.4	2.2	33.5	41.9
1 × 400	2.8	3.8	1.5	2.3	37.4	46.8
1 × 500	3.0	4.0	1.6	2.4	41.3	52.0
2 × 1	0.8	1.3	—	—	7.7	10.0
2 × 1.5	0.8	1.5	—	—	8.5	11.0
2 × 2.5	0.9	1.7	—	—	10.2	13.1
2 × 4	1.0	1.8	—	—	11.8	15.1
2 × 6	1.0	2.0	—	—	13.1	16.8
2 × 10	1.2	3.1	1.2	1.9	17.7	22.6
2 × 16	1.2	3.3	1.3	2.0	20.2	25.7
2 × 25	1.4	3.6	1.4	2.2	24.3	30.7
3 × 1	0.8	1.4	—	—	8.3	10.7
3 × 1.5	0.8	1.6	—	—	9.2	11.9
3 × 2.5	0.9	1.8	—	—	10.9	14.0
3 × 4	1.0	1.9	—	—	12.7	16.2
3 × 6	1.0	2.1	—	—	14.1	18.0
3 × 10	1.2	3.3	1.3	2.0	19.1	24.2
3 × 16	1.2	3.5	1.4	2.1	21.8	27.6
3 × 25	1.4	3.8	1.5	2.3	26.1	33.0
3 × 35	1.4	4.1	1.6	2.5	29.3	37.1
3 × 50	1.6	4.5	1.8	2.7	34.1	42.9
3 × 70	1.6	4.8	1.9	2.9	38.4	48.3
3 × 95	1.8	5.3	2.1	3.2	43.3	54.0
3 × 120	1.8	5.6	2.2	3.4	47.4	60.0
3 × 150	2.0	6.0	2.4	3.6	52.0	66.0
3 × 185	2.2	6.4	2.5	3.9	57.0	72.0
3 × 240	2.4	7.1	2.8	4.3	65.0	82.0
3 × 300	2.6	7.7	3.1	4.6	72.0	90.0
4 × 1	0.8	1.5	—	—	9.2	11.9
4 × 1.5	0.8	1.7	—	—	10.2	13.1
4 × 2.5	0.9	1.9	—	—	12.1	15.5

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Table 12 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
4 × 4	1.0	2.0	—	—	14.0	17.9
4 × 6	1.0	2.3	—	—	15.7	20.0
4 × 10	1.2	3.4	1.4	2.0	20.9	26.5
4 × 16	1.2	3.6	1.4	2.2	23.8	30.1
4 × 25	1.4	4.1	1.6	2.5	28.9	36.6
4 × 35	1.4	4.4	1.7	2.7	32.5	41.1
4 × 50	1.6	4.8	1.9	2.9	37.7	47.5
4 × 70	1.6	5.2	2.0	3.2	42.7	54.0
4 × 95	1.8	5.9	2.3	3.6	48.4	61.0
4 × 120	1.8	6.0	2.4	3.6	53.0	66.0
4 × 150	2.0	6.5	2.6	3.9	58.0	73.0
4 × 185	2.2	7.0	2.8	4.2	64.0	80.0
4 × 240	2.4	7.7	3.1	4.6	72.0	91.0
4 × 300	2.6	8.4	3.3	5.1	80.0	101.0
5 × 1	0.8	1.6	—	—	10.2	13.1
5 × 1.5	0.8	1.8	—	—	11.2	14.4
5 × 2.5	0.9	2.0	—	—	13.3	17.0
5 × 4	1.0	2.2	—	—	15.6	19.9
5 × 6	1.0	2.5	1.0	1.5	17.5	22.2
5 × 10	1.2	2.6	1.4	2.2	22.9	29.1
5 × 16	1.2	3.9	1.5	2.4	26.4	33.3
5 × 25	1.4	4.4	1.7	2.7	32.0	40.4

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Table 13 — Ordinary duty heat resisting 110 °C EVA or equivalent synthetic elastomer insulated and sheathed flexible cable, parallel twin, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designations: H05GG-F
H05GGH2-F

Construction:

Conductors — class 5 copper, flexible;
Insulation — compound type EI 3;
Sheath — compound type EM 4.

A separator tape shall be applied around each conductor if the conductors are plain. If the conductors are tinned, the use of a separator tape is optional.

For flat cables the cores shall be laid parallel.

2- to 5-cores shall be twisted together.

A centre filler may be used.

The sheath shall be extruded in a single layer and applied in such a way that it fills the spaces between the cores.

Core identification and sequence:

Twin — blue and brown;
3-core — green-and-yellow, blue and brown;
[A2] 4-core — green-and-yellow, brown, black, grey; or
— green-and-yellow, blue, brown, black[a].
5-core — green-and-yellow, blue, brown, black, grey [A2].

Colour of sheath — Not specified.

[A2] *Text deleted* [A2]

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter or dimensions	
			Lower limit	Upper limit
mm^2	mm	mm	mm	mm
2 × 0.75	0.6	0.8	5.7	7.4
2 × 0.75	0.6	0.8	3.7 × 6.0	4.7 × 7.4
2 × 1	0.6	0.9	6.1	8.0
2 × 1.5	0.8	1.0	7.6	9.8
2 × 2.5	0.9	1.1	9.0	11.6
3 × 0.75	0.6	0.9	6.2	8.1
3 × 1	0.6	0.9	6.5	8.5
3 × 1.5	0.8	1.0	8.0	10.4
3 × 2.5	0.9	1.1	9.6	12.4
3 × 4	1.0	1.2	11.3	14.5
3 × 6	1.0	1.4	12.8	16.3
4 × 0.75	0.6	0.9	6.8	8.8
4 × 1	0.6	0.9	7.1	9.3
4 × 1.5	0.8	1.1	9.0	11.6
4 × 2.5	0.9	1.2	10.7	13.8
4 × 4	1.0	1.3	12.7	16.2
4 × 6	1.0	1.5	14.2	18.1
5 × 0.75	0.6	1.0	7.6	9.9
5 × 1	0.6	1.0	8.0	10.3
5 × 1.5	0.8	1.1	9.8	12.7
5 × 2.5	0.9	1.3	11.9	15.3

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 14 — Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07RN-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 4;

Sheath — for specified thicknesses ≤2.4 mm: a single layer of compound type EM 2;

— for specified thicknesses >2.4 mm: either a single layer of compound type EM 2, or two layers, an inner layer of compound type EM 2 or EM 3 and an outer layer of compound type EM 2.

An optional separator tape may be applied around each conductor.

Optional coloured proofed tape is permitted over the insulation.

Where the insulation of conductors having a nominal cross-section in excess of 4 mm^2 is covered with a proofed textile tape, it shall be wound helically with an overlap of at least 1 mm.

2- to 5-cores shall be twisted together with the outer interstices filled with the sheathing compound to form an assembly of practically circular cross-section.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

Core identification and sequence:

Single-core — green-and-yellow, light blue or other colours except, green, yellow or any other bi-colours;

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

〉A2〈 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey 〉A2〈.

Colour of sheath — Not specified.

〉A2〈 *Text deleted* 〉A2〈

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
1 × 1.5	0.8	1.4	—	—	5.7	7.1
1 × 2.5	0.9	1.4	—	—	6.3	7.9
1 × 4	1.0	1.5	—	—	7.2	9.0
1 × 6	1.0	1.6	—	—	7.9	9.8
1 × 10	1.2	1.8	—	—	9.5	11.9
1 × 16	1.2	1.9	—	—	10.8	13.4
1 × 25	1.4	2.0	—	—	12.7	15.8
1 × 35	1.4	2.2	—	—	14.3	17.9
1 × 50	1.6	2.4	—	—	16.5	20.6
1 × 70	1.6	2.6	1.0	1.6	18.6	23.3
1 × 95	1.8	2.8	1.1	1.7	20.8	26.0
1 × 120	1.8	3.0	1.2	1.8	22.8	28.6
1 × 150	2.0	3.2	1.3	1.9	25.2	31.4
1 × 185	2.2	3.4	1.4	2.0	27.6	34.4
1 × 240	2.4	3.5	1.4	2.1	30.6	38.3
1 × 300	2.6	3.6	1.4	2.2	33.5	41.9
1 × 400	2.8	3.8	1.5	2.3	37.4	46.8
1 × 500	3.0	4.0	1.6	2.4	41.3	52.0
〉A2〈 1 × 630 〉A2〈	3.0	4.1	1.6	2.5	45.5	56.5

[a] 〉A2〈 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〉A2〈

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Table 14 — Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
2 × 1	0.8	1.3	—	—	7.7	10.0
2 × 1.5	0.8	1.5	—	—	8.5	11.0
2 × 2.5	0.9	1.7	—	—	10.2	13.1
2 × 4	1.0	1.8	—	—	11.8	15.1
2 × 6	1.0	2.0	—	—	13.1	16.8
2 × 10	1.2	3.1	1.2	1.9	17.7	22.6
2 × 16	1.2	3.3	1.3	2.0	20.2	25.7
2 × 25	1.4	3.6	1.4	2.2	24.3	30.7
3 × 1	0.8	1.4	—	—	8.3	10.7
3 × 1.5	0.8	1.6	—	—	9.2	11.9
3 × 2.5	0.9	1.8	—	—	10.9	14.0
3 × 4	1.0	1.9	—	—	12.7	16.2
3 × 6	1.0	2.1	—	—	14.1	18.0
3 × 10	1.2	3.3	1.3	2.0	19.1	24.2
3 × 16	1.2	3.5	1.4	2.1	21.8	27.6
3 × 25	1.4	3.8	1.5	2.3	26.1	33.0
3 × 35	1.4	4.1	1.6	2.5	29.3	37.1
3 × 50	1.6	4.5	1.8	2.7	34.1	42.9
3 × 70	1.6	4.8	1.9	2.9	38.4	48.3
3 × 95	1.8	5.3	2.1	3.2	43.3	54.0
3 × 120	1.8	5.6	2.2	3.4	47.4	60.0
3 × 150	2.0	6.0	2.4	3.6	52.0	66.0
3 × 185	2.2	6.4	2.5	3.9	57.0	72.0
3 × 240	2.4	7.1	2.8	4.3	65.0	82.0
3 × 300	2.6	7.7	3.1	4.6	72.0	90.0
4 × 1	0.8	1.5	—	—	9.2	11.9
4 × 1.5	0.8	1.7	—	—	10.2	13.1
4 × 2.5	0.9	1.9	—	—	12.1	15.5
4 × 4	1.0	2.0	—	—	14.0	17.9
4 × 6	1.0	2.3	—	—	15.7	20.0
4 × 10	1.2	3.4	1.4	2.0	20.9	26.5
4 × 16	1.2	3.6	1.4	2.2	23.8	30.1
4 × 25	1.4	4.1	1.6	2.5	28.9	36.6
4 × 35	1.4	4.4	1.7	2.7	32.5	41.1
4 × 50	1.6	4.8	1.9	2.9	37.7	47.5
4 × 70	1.6	5.2	2.0	3.2	42.7	54.0
4 × 95	1.8	5.9	2.3	3.6	48.4	61.0

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Table 14 — Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
4 × 120	1.8	6.0	2.4	3.6	53.0	66.0
4 × 150	2.0	6.5	2.6	3.9	58.0	73.0
4 × 185	2.2	7.0	2.8	4.2	64.0	80.0
4 × 240	2.4	7.7	3.1	4.6	72.0	91.0
4 × 300	2.6	8.4	3.3	5.1	80.0	101.0
5 × 1	0.8	1.6	—	—	10.2	13.1
5 × 1.5	0.8	1.8	—	—	11.2	14.4
5 × 2.5	0.9	2.0	—	—	13.3	17.0
5 × 4	1.0	2.2	—	—	15.6	19.9
5 × 6	1.0	2.5	1.0	1.5	17.5	22.2
5 × 10	1.2	3.6	1.4	2.2	22.9	29.1
5 × 16	1.2	3.9	1.5	2.4	26.4	33.3
5 × 25	1.4	4.4	1.7	2.7	32.0	40.4

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Table 15 — Heavy duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core, 450/750 V

Harmonized code designation: H07RN-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 4;

Sheath — either a single layer of compound type EM 2, or two layers, an inner layer of compound type EM 2 or EM 3 and an outer layer of compound type EM 2.

