BRITISH STANDARD

BS 6007:2000

Electric cables —

Single core unsheathed heat resisting cables for voltages up to and including 450/750 V, for internal wiring

ICS 29.060.20

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.)

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Contents

Foreword

This British Standard has been prepared by Subcommittee GEL/20/1. It supersedes BS 6007:1993 which is withdrawn.

This revision of BS 6007 specifies requirements for single core, unsheathed, rubber insulated 110 °C and 180 °C cables for internal wiring. It is aligned with HD 22.3 S3 and HD 22.7 S2.

The following cables which were in BS 6007:1993 have been transferred to other standards:

H05RR-F types (in BS 6007:1993, Table 3) have been transferred to BS 7919;

H07RN-F types (in BS 6007:1993, Tables 4 and 4A) have been transferred to BS 7919.

The following national types have been deleted from BS 6007 as being obsolete:

450/750 V single core, braided, rubber insulated cables (in BS 6007:1993, Table 1);

300/500 V flat twin rubber insulated cables (in BS 6007:1993, Table 2).

The following national type has been superseded by the H07BN4-F harmonized type in BS 7919:

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

The following harmonized type has been transferred from BS 6500:

H05SJ-K type smaller than 4 mm^2.

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

Annexes C, D, E and F are normative. Annexes A and B are informative.

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 inside back cover) 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”).

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

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[1)] British Approvals Service for Cables, 23 Presley Way, Crownhill, Milton Keynes, Buckinghamshire MK8 0ES.

1 Scope

This British Standard specifies requirements for the construction, dimensions and mechanical and electrical properties of single core unsheathed rubber insulated 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 as internal wiring.

The types of cable included in the standard are as follows:

Table 3	110 °C heat resisting rubber insulated cable, single core unsheathed (H07G-U)	450/750 V;
Table 4	110 °C heat resisting rubber insulated cable, single core unsheathed (H07G-R)	450/750 V;
Table 5	110 °C heat resisting rubber insulated cable, single core unsheathed (H07G-K)	450/750 V;
Table 6	110 °C heat resisting rubber insulated cable, single core unsheathed (H05G-U)	300/500 V;
Table 7	110 °C heat resisting rubber insulated cable, single core unsheathed (H05G-K)	300/500 V;
Table 8	Braided, 180 °C silicone rubber insulated cable, single core unsheathed and twisted twin (H05SJ-K)	300/500 V;
Table 9	180 °C silicone rubber insulated cable, single core unsheathed (H05S-U)	300/500 V;
Table 10	180 °C silicone rubber insulated cable, single core unsheathed (H05S-K)	300/500 V.

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 annexes C, D, E and F.

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 publication referred to applies.

BS 4727-2:Group 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 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.*

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

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 the 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 specified in the appropriate construction table (Tables 3 to 10).

Conformity shall be checked by examination.

5.2 Identification and marking

5.2.1 *General*

Each cable shall be identified by its colour as indicated in the appropriate construction table.

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 **5.2.4**.

5.2.2 *Colours*

The colour shall be either throughout the whole of the insulation or on its surface.

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

Conformity shall be checked by measurement.

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 cable intended for use as an earth connection or similar protection. The colour blue is for the identification of the cable intended to be connected to the neutral but, if there is no neutral, blue may be used to identify any cable except for the earthing or protective conductor.

NOTE 3 Attention is drawn to the fact that, according to the use to which the cables are to be put, they could be subject to core colour requirements specified in BS 7671, in other British Standards or in other standards, or in regulations or statutory requirements.

NOTE 4 In addition to the combination green/yellow, and the mono-colour blue, the following other mono-colours are recognized as harmonized: black, brown, grey, orange, pink, red, turquoise, violet and white.

5.2.3 ***Indication of origin***

All cables shall be provided with an indication of origin consisting either of 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.

Each specified mark shall be legible and shall be regarded as continuous if the distance between the end of one mark and the beginning of the next identical mark does not exceed 275 mm.

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 **5.2.4**.

5.2.4 ***CENELEC "Common Marking"***

It shall be permitted for a cable 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 alternative methods specified in **5.2.3**.

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 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 directly marked on, or in, the cable.

5.2.5 ***Identification mark***

Where cables are to be distinguished from cables in other standards by additional marking, the marking shall be as given in the applicable construction table.

The marking shall be continuous as specified in **5.2.3**.

Conformity shall be checked by measurement.

5.2.6 ***Clarity and durability of colour and marking***

The colours shall be clearly identifiable and durable.

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

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.

5.3 Cable testing

5.3.1 ***Schedule of tests***

Tests to be performed on cables specified in this standard shall be as specified in Table 2, which refers 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 also indicates which tests relate to the completed cables and which relate to components.

5.3.2 ***Test conditions***

5.3.2.1 *Ambient temperature*

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

5.3.2.2 *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 49 Hz to 61 Hz. The waveform shall be substantially sinusoidal.

6 Constructional details

6.1 Conductors

The conductors shall be annealed copper conforming to BS 6360. The class of conductor and whether the individual wires are to be plain or coated, for example with nickel, tin or silver shall be as given in the appropriate construction table.

The d.c. resistance of the conductors shall be as specified in **7.2**.

Plain conductors in cables specified in Tables 8 to 10 shall conform to the solderability requirements specified in **8.4**.

A separator tape shall be applied over the conductor where specified in the appropriate construction table.

NOTE The construction tables also indicate those cables with which the use of a separator is optional.

6.2 Insulation

6.2.1 *Type of insulation*

The insulation shall be either type EI 2 or type EI 3 conforming to BS 7655-1.1 as specified in the appropriate construction table.

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 annex D, 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.