An optional separator tape may be applied around each conductor.

An optional coloured proofed tape may be used over the insulation.

6- to 36-cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

Core identification shall be either:

— by number in accordance with BS EN 50334 where the inscription shall be either white or yellow on black; or

— by the pilot and marker colour coding system as specified in **5.2.2**.

Colour of sheath — Not specified.

〖A2〗 *Text deleted* 〈A2〉

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
6 × 1.5	0.8	2.5	1.0	1.6	13.4	17.2
12 × 1.5	0.8	2.9	1.2	1.7	17.6	22.4
18 × 1.5	0.8	3.2	1.3	1.9	20.7	26.3
24 × 1.5	0.8	3.5	1.4	2.1	24.3	30.7
36 × 1.5	0.8	3.8	1.5	2.3	27.8	35.2
6 × 2.5	0.9	2.7	1.1	1.6	15.7	20.0
12 × 2.5	0.9	3.1	1.2	1.9	20.6	26.2
18 × 2.5	0.9	3.5	1.4	2.1	24.4	30.9
24 × 2.5	0.9	3.9	1.6	2.3	28.8	36.4
36 × 2.5	0.9	4.3	1.7	2.6	33.2	41.8
6 × 4	1.0	2.9	1.2	1.7	18.2	23.2
12 × 4	1.0	3.5	1.4	2.1	24.4	30.9
18 × 4	1.0	3.9	1.6	2.3	28.8	36.4

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Table 16 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07BN4-F

Construction:

Conductors	— class 5 copper, flexible;
Insulation	— compound type EI 7;
Sheath	— for specified thicknesses ≤2.4 mm: a single layer of compound type EM 7;
	— for specified thicknesses >2.4 mm: either a single layer of compound type EM 7, or two layers, an inner layer of compound type EM 6 or EM 7 and an outer layer of compound type EM 7.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

2- to 5-cores shall be twisted together with the outer interstices filled with the sheathing compound to form an assembly of practically circular cross-section.

A binder tape is permitted over the assembly of cores.

Core identification and sequence:

Single-core	— green-and-yellow, light blue, or other colours except green, yellow or any other bi-colours;
Twin	— blue and brown;
3-core	— green-and-yellow, blue and brown;
[A2] 4-core	— green-and-yellow, brown, black, grey; or
	— green-and-yellow, blue, brown, black[a].
5-core	— green-and-yellow, blue, brown, black, grey [A2].

Colour of sheath — Not specified.

[A2] *Text deleted* [A2]

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
1 × 1.5	0.8	1.4	—	—	5.7	7.1
1 × 2.5	0.9	1.4	—	—	6.3	7.9
1 × 4	1.0	1.5	—	—	7.2	9.0
1 × 6	1.0	1.6	—	—	7.9	9.8
1 × 10	1.2	1.8	—	—	9.5	11.9
1 × 16	1.2	1.9	—	—	10.8	13.4
1 × 25	1.4	2.0	—	—	12.7	15.8
1 × 35	1.4	2.2	—	—	14.3	17.9
1 × 50	1.6	2.4	—	—	16.5	20.6
1 × 70	1.6	2.6	1.0	1.6	18.6	23.3
1 × 95	1.8	2.8	1.1	1.7	20.8	26.0
1 × 120	1.8	3.0	1.2	1.8	22.8	28.6
1 × 150	2.0	3.2	1.3	1.9	25.2	31.4
1 × 185	2.2	3.4	1.4	2.0	27.6	34.4
1 × 240	2.4	3.5	1.4	2.1	30.6	38.3
1 × 300	2.6	3.6	1.4	2.2	33.5	41.9
1 × 400	2.8	3.8	1.5	2.3	37.4	46.8
1 × 500	3.0	4.0	1.6	2.4	41.3	52.0
[A2] 1 × 630 [A2]	3.0	4.1	1.6	2.5	45.5	56.5

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 16 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
2 × 1	0.8	1.3	—	—	7.7	10.0
2 × 1.5	0.8	1.5	—	—	8.5	11.0
2 × 2.5	0.9	1.7	—	—	10.2	13.1
2 × 4	1.0	1.8	—	—	11.8	15.1
2 × 6	1.0	2.0	—	—	13.1	16.8
2 × 10	1.2	3.1	1.2	1.9	17.7	22.6
2 × 16	1.2	3.3	1.3	2.0	20.2	25.7
2 × 25	1.4	3.6	1.4	2.2	24.3	30.7
3 × 1	0.8	1.4	—	—	8.3	10.7
3 × 1.5	0.8	1.6	—	—	9.2	11.9
3 × 2.5	0.9	1.8	—	—	10.9	14.0
3 × 4	1.0	1.9	—	—	12.7	16.2
3 × 6	1.0	2.1	—	—	14.1	18.0
3 × 10	1.2	3.3	1.3	2.0	19.1	24.2
3 × 16	1.2	3.5	1.4	2.1	21.8	27.6
3 × 25	1.4	3.8	1.5	2.3	26.1	33.0
3 × 35	1.4	4.1	1.6	2.5	29.3	37.1
3 × 50	1.6	4.5	1.8	2.7	34.1	42.9
3 × 70	1.6	4.8	1.9	2.9	38.4	48.3
3 × 95	1.8	5.3	2.1	3.2	43.3	54.0
3 × 120	1.8	5.6	2.2	3.4	47.4	60.0
3 × 150	2.0	6.0	2.4	3.6	52.0	66.0
3 × 185	2.2	6.4	2.5	3.9	57.0	72.0
3 × 240	2.4	7.1	2.8	4.3	65.0	82.0
3 × 300	2.6	7.7	3.1	4.6	72.0	90.0
4 × 1	0.8	1.5	—	—	9.2	11.9
4 × 1.5	0.8	1.7	—	—	10.2	13.1
4 × 2.5	0.8	1.9	—	—	12.1	15.5
4 × 4	1.0	2.0	—	—	14.0	17.9
4 × 6	1.0	2.3	—	—	15.7	20.0
4 × 10	1.2	3.4	1.4	2.0	20.9	26.5
4 × 16	1.2	3.6	1.4	2.2	23.8	30.1
4 × 25	1.4	4.1	1.6	2.5	28.9	36.6
4 × 35	1.4	4.4	1.7	2.7	32.5	41.1

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Table 16 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
4 × 50	1.6	4.8	1.9	2.9	37.7	47.5
4 × 70	1.6	5.2	2.0	3.2	42.7	54.0
4 × 95	1.8	5.9	2.3	3.6	48.4	61.0
4 × 120	1.8	6.0	2.4	3.6	53.0	66.0
4 × 150	2.0	6.5	2.6	3.9	58.0	73.0
4 × 185	2.2	7.0	2.8	4.2	64.0	80.0
4 × 240	2.4	7.7	3.1	4.6	72.0	91.0
4 × 300	2.6	8.4	3.3	5.1	80.0	101.0
5 × 1	0.8	1.6	—	—	10.2	13.1
5 × 1.5	0.8	1.8	—	—	11.2	14.4
5 × 2.5	0.9	2.0	—	—	13.3	17.0
5 × 4	1.0	2.2	—	—	15.6	19.9
5 × 6	1.0	2.5	1.0	1.5	17.5	22.2
5 × 10	1.2	3.6	1.4	2.2	22.9	29.1
5 × 16	1.2	3.9	1.5	2.4	26.4	33.3
5 × 25	1.4	4.4	1.7	2.7	32.0	40.4

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Table 17 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core, 450/750 V

Harmonized code designation: H07BN4-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 7;

Sheath — either a single layer of compound type EM 7, or two layers, an inner layer of compound type EM 6 or EM 7 and an outer layer of compound type EM 7.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

6- to 36-cores shall be twisted together with the outer interstices filled with the sheathing compound to form an assembly of practically circular cross-section.

Core identification shall be either:

— by number in accordance with BS EN 50334 where the inscription shall be either white or yellow on black; or

— by the pilot and marker colour coding system specified in **5.2.2**.

Colour of sheath — Not specified.

A2 *Text deleted* A2

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
6 × 1.5	0.8	2.5	1.0	1.5	13.4	17.2
12 × 1.5	0.8	2.9	1.2	1.7	17.6	22.4
18 × 1.5	0.8	3.2	1.3	1.9	20.7	26.3
24 × 1.5	0.8	3.5	1.4	2.1	24.3	30.7
36 × 1.5	0.8	3.8	1.5	2.3	27.8	35.2
6 × 2.5	0.9	2.7	1.1	1.6	15.7	20.0
12 × 2.5	0.9	3.1	1.2	1.9	20.6	26.2
18 × 2.5	0.9	3.5	1.4	2.1	24.4	30.9
24 × 2.5	0.9	3.9	1.6	2.3	38.8	36.4
36 × 2.5	0.9	4.3	1.7	2.6	33.2	41.8
6 × 4	1.0	2.9	1.2	1.7	18.2	23.2
12 × 4	1.0	3.5	1.4	2.1	24.4	30.9
18 × 4	1.0	3.9	1.6	2.3	28.8	36.4

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Table 18 — Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07ZZ-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 8;

Sheath — specified thickness ≤2.4 mm: a single layer of compound type EM 8;

— specified thickness >2.4 mm: either a single layer of EM 8, or two layers, an inner layer of compound type EM 8 or EM 10 and an outer layer of compound type EM 8.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

2- to 5-cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section.

Core identification and sequence:

Single-core — green-and-yellow, light blue or other colours, except green, yellow or any other bi-colours;

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

[A2] 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey [A2].

Colour of sheath — Not specified.

[A2] *Text deleted* [A2]

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter		Minimum insulation resistance at 70 °C
		One layer	Two layers		Lower limit	Upper limit	
			Inner layer	Outer layer			
mm²	mm	mm	mm	mm	mm	mm	MΩ·km
1 × 1.5	0.8	1.4	—	—	5.7	7.1	0.012
1 × 2.5	0.9	1.4	—	—	6.3	7.9	0.010
1 × 4	1.0	1.5	—	—	7.2	9.0	0.009 4
1 × 6	1.0	1.6	—	—	7.9	9.8	0.008 1
1 × 10	1.2	1.8	—	—	9.5	11.9	0.007 6
1 × 16	1.2	1.9	—	—	10.8	13.4	0.006 2
1 × 25	1.4	2.0	—	—	12.7	15.8	0.005 8
1 × 35	1.4	2.2	—	—	14.3	17.9	0.004 9
1 × 50	1.6	2.4	—	—	16.5	20.6	0.004 8
1 × 70	1.6	2.6	1.0	1.6	18.6	23.3	0.004 1
1 × 95	1.8	2.8	1.1	1.7	20.8	26.0	0.004 0
1 × 120	1.8	3.0	1.2	1.8	22.8	28.6	0.003 6
1 × 150	2.0	3.2	1.3	1.9	25.2	31.4	0.003 6
1 × 155	2.2	3.4	1.4	2.0	27.2	34.4	0.003 6
1 × 240	2.4	3.5	1.4	2.1	30.6	38.3	0.003 4
1 × 300	2.6	3.6	1.4	2.2	33.5	41.9	0.003 3
1 × 400	2.8	3.8	1.5	2.3	37.4	46.8	0.003 1
1 × 500	3.0	4.0	1.6	2.4	41.3	52.0	0.003 0
[A2] 1 × 630 [A2]	3.0	4.1	1.6	2.5	45.5	56.5	0.002 6

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 18 — Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter		Minimum insulation resistance at 70 °C
		One layer	Two layers		Lower limit	Upper limit	
			Inner layer	Outer layer			
mm^2	mm	mm	mm	mm	mm	mm	MΩ·km
2 × 1	0.8	1.3	—	—	7.7	10.0	0.013
2 × 1.5	0.8	1.5	—	—	8.5	11.0	0.012
2 × 2.5	0.9	1.7	—	—	10.2	13.1	0.010
2 × 4	1.0	1.8	—	—	11.8	15.1	0.009 4
2 × 6	1.0	2.0	—	—	13.1	16.8	0.008 1
2 × 10	1.2	3.1	1.2	1.9	17.7	22.6	0.007 6
2 × 16	1.2	3.3	1.3	2.0	20.2	25.7	0.006 2
2 × 25	1.4	3.6	1.4	2.2	24.3	30.7	0.005 8
3 × 1	0.8	1.4	—	—	8.3	10.7	0.013
3 × 1.5	0.8	1.6	—	—	9.2	11.9	0.012
3 × 2.5	0.9	1.8	—	—	10.9	14.0	0.010
3 × 4	1.0	1.9	—	—	12.7	16.2	0.009 4
3 × 6	1.0	2.1	—	—	14.1	18.0	0.008 1
3 × 10	1.2	3.3	1.3	2.0	19.1	24.2	0.007 6
3 × 16	1.2	3.5	1.4	2.1	21.8	27.6	0.006 2
3 × 25	1.4	3.8	1.5	2.3	26.1	33.0	0.005 8
3 × 35	1.4	4.1	1.6	2.5	29.3	37.1	0.004 9
3 × 50	1.6	4.5	1.8	2.7	34.1	42.9	0.004 8
3 × 70	1.6	4.8	1.9	2.9	38.4	48.3	0.004 1
3 × 95	1.8	5.3	2.1	3.2	43.3	54.0	0.004 0
3 × 120	1.8	5.6	2.2	3.4	47.4	60.0	0.003 6
3 × 150	2.0	6.0	2.4	3.6	52.0	66.0	0.003 6
3 × 185	2.2	6.4	2.5	3.9	57.0	72.0	0.003 6
3 × 240	2.4	7.1	2.8	4.3	65.0	82.0	0.003 4
3 × 300	2.6	7.7	3.1	4.6	72.0	90.0	0.003 3
4 × 1	0.8	1.5	—	—	9.2	11.9	0.013
4 × 1.5	0.8	1.7	—	—	10.2	13.1	0.012
4 × 2.5	0.9	1.9	—	—	12.1	15.5	0.010
4 × 4	1.0	2.0	—	—	14.0	17.9	0.009 4
4 × 6	1.0	2.3	—	—	15.7	20.0	0.008 1
4 × 10	1.2	3.4	1.4	2.0	20.9	26.5	0.007 6
4 × 16	1.2	3.6	1.4	2.2	23.8	30.1	0.006 2
4 × 25	1.4	4.1	1.6	2.5	28.9	36.6	0.005 8
4 × 35	1.4	4.4	1.7	2.7	32.5	41.1	0.004 9

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Table 18 — Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter		Minimum insulation resistance at 70 °C
		One layer	Two layers		Lower limit	Upper limit	
			Inner layer	Outer layer			
mm^2	mm	mm	mm	mm	mm	mm	MΩ·km
4 × 50	1.6	4.8	1.9	2.9	37.7	47.5	0.004 8
4 × 70	1.6	5.2	2.0	3.2	42.7	54.0	0.004 1
4 × 95	1.8	5.9	2.3	3.6	48.4	61.0	0.004 0
4 × 120	1.8	6.0	2.4	3.6	53.0	66.0	0.003 6
4 × 150	2.0	6.5	2.6	3.9	58.0	73.0	0.003 6
4 × 185	2.2	7.0	2.8	4.2	64.0	80.0	0.003 6
4 × 240	2.4	7.7	3.1	4.6	72.0	91.0	0.003 4
4 × 300	2.6	8.4	3.3	5.1	80.0	101.0	0.003 3
5 × 1	0.8	1.6	—	—	10.2	13.1	0.013
5 × 1.5	0.8	1.8	—	—	11.2	14.4	0.012
5 × 2.5	0.9	2.0	—	—	13.3	17.0	0.010
5 × 4	1.0	2.2	—	—	15.6	19.9	0.009 4
5 × 6	1.0	2.5	1.0	1.5	17.5	22.2	0.008 1
5 × 10	1.2	3.6	1.4	2.2	22.9	29.1	0.007 6
5 × 16	1.2	3.9	1.5	2.4	26.4	33.3	0.006 2
5 × 25	1.4	4.4	1.7	2.7	32.0	40.4	0.005 8

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Table 19 — Heavy duty cross-linked polymer insulated and sheathed flexible cable having low emission of smoke and corrosive gases, 6-core, 12-core, 18-core, 24-core and 36-core, 450/750 V

Harmonized code designation: H07ZZ-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 8;

Sheath — either a single layer of compound type EM 8, or two layers, an inner layer of compound type EM 8 or EM 10 and an outer layer of compound type EM 8.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

6- to 36-cores shall be twisted together with the outer interstices filled with the sheathing compound to form an assembly of practically circular cross-section.

A binder tape is permitted over the assembly of cores.

Core identification shall be either:

— by number in accordance with BS EN 50334 where the inscription shall be either white or yellow on black; or

— by the pilot and marker colour coding system specified in **5.2.2**.

Colour of sheath — Not specified.

A2 *Text deleted* A2

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter		Minimum insulation resistance at 70 °C
		One layer	Two layers		Lower limit	Upper limit	
			Inner layer	Outer layer			
mm²	mm	mm	mm	mm	mm	mm	MΩ·km
6 × 1.5	0.8	2.5	1.0	1.5	13.4	17.2	0.012
12 × 1.5	0.8	2.9	1.2	1.7	17.6	22.4	0.012
18 × 1.5	0.8	3.2	1.3	1.9	20.7	26.3	0.012
24 × 1.5	0.8	3.5	1.4	2.1	24.3	30.7	0.012
36 × 1.5	0.8	3.8	1.5	2.3	27.8	35.2	0.012
6 × 2.5	0.9	2.7	1.1	1.6	15.7	20.0	0.010
12 × 2.5	0.9	3.1	1.2	1.9	20.6	26.2	0.010
18 × 2.5	0.9	3.5	1.4	2.1	24.4	30.9	0.010
24 × 2.5	0.9	3.9	1.6	2.3	28.8	36.4	0.010
36 × 2.5	0.9	4.3	1.7	2.6	33.2	41.8	0.010
6 × 4	1.0	2.9	1.2	1.7	18.2	23.2	0.009 4
12 × 4	1.0	3.5	1.4	2.1	24.4	30.9	0.009 4
18 × 4	1.0	3.9	1.6	2.3	28.8	36.4	0.009 4

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Table 20 — Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07RN8-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type EI 4;

Sheath — for specified thicknesses ≤2.4 mm: a single layer of compound type EM 2;

— for specified thicknesses >2.4 mm: either a single layer of compound type EM 2, or two layers, an inner layer of compound type EM 2 or EM 3 and an outer layer of compound type EM 2.

An optional separator tape of may be applied around each conductor.

An optional non-hygroscopic tape may be applied on each core.

Where the insulation of conductors having a nominal cross-section in excess of 4 mm^2 is covered with a non-hygroscopic tape, it shall be helically wound with an overlap of at least 1 mm. The tape shall be applied to the insulation in such a manner that it can be removed without damage to the insulation.

2- to 5-cores and fillers, if any, shall be twisted together.

A centre filler may be used.

In the case of the cores having conductors of large cross-section, a non-hygroscopic tape may be applied around the core assembly before application of the sheath, provided that the finished cable does not have any substantial cavity in the outer interstices between the cores.

For twin circular cables, the spaces between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

Core identification and sequence:

Single-core — green-and-yellow, light blue or other colours, except green, yellow or any other bi-colours;

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

〚A2〛 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey 〈A2〉.

Colour of sheath — Not specified.

〚A2〛 *Text deleted* 〈A2〉

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
1 × 1.5	0.8	1.4	—	—	5.7	7.1
1 × 2.5	0.9	1.4	—	—	6.3	7.9
1 × 4	1.0	1.5	—	—	7.2	9.0
1 × 6	1.0	1.6	—	—	7.9	9.8
1 × 10	1.2	1.8	—	—	9.5	11.9
1 × 16	1.2	1.9	—	—	10.8	13.4
1 × 25	1.4	2.0	—	—	12.7	15.8
1 × 35	1.4	2.2	—	—	14.3	17.9
1 × 50	1.6	2.4	—	—	16.5	20.6
1 × 70	1.6	2.6	1.0	1.6	18.6	23.3
1 × 95	1.8	2.8	1.1	1.7	20.8	26.0
1 × 120	1.8	3.0	1.2	1.8	22.8	28.6

[a] 〚A2〛 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〈A2〉

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Table 20 — Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
1 × 150	2.0	3.2	1.3	1.9	25.2	31.4
1 × 185	2.2	3.4	1.4	2.0	27.6	34.4
1 × 240	2.4	3.5	1.4	2.1	30.6	38.3
1 × 300	2.6	3.6	1.4	2.2	33.5	41.9
1 × 400	2.8	3.8	1.5	2.3	37.4	46.8
1 × 500	3.0	4.0	1.6	2.4	41.3	52.0
[A2] 1 × 630 [A2]	3.0	4.1	1.6	2.5	45.5	56.5
2 × 1	0.8	1.3	—	—	7.7	10.0
2 × 1.5	0.8	1.5	—	—	8.5	11.0
2 × 2.5	0.9	1.7	—	—	10.2	13.1
2 × 4	1.0	1.8	—	—	11.8	15.1
2 × 6	1.0	2.0	—	—	13.1	16.8
2 × 10	1.2	3.1	1.2	1.9	17.7	22.6
2 × 16	1.2	3.3	1.3	2.0	20.2	25.7
2 × 25	1.4	3.6	1.4	2.2	24.3	30.7
3 × 1	0.8	1.4	—	—	8.3	10.7
3 × 1.5	0.8	1.6	—	—	9.2	11.9
3 × 2.5	0.9	1.8	—	—	10.9	14.0
3 × 4	1.0	1.9	—	—	12.7	16.2
3 × 6	1.0	2.1	—	—	14.1	18.0
3 × 10	1.2	3.3	1.3	2.0	19.1	24.2
3 × 16	1.2	3.5	1.4	2.1	21.8	27.6
3 × 25	1.4	3.8	1.5	2.3	26.1	33.0
3 × 35	1.4	4.1	1.6	2.5	29.3	37.1
3 × 50	1.6	4.5	1.8	2.7	34.1	42.9
3 × 70	1.6	4.8	1.9	2.9	38.4	48.3
3 × 95	1.8	5.3	2.1	3.2	43.3	54.0
3 × 120	1.8	5.6	2.2	3.4	47.4	60.0
3 × 150	2.0	6.0	2.4	3.6	52.0	66.0
3 × 185	2.2	6.4	2.5	3.9	57.0	72.0
3 × 240	2.4	7.1	2.8	4.3	65.0	82.0
3 × 300	2.6	7.7	3.1	4.6	72.0	90.0

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Table 20 — Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, single-core, circular twin, 3-core, 4-core and 5-core, 450/750 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
4 × 1	0.8	1.5	—	—	9.2	11.9
4 × 1.5	0.8	1.7	—	—	10.2	13.1
4 × 2.5	0.9	1.9	—	—	12.1	15.5
4 × 4	1.0	2.0	—	—	14.0	17.9
4 × 6	1.0	2.3	—	—	15.7	20.0
4 × 10	1.2	3.4	1.4	2.0	20.9	26.5
4 × 16	1.2	3.6	1.4	2.2	23.8	30.1
4 × 25	1.4	4.1	1.6	2.5	28.9	36.6
4 × 35	1.4	4.4	1.7	2.7	32.5	41.1
4 × 50	1.6	4.8	1.9	2.9	37.7	47.5
4 × 70	1.6	5.2	2.0	3.2	42.7	54.0
4 × 95	1.8	5.9	2.3	3.6	48.4	61.0
4 × 120	1.8	6.0	2.4	3.6	53.0	66.0
4 × 150	2.0	6.5	2.6	3.9	58.0	73.0
4 × 185	2.2	7.0	2.8	4.2	64.0	80.0
4 × 240	2.4	7.7	3.1	4.6	72.0	91.0
4 × 300	2.6	8.4	3.3	5.1	80.0	101.0
5 × 1	0.8	1.6	—	—	10.2	13.1
5 × 1.5	0.8	1.8	—	—	11.2	14.4
5 × 2.5	0.9	2.0	—	—	13.3	17.0
5 × 4	1.0	2.2	—	—	15.6	19.9
5 × 6	1.0	2.5	1.0	1.5	17.5	22.2
5 × 10	1.2	3.6	1.4	2.2	22.9	29.1
5 × 16	1.2	3.9	1.5	2.4	26.4	33.3
5 × 25	1.4	4.4	1.7	2.7	32.0	40.4

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Table 21 — Heavy duty water resisting rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cable, 6-core, 12-core, 18-core, 24-core and 36-core, 450/750 V

Harmonized code designation: H07RN8-F

Construction:

Conductors	— class 5 copper, flexible;
Insulation	— compound type EI 4;
Sheath	— either a single layer of compound type EM 2, or two layers, an inner layer of compound type EM 2 or EM 3 and an outer layer of compound type EM 2.

An optional separator tape may be applied around each conductor.

A centre core is not permitted.

A protective conductor, if any, shall be applied in the outer layer.

A centre filler may be used and is compulsory for cables having 6-, 18- and 36-cores and shall be of a non-hygroscopic material.

6- to 36-cores and fillers, if any, shall be twisted together.

A non-hygroscopic tape may be applied around the core assembly before the application of the sheath.

The sheath either in a single layer or in two layers shall fill the spaces between the cores. Where a non-hygroscopic tape is applied around the core assembly this requirement shall not apply.

Core identification shall be either:

— by number in accordance with BS EN 50334 where the inscription shall be either white or yellow on black; or

— by the pilot and marker colour coding system specified in **5.2.2**.

Colour of sheath — Not specified.

〖A2〗 *Text deleted* 〈A2〉

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath			Mean overall diameter	
		One layer	Two layers		Lower limit	Upper limit
			Inner layer	Outer layer		
mm^2	mm	mm	mm	mm	mm	mm
6 × 1.5	0.8	2.5	1.0	1.5	13.4	17.2
12 × 1.5	0.8	2.9	1.2	1.7	17.6	22.4
18 × 1.5	0.8	3.2	1.3	1.9	20.7	26.3
24 × 1.5	0.8	3.5	1.4	2.1	24.3	30.7
36 × 1.5	0.8	3.8	1.5	2.3	27.8	35.2
6 × 2.5	0.9	2.7	1.1	1.6	15.7	20.0
12 × 2.5	0.9	3.1	1.2	1.9	20.6	26.2
18 × 2.5	0.9	3.5	1.4	2.1	24.4	30.9
24 × 2.5	0.9	3.9	1.6	2.3	28.8	36.4
36 × 2.5	0.9	4.3	1.7	2.6	33.2	41.8
6 × 4	1.0	2.9	1.2	1.7	18.2	23.2
12 × 4	1.0	3.5	1.4	2.1	24.4	30.9
18 × 4	1.0	3.9	1.6	2.3	28.8	36.4

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A2

Table 22 — Ordinary duty heat resisting 180 °C silicone rubber insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designations: H05SS-F
H05SST-F

Construction:

Conductors — class 5 copper, flexible;
Insulation — compound type EI 2;
Sheath — compound type EM 9;
— for cable type H05SST-F, the sheath shall be provided with a braid of suitable material which shall have a uniform texture without knots or gaps.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

2- to 5-cores shall be twisted together.

Core identification and sequence:

Twin — blue and brown;
3-core — green-and-yellow, blue and brown;
4-core — green-and-yellow, brown, black, grey; or
— green-and-yellow, blue, brown, black[b].
5-core — green-and-yellow, blue, brown, black, grey.

Colour of sheath — Not specified.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter for type H05SS-F[a]	
			Lower limit	Upper limit
mm^2	mm	mm	mm	mm
2 × 0.75	0.6	0.8	5.7	7.4
2 × 1	0.6	0.9	6.1	8.0
2 × 1.5	0.8	1.0	7.6	9.8
2 × 2.5	0.9	1.1	9.0	11.6
3 × 0.75	0.6	0.9	6.2	8.1
3 × 1	0.6	0.9	6.5	8.5
3 × 1.5	0.8	1.0	8.0	10.4
3 × 2.5	0.9	1.1	9.6	12.4
3 × 4	1.0	1.2	11.3	14.5
3 × 6	1.0	1.4	12.8	16.3
4 × 0.75	0.6	0.9	6.8	8.8
4 × 1	0.6	0.9	7.1	9.3
4 × 1.5	0.8	1.1	9.0	11.6
4 × 2.5	0.9	1.2	10.7	13.8
4 × 4	1.0	1.3	12.7	16.2
4 × 6	1.0	1.5	14.2	18.1
5 × 0.75	0.6	1.0	7.6	9.9
5 × 1	0.6	1.0	8.0	10.3
5 × 1.5	0.8	1.1	9.8	12.7
5 × 2.5	0.9	1.3	11.9	15.3

[a] For type H05SST-F, the lower and upper limits for the overall diameter are increased by 1.0 mm.
[b] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core.

A2

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Table 23 — Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and thermoplastic polyurethane sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05BQ-F

Construction:

Conductors	— class 5 copper, flexible;
Insulation	— compound type EI 6;
Sheath	— compound type TMPU.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

2- to 5-cores shall be twisted together.

The twisted cores may be covered by either an extruded inner covering of an unvulcanized rubber or plastics compound or by a tape of suitable material, which may be combined with separate fillers. Alternatively the sheath may fill the spaces between the cores.

Core identification and sequence:

Twin	— blue and brown;
3-core	— green-and-yellow, blue and brown;
〉A2〈 4-core	— green-and-yellow, brown, black, grey; or
	— green-and-yellow, blue, brown, black[a].
5-core	— green-and-yellow, blue, brown, black, grey. 〉A2〈

Colour of sheath — Not specified.

〉A2〈 *Text deleted* 〉A2〈

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit	Upper limit
mm^2	mm	mm	mm	mm
2 × 0.75	0.6	0.8	5.7	7.4
2 × 1	0.6	0.9	6.1	8.0
3 × 0.75	0.6	0.9	6.2	8.1
3 × 1	0.6	0.9	6.5	8.5
4 × 0.75	0.6	0.9	6.8	8.8
4 × 1	0.6	0.9	7.1	9.3
5 × 0.75	0.6	1.0	7.6	9.9
5 × 1	0.6	1.0	8.0	10.3

[a] 〉A2〈 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〉A2〈

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Table 24 — Heavy duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and thermoplastic polyurethane sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 450/750 V

Harmonized code designation: H07BQ-F

Construction:

Conductors	— class 5 copper, flexible;
Insulation	— composed type EI 6;
Sheath	— compound type TMPU.

An optional separator tape may be applied around each conductor.

A centre filler may be used.

2- to 5-cores shall be twisted together.

The twisted cores may be covered by either an extruded inner covering of an unvulcanised rubber or plastics compound or a tape of suitable material, which may be combined with separate fillers. Alternatively the sheath may fill the spaces between the cores.

Core identification:

Twin	— blue and brown;
3-core	— green-and-yellow, blue and brown;
〉A2〈 4-core	— green-and-yellow, brown, black, grey; or
	— green-and-yellow, blue, brown, black[a].
5-core	— green-and-yellow, blue, brown, black, grey. 〉A2〈

Colour of sheath — Not specified.

〉A2〈 *Text deleted* 〉A2〈

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit	Upper limit
mm^2	mm	mm	mm	mm
2 × 1.5	0.8	1.0	7.6	9.8
2 × 1.5	0.9	1.1	9.0	11.6
2 × 4	1.0	1.2	10.6	13.7
2 × 6	1.0	1.3	11.8	15.1
2 × 10	1.2	2.0	15.6	19.9
2 × 16	1.2	2.1	17.9	22.8
3 × 1.5	0.8	1.0	8.0	10.4
3 × 2.5	0.9	1.1	9.6	12.4
3 × 4	1.0	1.2	11.3	14.5
3 × 6	1.0	1.4	12.8	16.3
3 × 10	1.2	2.1	16.8	21.4
3 × 16	1.2	2.3	19.5	24.7
4 × 1.5	0.8	1.1	9.0	11.6
4 × 2.5	0.9	1.2	10.7	13.8
4 × 4	1.0	1.3	12.7	16.2
4 × 6	1.0	1.5	14.2	18.1
4 × 10	1.2	2.2	18.6	23.6
4 × 16	1.2	2.3	21.3	27.0
5 × 1.5	0.8	1.1	9.8	12.7
5 × 2.5	0.9	1.3	11.9	15.3
5 × 4	1.0	1.4	14.1	17.9
5 × 4	1.0	1.6	15.7	20.0
5 × 10	1.2	2.3	20.4	25.9
5 × 16	1.2	2.5	23.7	30.0

[a] 〉A2〈 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〉A2〈

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Table 25 — *Spare*

Table 26 — *Spare*

Table 27 — *Spare*

Table 28 — *Spare*

Table 29 — *Spare*

Table 30 — *Spare*

Table 31 — *Spare*

Table 32 — *Spare*

Table 33 — *Spare*

Table 34 — *Spare*

Table 35 — *Spare*

Table 36 — *Spare*

Table 37 — *Spare*

Table 38 — *Spare*

Table 39 — *Spare*

Table 40 — Ordinary duty PVC insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05VV-F

NOTE Equivalent cables having conductor sizes smaller than 4 mm² are specified in BS 6500.

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type TI 2;

Sheath — compound type TM 2.

A centre filler may be used.

A tape may be applied which may cover the cores fully or partly. The tape shall not adhere to the cores.

2- to 5-cores and fillers, if any, shall be twisted together to give a practically circular cross-section.

For twin cables, the spaces between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

The sheath may fill the outer interstices thus forming a filling but it shall not adhere to the cores.

Core identification and sequence:

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

[A2] 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey. [A2]

Colour of sheath — Not specified.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter		Minimum insulation resistance at 70 °C
			Lower limit	Upper limit	
mm²	mm	mm	mm	mm	MΩ·km
2 × 4	0.8	1.1	9.7	12.1	0.007
3 × 4	0.8	1.2	10.5	13.1	0.007
4 × 4	0.8	1.2	11.5	14.3	0.007
5 × 4	0.8	1.4	13.0	16.1	0.007

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 41 — Ordinary duty 90 °C PVC insulated and sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05V2V2-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type TI 3;

Sheath — compound type TM 3.

A tape may be applied which may cover the cores fully or partly. The tape shall not adhere to the cores.

2- to 5-cores and fillers, if any, shall be twisted together to give a practically circular cross-section.

For twin cables, the spaces between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

A centre filler may be used except for twin cables.

The sheath may fill the outer interstices thus forming a filling but it shall not adhere to the cores.

Core identification and sequence:

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

[A2] 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey. [A2]

Colour of sheath — Not specified.

[A2] *Text deleted* [A2]

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter		Minimum insulation resistance at 90 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 4	0.8	1.1	9.7	12.1	0.007
3 × 4	0.8	1.2	10.5	13.1	0.007
4 × 4	0.8	1.2	11.5	14.3	0.007
5 × 4	0.8	1.4	13.0	16.1	0.007

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 42 — Ordinary duty PVC insulated and oil resisting PVC sheathed flexible cable, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05VV5-F

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type TI 2;

Sheath — compound type TM 5.

A centre filler may be used.

2- to 5-cores shall be twisted together.

A tape may be applied which may cover the cores fully or partly. The tape shall not adhere to the cores.

For 2-core cables, the spaces between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

Core identification and sequence:

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

[A2] 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[a].

5-core — green-and-yellow, blue, brown, black, grey. [A2]

Colour of sheath — Not specified.

[A2] *Text deleted* [A2]

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter		Minimum insulation resistance at 70 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5	0.6	0.7	5.2	6.6	0.013
2 × 0.75	0.6	0.8	5.7	7.2	0.011
2 × 1	0.6	0.8	5.9	7.5	0.010
2 × 1.5	0.7	0.8	6.8	8.6	0.010
2 × 2.5	0.8	0.9	8.2	10.3	0.009
3 × 0.5	0.6	0.7	5.5	7.0	0.013
3 × 0.75	0.6	0.8	6.0	7.6	0.011
3 × 1	0.6	0.8	6.3	8.0	0.010
3 × 1.5	0.7	0.9	7.4	9.4	0.010
3 × 2.5	0.8	1.0	9.0	11.2	0.009
4 × 0.5	0.6	0.8	6.2	7.9	0.013
4 × 0.75	0.6	0.8	6.6	8.3	0.011
4 × 1	0.6	0.8	6.9	8.7	0.010
4 × 1.5	0.7	0.9	8.2	10.2	0.010
4 × 2.5	0.8	1.1	10.1	12.5	0.009
5 × 0.5	0.6	0.8	6.8	8.6	0.013
5 × 0.75	0.6	0.9	7.4	9.3	0.011
5 × 1	0.6	0.9	7.8	9.8	0.010
5 × 1.5	0.7	1.0	9.1	11.4	0.010
5 × 2.5	0.8	1.1	11.0	13.7	0.009

[a] [A2] HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. [A2]

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Table 43 — Ordinary duty PVC insulated and oil resisting PVC sheathed flexible cable, 6-core, 7-core, 12-core, 18-core, 27-core, 36-core, 48-core and 60-core, 300/500 V

Harmonized code designation: H05VV5-F

Construction:

Conductor — class 5 copper, flexible;

Insulation — compound type TI 2;

Sheath — compound type TM 5.

A centre core is not permitted but a centre filler may be used.

Assemblies shall have 1-core coloured green/yellow.

Around each layer a tape may be applied which may cover the cores fully or partly. The tape shall not adhere to the cores.

6- to 60-cores shall be twisted together, if necessary in several concentric layers.

Core identification shall be by number in accordance with BS EN 50334 where the inscription shall be either white or yellow on black.

Colour of sheath — Not specified.

A2 *Text deleted* A2

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter		Minimum insulation resistance at 70 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
6 × 0.5	0.6	0.9	7.6	9.6	0.013
6 × 0.75	0.6	0.9	8.1	10.1	0.011
6 × 1	0.6	1.0	8.7	10.8	0.010
6 × 1.5	0.7	1.1	10.2	12.6	0.010
6 × 2.5	0.8	1.2	12.2	15.1	0.009
7 × 0.5	0.6	0.9	8.3	10.4	0.013
7 × 0.75	0.6	1.0	9.0	11.3	0.011
7 × 1	0.6	1.0	9.5	11.8	0.010
7 × 1.5	0.7	1.2	11.3	14.1	0.010
7 × 2.5	0.8	1.3	13.6	16.8	0.009
12 × 0.5	0.6	1.1	10.4	12.9	0.013
12 × 0.75	0.6	1.1	11.0	13.7	0.011
12 × 1	0.6	1.2	11.8	14.6	0.010
12 × 1.5	0.7	1.3	13.8	17.0	0.010
12 × 2.5	0.8	1.5	16.8	20.6	0.009
18 × 0.5	0.6	1.2	12.3	15.3	0.013
18 × 0.75	0.6	1.3	13.2	16.4	0.011
18 × 1	0.6	1.3	14.0	17.2	0.010
18 × 1.5	0.7	1.5	16.5	20.3	0.010
18 × 2.5	0.8	1.8	20.2	24.8	0.009
27 × 0.5	0.6	1.4	15.1	18.6	0.013
27 × 0.75	0.6	1.5	16.2	19.9	0.011
27 × 1	0.6	1.5	17.0	21.0	0.010
27 × 1.5	0.7	1.8	20.3	24.9	0.010
27 × 2.5	0.8	2.1	24.7	30.2	0.009

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Table 43 — Ordinary duty PVC insulated and oil resisting PVC sheathed flexible cable, 6-core, 7-core, 12-core, 18-core, 27-core, 36-core, 48-core and 60-core, 300/500 V (*continued*)

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter		Minimum insulation resistance at 70 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
36 × 0.5	0.6	1.5	17.0	20.9	0.013
36 × 0.75	0.6	1.6	18.2	22.4	0.011
36 × 1	0.6	1.7	19.4	23.8	0.010
36 × 1.5	0.7	2.0	23.0	28.2	0.010
36 × 2.5	0.8	2.3	28.0	34.2	0.009
48 × 0.5	0.6	1.7	19.8	24.3	0.013
48 × 0.75	0.6	1.8	21.2	25.9	0.011
48 × 1	0.6	1.9	22.5	27.6	0.010
48 × 1.5	0.7	2.2	26.6	32.5	0.010
48 × 2.5	0.8	2.4	32.1	39.1	0.009
60 × 0.5	0.6	1.8	21.7	26.6	0.013
60 × 0.75	0.6	2.0	23.4	28.7	0.011
60 × 1	0.6	2.1	24.9	30.5	0.010
60 × 1.5	0.7	2.4	29.4	35.8	0.010
60 × 2.5	0.8	2.4	35.0	42.6	0.009

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Table 44 — Ordinary duty low temperature PVC insulated and sheathed flexible cable, parallel twin, circular twin, 3-core, 4-core and 5-core, 300/500 V

National type

Construction:

Conductors — class 5 copper, flexible;

Insulation — compound type TI 4;

Sheath — compound type 10.

A centre filler may be used except for twin cables.

For circular cables, the cores and fillers, if any, shall be twisted together to give a practically circular cross-section.

For flat cables, the cores shall be laid parallel.

A tape may be applied which may cover the cores fully or partly. The tape shall not adhere to the cores.

The sheath may fill the outer interstices thus forming a filling but it shall not adhere to the cores.

Core identification and sequence:

Twin — blue and brown;

3-core — green-and-yellow, blue and brown;

〉A2〈 4-core — green-and-yellow, brown, black, grey; or

— green-and-yellow, blue, brown, black[b].

5-core — green-and-yellow, blue, brown, black, grey. 〉A2〈

Colour of sheath — Not specified.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter or dimensions		Minimum insulation resistance at 70 °C
			Lower limit[a]	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5	0.6	0.8	5.6	7.0	0.013
2 × 0.75	0.6	0.8	3.7 × 6.0	4.5 × 7.2	0.011
2 × 0.75	0.6	0.8	5.7	7.2	0.011
2 × 1	0.6	0.8	3.9 × 6.2	4.7 × 7.5	0.010
2 × 1	0.6	0.8	5.9	7.5	0.010
2 × 1.5	0.7	0.8	6.8	8.6	0.010
2 × 2.5	0.8	1.0	8.4	10.6	0.009
2 × 4	0.8	1.1	10.1	12.0	0.007
3 × 0.75	0.6	0.8	6.0	7.6	0.011
3 × 1	0.6	0.8	6.3	8.0	0.010
3 × 1.5	0.7	0.9	7.4	9.4	0.010
3 × 2.5	0.8	1.1	9.2	11.4	0.009
3 × 4	0.8	1.2	11.0	13.0	0.007
4 × 0.75	0.6	0.8	6.6	8.3	0.011
4 × 1	0.6	0.9	7.1	9.0	0.010
4 × 1.5	0.7	1.0	8.4	10.5	0.010
4 × 2.5	0.8	1.1	10.1	12.5	0.009
4 × 4	0.8	1.2	12.0	14.0	0.007
5 × 0.75	0.6	0.9	7.4	9.3	0.011
5 × 1	0.6	0.9	7.8	9.8	0.010
5 × 1.5	0.7	1.1	9.3	11.6	0.010
5 × 2.5	0.8	1.2	11.2	13.9	0.009
5 × 4	0.8	1.4	13.5	15.5	0.007

[a] See **7.9.2**.

[b] 〉A2〈 HD 308 allows for two alternative core identification methods for 4-core cables with a green-and-yellow core. 〉A2〈

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Annex A (informative)
Guide to use of insulated flexible cables

For guidance on the use of the cables specified in this standard, the user should consult the relevant product or equipment standard for the item for which the cable is to be used. Guidance on the use of cables is also given in BS 7540.

Annex B (informative)
Guidance on procedure for routine tests on rubber and PVC insulated flexible cables of rated voltages U_0/U up to 450/750 V

NOTE The following information is intended to provide guidance to the cablemaker on suitable procedures for the routine testing of cores and completed cables. They may be instituted by the manufacturer at his discretion and should not be regarded as requirements for this standard.

B.1 Tests on cores

B.1.1 *Spark test*

Carry out the spark test in accordance with BS 5099 using the test voltages given in Table B.1.

Table B.1 — Spark test voltage

Tabulated[a] radial thickness of insulation		Test voltage	
Above mm	Up to and including mm	a.c. (r.m.s.) kV	d.c. kV
—	0.5	4	6
0.5	1.0	6	9
1.0	1.5	10	15
1.5	2.0	15	23
2.0	2.5	20	30
2.5	—	25	38

[a] See relevant construction table.

B.2 Tests on completed cables

B.2.1 *General*

Subject completed cables to the tests described in **B.2.2**, **B.2.3** and **B.2.4**.

B.2.2 *Conductor resistance*

B.2.2.1 *Procedure*

Leave the cable in a test area, which is at a reasonably constant temperature, for sufficient time to ensure that the cable temperature is equal to the ambient temperature.

Measure the d.c. resistance of the conductor at ambient temperature.

B.2.2.2 *Recommended test criteria*

Calculate the resistance per unit length from the production length of the completed cable and not from the length of the individual cores.

The d.c. resistance of the conductor corrected to 20 °C by the appropriate factor given in BS 6360 should conform to BS 6360.

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B.2.3 *Voltage test*

B.2.3.1 *Procedure*

Subject completed twin and multicore cables to the voltage test without immersion in water.

Apply the voltage between conductor and groups of conductors in such a way that the insulation on each core is tested against all adjacent cores.

Make the test at room temperature with an alternating voltage of approximately sine-wave form, having a frequency in the range of 49 Hz to 61 Hz. Increase the voltage gradually and maintain at the full r.m.s. value given in Table B.2 for 5 min.

The conductors of multicore cables may be suitably connected for successive application of the test voltage to limit the total testing time provided that the sequence of connections ensures that the voltage is applied, for the time given, between each conductor and each other conductor.

B.2.3.2 *Recommended test criteria*

No breakdown of the insulation should occur.

Table B.2 — Insulation test voltage

Tabulated[a] radial thickness of insulation		Test voltage a.c. (r.m.s)
Above mm	Up to and including mm	 kV
—	0.7	1.5
0.7	1.0	2.0
1.0	—	2.5

[a] See relevant construction table.

B.2.4 *Insulation resistance*

B.2.4.1 *Procedure*

Immediately after completion of the voltage test described in **B.2.3** apply a d.c. voltage of 300 V to 500 V for 1 min and measure the insulation resistance between each conductor and all other conductors connected together.

B.2.4.2 *Recommended test criteria*

The insulation resistance of each core should be not less than that derived from the following formula:

$$R = K \log_{10}\left(\frac{D}{d}\right)$$

where

R is the insulation resistance of each core at 20 °C in megohm kilometres (MΩ·km);

K is the insulation resistance constant at 20 °C in megohm kilometres (MΩ·km);

D is the diameter over the insulation in millimetres (mm);

d is the diameter over the conductor in millimetres (mm).

K should be taken as 35 MΩ·km for insulation types TI 2, TI 3, TI 4 and EI 8, as 870 MΩ·km for insulation type EI 2, as 700 MΩ·km for insulation type EI 4 and as 3 500 MΩ·km for insulation type EI 7.

NOTE If manufacturers wish to perform insulation resistance tests on insulation types EI 3 and EI 6 as part of quality control procedures, they should decide on an appropriate value of K for these materials.

If the test is carried out at an ambient temperature other than 20 °C, the measured insulation resistance shall be multiplied by the appropriate correction factor from Table B.3 to give the insulation resistance at 20 °C.

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Table B.3 — Temperature correction factors

Temperature °C	Correction factor
10	0.67
11	0.69
12	0.72
13	0.74
14	0.77
15	0.80
16	0.82
17	0.85
18	0.89
19	0.94
20	1.00
21	1.06
22	1.13
23	1.20
24	1.27
25	1.35
26	1.44
27	1.54
28	1.65
29	1.77
30	1.90

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Annex C (normative)
Electrical tests

C.1 Test conditions

Unless otherwise specified, make tests at ambient temperature with alternating voltage of approximately sine-wave form, having a frequency in the range of 49 Hz to 61 Hz, and of the value given in Table C.1 or Table C.2, as applicable. The ratio peak value/r.m.s. value shall be equal to $\sqrt{2}$ with a tolerance of ±7 %.

Table C.1 — Summary of electrical tests for cables with thermosetting insulation specified in Clause 6

Test	Unit	300/500 V and 450/750 V cables
Conductor resistance (see **6.8.2**)		
Length of sample (minimum)	m	1
Voltage test on completed cable (see **6.8.3**)		
Length of sample (minimum)	m	20
Period of immersion (minimum)	h	1
Temperature of water	°C	20 ± 5
Applied a.c. voltage (r.m.s.)		
300/500 V cables	V	2 000
450/750 V cables	V	2 500
Time of application	min	15
Voltage test on cores (see **6.8.4**)		
Length of sample (minimum)	m	5
Period of immersion (minimum)	h	1
Temperature of water	°C	20 ± 5
Applied a.c. voltage (r.m.s.)		
300/500 V cables with insulation thickness up to and including 0.6 mm	V	1 500
300/500 V cables with insulation thickness exceeding 0.6 mm	V	2 000
450/750 V cables for all insulation thicknesses	V	2 500
Time of application	min	5
Absence of faults in the insulation (see **6.8.5**)		
Spark test		
Result to be obtained		No breakdown of the insulation
Voltage test		
Applied a.c. voltage (r.m.s.) for 300/500 V cables	V	2 000
Applied a.c. voltage (r.m.s) for 450/750 V cables	V	2 500
Applied d.c. voltage	V	5 000
Duration of test	min	5
Result to be obtained		No breakdown of the insulation
Surface resistance test on EM 2, EM 3, EM 4, EM 6, EM 7 and TMPU sheath (see **6.8.6**)		
Surface resistance (minimum)	Ω	1×10^9
Insulation resistance(see **6.8.8**)		
Length of sample (previously tested to **C.3**)	m	5
Period of immersion (minimum)	h	2
Temperature of water	°C	70 ± 2
Long term resistance of insulation to d.c. (see **6.8.7**)		
Length of sample	m	5
Period of immersion (minimum)	h	10 × 24
Temperature of solution	°C	60 ± 5
Duration of applied voltage	h	10 × 24

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Table C.2 — Summary of electrical tests for cables with thermoplastic insulation specified in Clause 7

Test	Unit	300/500 V cables
Conductor resistance (see **7.8.2**)		
Length of sample (minimum)	m	1
Voltage test on completed cable (see **7.8.3**)		
Length of sample (minimum)	m	20
Period of immersion (minimum)	h	1
Temperature of water	°C	20 ± 5
Applied a.c. voltage (r.m.s.)	V	2 000
Time of application	min	15
Voltage test on cores (see **7.8.4**)		
Length of sample (minimum)	m	5
Period of immersion (minimum)	h	1
Temperature of water	°C	20 ± 5
Applied voltage (a.c.) according to the specified thickness of insulation:		
for insulation thickness up to and including 0.6 mm	V	1 500
for insulation thickness exceeding 0.6 mm	V	2 000
Time of application	min	5
Absence of faults in the insulation (see **7.8.5**)		
Spark test		
Result to be obtained		No breakdown of the insulation
Voltage test		
Applied a.c. voltage (r.m.s.)	V	2 000
Applied d.c. voltage	V	5 000
Duration of test	min	5
Result to be obtained		No breakdown of the insulation
Insulation resistance (see **7.8.6**)		
Length of sample (previously tested to **C.3**)	m	5
Period of immersion (minimum)	h	2
Temperature of water (compound types TI 2 and TI 4)	°C	70 ± 2
(compound type TI 3)	°C	90 ± 2
Long term resistance of insulation to d.c. (see **7.8.7**)		
Length of sample	m	5
Period of immersion (minimum)	h	10 × 24
Temperature of solution	°C	60 ± 5
Duration of applied voltage	h	10 × 24

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C.2 Voltage test on completed cable

C.2.1 *Test sample*

Take a sample of cable, as manufactured, of the length given in Table C.1 or Table C.2, as appropriate.

C.2.2 *Procedure*

Immerse the sample in water at the temperature, and for the period, given in Table C.1 or Table C.2, as appropriate. Ensure that the ends of the cores protrude above the water by a distance sufficient to prevent excessive surface leakage when the test voltage is applied.

Apply a voltage of the magnitude given in Table C.1 or Table C.2, as appropriate, in turn between each conductor and all the others connected together and to the water, and between all conductors and the water, for the time given in Table C.1 or Table C.2, as appropriate.

The conductors of multicore cables may be suitably connected for successive application of the test voltage to limit the total testing time provided that the sequence of connections ensures that the voltage is applied, for the given time, between each conductor and each other conductor.

C.3 Voltage test on cores

C.3.1 *Test sample*

Prepare a sample of cable of the length given in Table C.1 or Table C.2, as appropriate, by carefully removing the sheath and any other covering or filling from a length of completed cable.

C.3.2 *Procedure*

Immerse the sample in water at the temperature, and for the period, given in Table C.1 or Table C.2, as appropriate. Ensure that the ends of the cores protrude above the water by a distance sufficient to prevent excessive surface leakage when the test voltage is applied. Apply a voltage of the magnitude given in Table C.1 or Table C.2, as appropriate, between the conductors and the water for the time given in Table C.1 or Table C.2, as appropriate.

C.4 Insulation resistance test

C.4.1 *Test sample*

Make the test on a sample of cable of the length given in Table C.1 or Table C.2, as appropriate, previously submitted to the test specified in **C.3**.

C.4.2 *Procedure*

Immerse the sample in water previously heated to the temperature given in Table C.1 or Table C.2 as appropriate, with a length of about 250 mm at each end of the sample projecting above the water, for the period of time given in Table C.1 or Table C.2, as appropriate.

Apply a d.c. voltage of between 80 V and 500 V between each conductor and the water.

Measure the insulation resistance of each core 1 min after application of the voltage. Use this value to calculate the insulation resistance of a 1 km length of each core.

C.5 Long term resistance of insulation to d.c.

C.5.1 *Test sample*

Carry out the test on a sample of cable of the length given in Table C.1 or Table C.2, as appropriate, from which all coverings have been removed.

Take care to avoid damage to the core(s) during removal of the coverings.

C.5.2 *Procedure*

Immerse the sample, for the period and at the temperature given in Table C.1 or Table C.2, as appropriate, in an aqueous solution of sodium chloride having a concentration of 10 g/l, with a length of about 250 mm at each end of the sample projecting above the solution. Connect the negative pole of a 220 V d.c. supply to the conductor(s) of the sample and the positive pole to a copper electrode immersed in the solution for the time given in Table C.1 or Table C.2, as appropriate

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C.6 Absence of faults in the insulation

C.6.1 *General*

Test all flexible cable that is in the final stage of manufacture, whether it is in delivery lengths or in manufacturing lengths prior to being cut into delivery lengths.

C.6.2 *Procedure*

C.6.2.1 *General*

Test single-core cables by the spark test in accordance with **C.6.2.2**. Test all other cables, including sheathed flat cables, by the voltage test in accordance with **C.6.2.3**.

C.6.2.2 *Spark test*

C.6.2.2.1 *Apparatus*

The spark test equipment shall provide a magnitude and presence of the voltage that, together with the electrode system employed and the speed of passage employed, is capable of detecting a puncture in the insulation of the cable having a diameter equal to or greater than half of the specified insulation thickness.

The voltage applied by the spark tester shall be a.c. or d.c.

When the spark test equipment is tested as described in Annex E all the faults shall be registered by the equipment and the recovery time of the spark tester shall be not greater than 1 s.

C.6.2.2.2 *Procedure*

The flexible cable shall be passed through the spark test equipment using the electrode system, voltage levels and operating speed of passage established under **C.6.2.2.1**.

C.6.2.3 *Voltage test*

With the flexible cable in the dry state and at ambient temperature apply a voltage of the magnitude given in Table C.1 or Table C.2, as appropriate, supplied either from an a.c. source or from a d.c. source, between each conductor and all the other conductors connected to earth.

Increase the voltage gradually and maintain it at the full value for the duration given in Table C.1 or Table C.2, as appropriate.

C.7 Surface resistance of sheath

NOTE This test is applicable to cables with sheaths made of type EM 2, EM 3, EM 4, EM 6, EM 7 and TMPU compounds.

C.7.1 *Test samples*

Carry out the test on three samples of completed flexible cable, each about 250 mm in length.

C.7.2 *Procedure*

Clean the sheath of each of the samples with industrial methylated spirit, and apply to each sample two electrodes, consisting of wire helices of copper wire of between 0.2 mm and 0.6 mm diameter, at a distance of (100 ± 2) mm from each other. After the wire has been applied, clean the surface of the sheath again thoroughly between the electrodes.

Condition the samples with electrodes attached in a conditioning chamber at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) % for 24 h.

Immediately after removal from the conditioning chamber, apply a d.c. voltage of between 100 V and 500 V between the electrodes, and measure the resistance after 1 min.

Multiply the measured resistance of each sample, in ohms, by $a/100$, where a is the circumference of the sheath of the sample, in millimetres. Record the median of the three values so obtained as the surface resistance of the sheath.

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Annex D (normative)
Mechanical test — Two pulley flexing test

D.1 General

This test is not applicable to:

— any cables with greater than 18-cores in two layers;

— any cables with thermoplastic insulation having a conductor size greater than 2.5 mm^2;

— any cable with thermosetting insulation of conductor size greater than 4 mm^2.

D.2 Apparatus

This test shall be carried out by means of the apparatus shown in Figure D.1. This apparatus consists of a carrier C, a driving system for the carrier and four pulley wheels for each sample of cable to be tested. The carrier C supports two pulley wheels A and B, which are of the same diameter. The two fixed pulley wheels, at either end of the apparatus, may be of a different diameter from pulley wheels A and B, but all four pulley wheels shall be so arranged that the sample is horizontal between them. The carrier makes cycles of forward and backward movements over a distance of 1 m at an approximately constant speed of 0.33 m/s between each reversal of the direction of movement.

The pulley wheels shall be made of metal. Pulley wheels with a semi-circular shaped groove shall be used for testing circular cables and pulley wheels with a flat groove for testing flat cables. The restraining clamps D shall be fixed so that the pull is always applied by the weight from which the carrier is moving away. The distance from one restraining clamp to its support, while the other clamp is resting on its support, shall be a maximum of 50 mm.

The driving system shall be such that the carrier reverses smoothly and without jerks when it changes from one direction of movement to the other.

D.3 Sample preparation

A sample of flexible cable about 5 m long shall be stretched over the pulley wheels, as shown in Figure D.1, each end being loaded with a weight. The mass of this weight and the diameter of pulley wheels A and B shall be as given in Table D.1 or Table D.2 as appropriate.

D.4 Current loading of cores

During the flexing test the cable sample shall be loaded with the current specified in Table D.1 or Table D.2 as applicable, as follows.

— 2-core and 3-core cables: All cores shall be loaded fully.

— 4-core and 5-core cables: Three cores shall be loaded fully or all cores shall be loaded with a current of I_n amps, calculated according to the following formula:

$$I_n = I_3 \sqrt{\frac{3}{n}}$$

where

n is the number of cores;

I_3 is the full current given in Table D.1 or Table D.2 as appropriate.

For the current loading either a low voltage or a voltage about 230/400 V shall be used. On cores which are not loaded, a signal current shall be applied.

D.5 Voltage between cores

For all two-core cables, the voltage between the conductors shall be 230 V a.c. For all other cables having three or more cores, a three-phase a.c. voltage of 400 V shall be applied to three conductors, any additional conductors being connected to the neutral.

NOTE This also applies when a low voltage current loading system is used.

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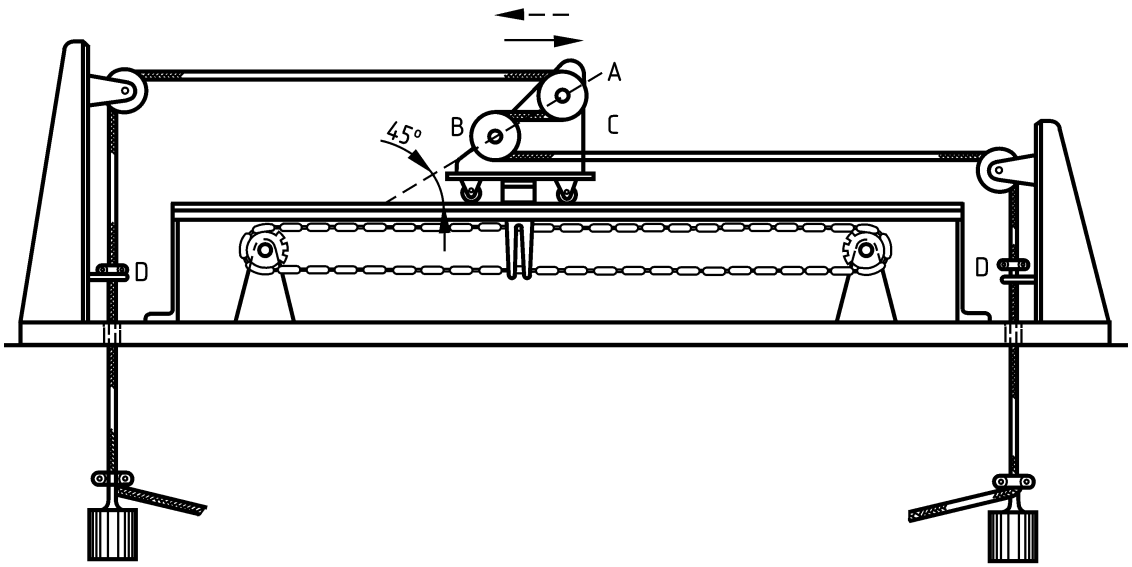
D.6 Fault detection

The flexing apparatus shall be constructed so that it will detect a fault and stop if any of the following occur during the flexing test:

— interruption of the test current;

— short circuit between the cores;

— short circuit between the test sample and the pulley wheels (flexing apparatus).



Key

A and B	Pulley wheels
C	Carrier
D	Restraining clamps

Figure D.1 — Flexing apparatus

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Table D.1 — Mass of weights, diameter of pulley wheels and current loading for cables with thermoplastic insulation and sheath

Type of flexible cable	Number of cores[a]	Nominal cross-sectional area of conductors mm²	Mass of each weight kg	Diameter of pulley wheels A and B[b] mm	Current (I_3) A
Cables specified in Table 40, Table 41, Table 42, Table 43 and Table 44	2	0.5	0.5	60	1.5
		0.75	1.0	80	3
		1	1.0	80	5
		1.5	1.0	80	8
		2.5	1.5	120	12.5
	3	0.5	0.5	80	1.5
		0.75	1.0	80	3
		1	1.0	80	5
		1.5	1.0	80	8
		2.5	1.5	120	12.5
	4	0.5	0.5	80	1.5
		0.75	1.0	80	3
		1	1.0	80	5
		1.5	1.5	120	8
		2.5	1.5	120	12.5
	5	0.5	1.0	80	1.5
		0.75	1.0	80	3
		1	1.0	120	5
		1.5	1.5	120	8
		2.5	2.0	120	12.5
	6	0.5	1.0	120	1.5
		0.75	1.5	120	3
		1.0	1.5	120	5
		1.5	2.0	120	8
		2.5	3.5	160	12.5
	7	0.5	1.0	120	1.5
		0.75	1.5	120	3
		1.0	1.5	120	5
		1.5	2.0	160	8
		2.5	3.5	160	12.5
	12	0.5	1.5	120	1.5
		0.75	2.0	160	3
		1.0	3.0	160	5
		1.5	4.0	160	8
		2.5	7.0	200	12.5
	18	0.5	2.0	160	1.5
		0.75	3.0	160	3
		1.0	4.0	160	5
		1.5	6.0	200	8
		2.5	7.5	200	12.5

[a] Cables with numbers of cores between 7 and 18, but not specified in this table, are "non-preferred" cable types. They may be tested using the mass of weights, pulley wheel diameter and current given in the table for the same conductor size with the next highest specified number of cores.

[b] Diameter measured at the lowest point of the groove.

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Table D.2 — Mass of weights, diameter of pulley wheels and current loading for cables with thermosetting insulation and sheath

Type of flexible cable	Number of cores[a]	Nominal cross-sectional area of conductors mm²	Mass of each weight kg	Diameter of pulley wheels A and B[b] mm	Current (I_3) A
Cables specified in Table 10 to Table 24 inclusive	2	0.75	1.0	80	6
		1	1.0	120	10
		1.5	1.0	120	16
		2.5	1.5	120	25
		4	2.5	160	32
	3	0.75	1.0	80	6
		1	1.0	120	10
		1.5	1.5	120	16
		2.5	2.0	160	25
		4	3.0	160	32
	4	0.75	1.0	80	6
		1	1.5	120	10
		1.5	1.5	120	16
		2.5	2.5	160	25
		4	3.5	200	32
	5	0.75	1.0	80	6
		1	1.5	120	10
		1.5	2.5	160	16
		2.5	3.0	160	25
		4.0	4.0	200	32
	7	1.5	3.5	160	16
		2.5	5.0	200	25
	12	1.5	5.0	200	16
		2.5	7.5	200	25
	18	1.5	7.5	200	16
		2.5	9.0	200	25

[a] For cables with numbers of cores above 5 and below 18 not given in this table, the pulley wheel diameter shall be 200 mm, the mass of each weight shall be 8 times to 10 times the mass of 1 m of the cable to be tested and the current shall be as stated in the table for the appropriate conductor size.
[b] Diameter measured at the lowest point of the groove.

Annex E (normative)
Procedure for checking the efficacy of the spark testing method and equipment

E.1 Object

The object of this annex is to provide a standard procedure by which manufacturers can determine whether their spark testing equipment and method are effective in detecting faults in the insulation when used for the spark test specified in **C.6.2.2**.

E.2 Procedure

E.2.1 The test shall be carried out on two test lengths of core which have been especially prepared in accordance with **E.2.2**. One of the cores shall have the smallest insulation thickness of the relevant types of cable; the other core shall have the largest insulation thickness of the relevant types of cable.

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E.2.2 The preparation of the punctures in the insulation shall be effected as follows.

a) The insulation shall be removed from the core for a length of about 5 times the nominal insulation thickness.

b) From the piece of insulation which has been removed, a segment of about 30° shall be removed; the remaining piece of the insulation shall then be replaced on the conductor (see Figure E.1).

c) Over the replaced piece of the insulation, one layer of adhesive tape, e.g. polyethylene terephthalate, shall be placed in a longitudinal direction, with an overlap. This overlap shall be situated on the opposite side of the core to the position where the insulation was removed (see Figure E.2).

d) The layer of tape shall have a length of at least 10 times the nominal insulation thickness. In this layer, in the middle of the place where the insulation has been removed, a hole shall be punched in the tape with a hot needle. The diameter of this hole shall be equal to half of the allowed minimum insulation thickness.

The other test piece shall be prepared in the same way.

E.2.3 The prepared test-pieces shall then be passed through the spark test equipment at the highest speed for which the equipment is intended, and with a voltage applied between the electrode and the conductor. The applied voltage shall be that used during cable manufacturing for the corresponding insulation thickness.

A fault shall be registered as each test piece is passed through the equipment.

E.3 Method to check the recovery time

At least two faults shall be passed through the spark test equipment at its actual operating speed, v (in metres per second), the distance in metres between successive faults being not greater than the value of v.

All the faults shall be registered by the equipment.

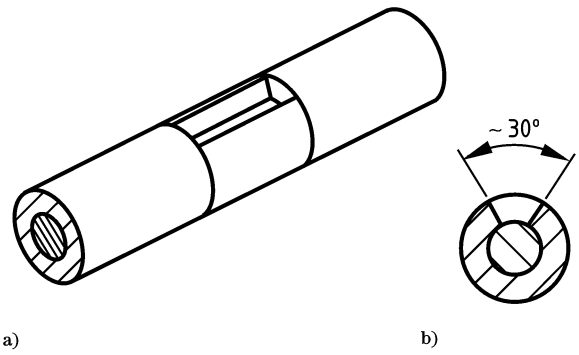

Figure E.1 — Preparation of core for spark test equipment check: removal of insulation

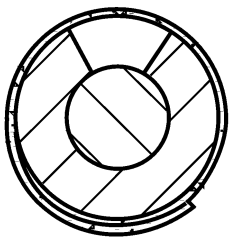

Figure E.2 — Preparation of core for spark test equipment check: covering with tape

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Annex F (normative)
Solderability test for plain conductors

F.1 Principle

The test is to verify that the components of the core do not contaminate or change the surface condition of plain copper in such a way that prevents good uniform adhesion of solder to the copper.

F.2 Pre-selection of samples

Before the test is carried out, the normal ageing test in an air oven shall be carried out in accordance with the relevant section of BS 7655.

When the normal ageing test in the air oven has been completed, the conductors of the test samples shall be examined. If there is no blackening of the conductors no further action is required.

If the conductors are blackened, the normal ageing test in the air oven shall be repeated on new samples, except that the ageing conditions shall be 168 h at (70 ± 2) °C. At the end of this ageing period the conductors shall be examined, and if there is no blackening no further action is required. If the conductors are blackened, the test described in **F.3**, **F.4** and **F.5** shall be carried out.

F.3 Selection of samples and preparation of test pieces

F.3.1 One sample having a length suitable for the bending test described in **F.3.2** shall be taken at each of three points in the cable, and the cores in each sample shall be carefully separated from all other components.

F.3.2 Each sample of core thus obtained shall be wound, in three turns, on a mandrel, the diameter of which is three times that of the core.

The sample shall then be unwound and straightened out, and then shall be wound again in such a way that the insulation which was compressed the first time is stretched the second time.

This cycle of operations shall be repeated twice more, to give a total of three bending operations in one direction and three in the other.

F.3.3 From each sample of core which has been straightened out after the third cycle of bending operations, a test piece having a length of about 150 mm shall be taken from that part of the core which has actually been wound.

Each test piece shall then be subjected to accelerated ageing in an air oven for 168 h at a temperature of (70 ± 2) °C.

After this accelerated ageing, the test pieces shall be left at ambient temperature for at least 16 h. Then each test piece shall be stripped at one end over a length of 60 mm and subjected to the solderability test by the solder-bath method described in **F.4** and **F.5**.

F.4 Description of the solder bath

The solder bath shall have a volume sufficient to ensure that the temperature of the solder remains uniform at the moment when the conductor is introduced. It shall be provided with a device which maintains the temperature of the solder at (270 ± 10) °C.

The height of the solder bath shall be at least 75 mm.

The visible surface area of the bath shall be reduced as far as possible, by using a perforated plate of heat resisting material in order to protect the core against direct radiation from the bath.

The composition of the solder shall be tin (between 59.5 % and 61.5 %) and lead. Impurities (as a percentage of the total mass) shall not exceed the following:

- antimony 0.50;
- bismuth 0.25;
- copper 0.08;
- iron 0.02;
- zinc 0.005;
- aluminium 0.005;
- others 0.080.

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F.5 Test procedure

The surface of the solder bath shall be kept clean and shining.

After immersion for 10 s at ambient temperature in a pickling bath consisting of a solution of zinc chloride in water (ZnCl being 10 % of the total mass), the bared end of each test piece shall be immersed in the solder bath over a length of 50 mm in the direction of its longitudinal axis.

The speed of immersion shall be (25 ± 5) mm/s.

The duration of immersion shall be (5 ± 0.5) s.

The speed of emergence shall be (25 ± 5) mm/s.

The number of immersions shall be three and the interval between each immersion shall be as short as possible, and in any case not more than 5 s.

Annex G (normative)
Compatibility test

G.1 General

This test is intended to determine whether the insulation and sheath are likely to deteriorate due to contact with the other components in the cable.

G.2 Procedure

Prepare a test sample, and age it in an air oven, in accordance with BS EN 60811-1-2:1995, **8.1.4**, using temperatures and times as follows:

— compounds EI 7, EM 7, EI 6 and TMPU: 7 days at (100 ± 2) °C;
— compounds EI 8, EM 8, EM 10, type 10, TI 2, TI 4, TM 2 and TM 5: 7 days at (80 ± 2) °C;
— compounds TI 3 and TM 3: 14 days at (100 ± 2) °C.

Place a sheet of clean white blotting paper under each test piece in the oven to detect any exudate which may drip from the cable.

After completion of the ageing test, measure the tensile strength and the elongation at break of the insulation and sheath in accordance with BS EN 60811-1-1.

Annex H *Spare*

Annex I (normative)
Water immersion tests for H07RN8-F flexible cables

I.1 Long term voltage tests in water

I.1.1 *Voltage pre-test on completed cable*

A sample consisting of at least 20 m of completed cable shall be tested. The sample shall be immersed in potable tap water at (20 ± 5) °C for at least 1 h. Then the a.c. voltage test specified in **C.2** shall be carried out.

If no breakdown of the insulation occurs the sample shall be used for the tests specified in **I.1.2** and **I.1.3**. If breakdown of the insulation occurs, the cable shall be deemed to have failed the test.

I.1.2 *Voltage test on completed cable at 50 °C after pre-test*

A 5 m sample of completed cable shall be taken from the 20 m length of cable which has been tested in accordance with **I.1.1** and immersed in potable tap water at (50 ± 2) °C for a period of 100 days. During this immersion period an a.c. test voltage of 1 kV shall be applied between one conductor connected to the water and all others connected together in the case of a multicore cable, and between the conductor and the water in the case of a single-core cable. If the cable contains a circuit protective conductor this shall be the conductor connected to the water.

No breakdown of the insulation shall occur.

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I.1.3 *Insulation resistance tests on cores after pre-test*

I.1.3.1 *Test samples*

Three samples of core each 5 m long shall be taken from the 20 m length of completed cable which has been tested in accordance with **I.1.1**.

I.1.3.2 *Voltage test on cores*

The three samples shall be immersed in potable tap water at (50 ± 2) °C for at least 24 h. Then an a.c. test voltage of 2 500 V shall be applied between each conductor and the water for a period of 5 min.

No breakdown of the insulation shall occur.

Immediately after this test the insulation resistance shall be measured in accordance with **C.4** at a temperature of (50 ± 2) °C.

The value of volume resistivity, ρ, expressed in ohm centimetres (Ω·cm) calculated from the following equation, shall be $\geq 10^{12}$ Ω·cm.

$$\rho = \frac{2.725 \times R \times 10^{11}}{\log_{10}(D/d)}$$

where

R is the insulation resistance in megohm kilometres (MΩ·km);

d is the diameter of the bare conductor as given in BS EN 60719:1993, Table 1 (for class 1 and class 2 conductors) or Table 2 (for class 5 and class 6 conductors);

D is the value of d plus twice the specified mean value of the thickness of the insulation and any mandatory separator between the conductor and the insulation.

I.1.3.3 *Voltage test on cores at 50 °C*

The three samples which have been tested in accordance with **I.1.3.2** shall be immersed in potable tap water at (50 ± 2) °C for a period of 14 days. During this period an a.c. test voltage of 1 000 V shall be applied between each conductor and the water.

No breakdown of the insulation shall occur.

Immediately after this test the insulation resistance shall be measured in accordance with **C.4** at a temperature of (50 ± 2) °C.

The value of volume resistivity, calculated from the formula given in **I.1.3.2** shall be $\geq 10^{11}$ Ω·cm.

I.2 Mechanical properties of sheath after water immersion

I.2.1 *General*

This test shall be carried out on samples taken from:

a) the sheath, when applied as a single layer; or

b) the inner and outer layers of the sheath, when applied in two layers.

I.2.2 *Procedure*

Four sets of three dumb bell samples shall be taken from each layer of the sheath of the cable as manufactured, as described in BS EN 60811-1-1:1995, **9.2.3** and conditioned for 7 days at a temperature of (20 ± 5) °C and a relative humidity of (50 ± 5) %. At the end of the conditioning period the sets of samples shall be used as follows.

a) One set shall be weighed to an accuracy of 0.1 mg. The samples shall then be immersed in potable tap water at (50 ± 5) °C for 100 days.

After removal from the potable tap water, surface water shall be removed by wiping lightly with a filter paper and the samples conditioned for 16 h at a temperature of (20 ± 5) °C and a relative humidity of (50 ± 5) %.

The samples shall then be re-weighed to an accuracy of 0.1 mg as soon as possible after removal from the conditioning chamber.

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b) Three sets shall be used for determination of tensile strength and elongation at break as follows:

1) one set, without immersion;

2) the second set, after immersion in potable tap water at (50 ± 2) °C for 28 days;

3) the third set, after immersion in potable tap water at (50 ± 2) °C for 100 days.

I.2.3 *Requirements*

The samples shall conform to the following requirements.

a) *Increase in mass*

The increase in mass after immersion in potable tap water for 100 days shall be not greater than 40 % of the mass before immersion.

b) *Tensile strength and elongation at break*

After 100 days immersion the tensile strength and elongation at break shall be not less than the values given in Table I.1.

The variation in tensile strength and in elongation at break between 28 days immersion and 100 days immersion shall be as given in Table I.1.

Table I.1 — Tensile strength and elongation at break after water immersion

Parameter	Inner layer	Single layer/outer layer
Minimum tensile strength after 100 days (N/mm^2)	5	7
Minimum elongation at break after 100 days (%)	175	200
Maximum percentage variation[a] in tensile strength between 28 days and 100 days	±15	±15
Maximum percentage variation[a] in elongation at break between 28 days and 100 days	±20	±20
[a] The variation is the difference between the respective values obtained after 28 days and after 100 days, expressed as a percentage of the former.		

Annex J *Spare*

Annex K (normative)
Measurement of thickness

K.1 Measurement of insulation thickness

K.1.1 *Procedure*

The thickness of insulation shall be measured in accordance with BS EN 60811-1-1:1995, **8.1**. Three samples shall be taken from the cable; each sample shall be separated from the next by a distance of at least 1 m.

Conformity shall be checked on each core.

If withdrawal of the conductor is difficult, it shall be stretched in a tensile testing machine or the piece of core shall be loosened by stretching or some other suitable means that does not damage the insulation.

K.1.2 *Evaluation of results*

The mean of the 18 values (expressed in millimetres) obtained from the three pieces of insulation from each core shall be calculated to two decimal places and rounded off as follows, and this shall be taken as the mean value of the thickness of insulation.

If in the calculation the second decimal figure is 5 or more, the first decimal figure shall be raised to the next number. Thus, for example, 1.74 shall be rounded to 1.7 and 1.75 to 1.8.

The lowest of all values obtained shall be taken as the minimum thickness of insulation at any place.

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K.2 Measurement of sheath thickness for circular cables

K.2.1 *Procedure*

The thickness of the sheath for circular cables shall be measured in accordance with BS EN 60811-1-1:1995, **8.2**.

One sample of cable shall be taken from each of three places, separated by at least 1 m.

K.2.2 *Evaluation of the measurement results*

The mean of all the values (expressed in millimetres) obtained from the three pieces of sheath shall be calculated to two decimal places and rounded off as follows, and this shall be taken as the mean value of the thickness of sheath.

If in the calculation the second decimal figure is 5 or more, the first decimal figure shall be raised to the next number. Thus, for example, 1.74 shall be rounded to 1.7 and 1.75 to 1.8.

The lowest of all values obtained shall be taken as the minimum thickness of sheath at any place.

K.3 Measurement of sheath thickness for flat cables

K.3.1 *Measuring equipment*

A measuring microscope or a profile projector shall be used, each instrument being capable of at least ×10 magnification. The equipment shall have an accuracy of 0.01 mm. In cases of dispute a microscope allowing a reading with an accuracy of 0.01 mm or a profile projector giving at least ×20 magnification shall be used.

K.3.2 *Preparation of test pieces*

One sample of cable shall be taken from each of three places, separated by at least 1 m.

After all materials inside the sheath have been removed, a test piece shall be prepared from each sample by cutting with a suitable device (sharp knife, razor blade, etc.) a slice of the sheath along a plane perpendicular to the longitudinal axis of the cable. If the sheath carried an indented marking, the test piece shall be taken so as to include such marking.

K.3.3 *Measuring procedure*

The test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

Measurements shall be taken on lines approximately parallel to the minor axis and on the major axis of the cross-section, at the position of each core, as shown in Figure K.1.

The thinnest place on the sheath shall be measured. Where this does not coincide with one of the designated measurement points shown in Figure K.1, it shall be substituted for the closest such point, to give a total of six measurements.

The measurements shall be made in millimetres to two decimal places.

K.3.4 *Evaluation of the measurement results*

The mean of all the values (expressed in millimetres) obtained from the three pieces of sheath shall be calculated to two decimal places and rounded off as given below, and this shall be taken as the mean value of the thickness of sheath.

If in the calculation the second decimal figure is 5 or more, the first decimal figure shall be raised to the next number. Thus, for example, 1.74 shall be rounded to 1.7 and 1.75 to 1.8.

The lowest of all values obtained shall be taken as the minimum thickness of sheath at any place.

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K.4 Measurement of sheath thickness for two separate homogeneous layers

K.4.1 *Procedure*

The combined thickness of the two separate homogeneous layers shall be measured in accordance with BS EN 60811-1-1:1995, **8.2**.

If the two layers of sheath are easily separable, the thickness of each layer shall be measured in accordance with BS EN 60811-1-1:1995, **8.2**.

If the two layers are bonded together, the thickness of the inner layer of the sheath only shall be measured. The test sample shall be prepared in accordance with BS EN 60811-1-1:1995, **8.1** and the measurement procedure shall be carried out in accordance with BS EN 60811-1-1:1995, **8.4.2**.

One sample of cable shall be taken from each of three places, separated by at least 1 m.

K.4.2 *Evaluation of the measurement results*

The mean of all the values (expressed in millimetres) obtained from the three pieces of sheath shall be calculated to two decimal places and rounded off as given below and this shall be taken as the mean value of the thickness of the sheath.

If in the calculation, the second decimal figure is 5 or more, the first decimal figure shall be raised to the next number; thus for example, 1.74 shall be rounded to 1.7 and 1.75 to 1.8.

The lowest of all the values obtained shall be taken as the minimum thickness of the sheath at any place.

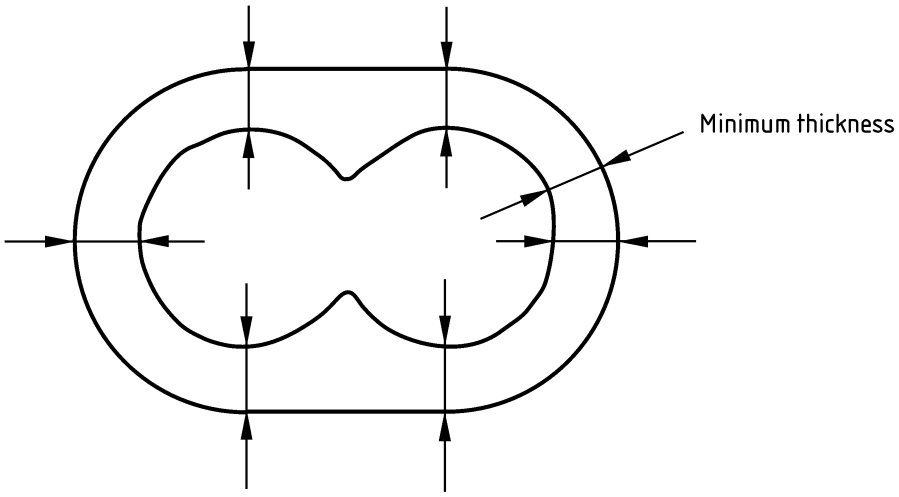

Figure K.1 — Measurement of sheath thickness

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HD 22.12 S1:1996, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 12: Heat resistant EPR cords and flexible cables.*

HD 22.13 S1:1996, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 13: Single and multicore flexible cables, insulated and sheathed with cross-linked polymer and having low emission of smoke and corrosive gases.*

HD 22.15 S1:1999, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 15: Multicore cables insulated and sheathed with heat resistant silicone rubber.*

HD 22.16 S1:2000, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 16: Water resistant polychoroprene or equivalent synthetic elastomer sheathed cables.*

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