6.3 Overall braid

For cables specified in Table 8, a braid covering the insulation shall be applied. The yarns forming the braid shall be glass fibre, treated with a suitable substance in order to resist fraying. The braid shall have a uniform texture, without knots or gaps.

Table 1 — List of tests applicable to cables specified in Tables 3 to 10

Clause number	Test	Cable specified in table							
		3	4	5	6	7	8	9	10
	Electrical tests								
7.2	Conductor resistance	X	X	X	X	X	X	X	X
7.3	Voltage test on cable at 2 000 V	—	—	—	X	X	X	X	X
7.3	Voltage test on cable at 2 500 V	X	X	X	—	—	—	—	—
7.4	Absence of faults in the insulation	X	X	X	X	X	X	X	X
7.5	Insulation resistance at 110 °C	X	X	X	X	X	—	—	—
	Constructional and dimensional tests								
5.1	Check on construction	X	X	X	X	X	X	X	X
6.2.3	Measurement of insulation thickness	X	X	X	X	X	X	X	X
8.2	Measurement of overall diameter	X	X	X	X	X	X	X	X
8.3	Measurement of ovality	—	—	—	—	—	X	X	X
8.4	Solderability test (plain conductors)	—	—	—	—	—	X	X	X

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	T
application	**6.2.2**	Visual examination	S
thickness	**6.2.3**	Annex D	S
Cable identification:			
colour	**5.2.2**	Visual examination	S
clarity and durability of colour and marking	**5.2.6**	**5.2.6**	S
Tests on completed cables			
Cable markings	**5.2**	Visual examination and measurement	R
Conductor resistance	**7.2**	BS 6360	S
Voltage test on completed cables	**7.3**	**C.2**	S
Absence of faults in the insulation	**7.4**	**C.3**	R
Insulation resistance	**7.5**	**C.4**	S
Mean overall diameter	**8.2**	BS EN 60811-1-1:1995, **8.3**	S
Ovality	**8.3**	BS EN 60811-1-1:1995, **8.3**	S
Solderability test	**8.4**	Annex F	T

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

7 Electrical tests

7.1 General

The electrical tests to be performed on cables specified in this standard shall be as specified in Table 1.

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

7.2 Conductor resistance

When the d.c. resistance of each conductor is measured in accordance with BS 6360 on a sample of cable at least 1 m in length it shall conform to BS 6360.

7.3 Voltage test on completed cable

When the cable is tested as described in **C.2** no breakdown of the insulation shall occur.

7.4 Absence of faults in the insulation

When the cable is tested as described in **C.3** no breakdown of the insulation shall occur.

7.5 Insulation resistance

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

8 Non-electrical tests

8.1 General

The non-electrical tests to be performed on cables specified in this standard 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.

8.2 Mean overall diameter

The mean overall diameter of the cable shall be within the limits specified 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 and the mean of the six values obtained shall be taken as the mean overall diameter.

8.3 Ovality

For the cables specified in Tables 8 to 10, the difference between any two values of the overall diameter 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.

8.4 Solderability test

For the cables specified in Tables 8 to 10, 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** to **F.5**, the part of the plain conductor which has been immersed in the solder bath shall be adequately tinned.

Table 3 — 110 °C heat resisting rubber insulated cable, 450/750 V, single core unsheathed

Harmonized code designation: H07G-U

Construction:

Conductor — class 1 copper, plain or tinned.

Insulation — compound type EI 3.

A separator of suitable material shall be applied around the conductor if the conductor is plain. If the conductor is tinned the use of a separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Marking:

At least the mandatory marking “G” shall be printed, indented or embossed on the insulation.

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter		Minimum insulation resistance at 110 °C
		Lower limit	Upper limit	
mm^2	mm	mm	mm	MΩ·km
1.5	0.8	2.8	3.5	0.012
2.5	0.9	3.4	4.3	0.011
4	1.0	4.0	5.0	0.010
6	1.0	4.5	5.6	0.009
10	1.2	5.7	7.1	0.008

Table 4 — 110 °C heat resisting rubber insulated cable, 450/750 V, single core unsheathed

Harmonized code designation: H07G-R

Construction:

Conductor — class 2 copper, plain or tinned.

Insulation — compound type EI 3.

A separator of suitable material shall be applied around the conductor if the conductor is plain. If the conductor is tinned the use of a separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Marking:

At least the mandatory marking "G" shall be printed, indented or embossed on the insulation.

Nominal cross-sectional area of conductor	**Radial thickness of insulation**	**Mean overall diameter**		**Minimum insulation resistance at 110 °C**
		Lower limit	**Upper limit**	
mm^2	mm	mm	mm	MΩ·km
1.5	0.8	2.9	3.7	0.012
2.5	0.9	3.5	4.4	0.011
4	1.0	4.2	5.2	0.010
6	1.0	4.7	5.9	0.008
10	1.2	6.0	7.4	0.008
16	1.2	6.8	8.5	0.006
25	1.4	8.4	10.6	0.006
35	1.4	9.4	11.8	0.005
50	1.6	10.9	13.7	0.005
70	1.6	12.5	15.6	0.004
95	1.8	14.5	18.1	0.004
120	1.8	15.9	19.9	0.004
150	2.0	17.7	22.1	0.004
185	2.2	19.7	24.6	0.003
240	2.4	22.4	28.0	0.003

Table 5 — 110 °C heat resisting rubber insulated cable, 450/750 V, single core unsheathed

Harmonized code designation: H07G-K

Construction:

Conductor — class 5 copper, plain or tinned.

Insulation — compound type EI 3.

A separator of suitable material shall be applied around the conductor if the conductor is plain. If the conductor is tinned the use of a separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Marking:

At least the mandatory marking "G" shall be printed, indented or embossed on the insulation.

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter		Minimum insulation resistance at 110 °C
		Lower limit	Upper limit	
mm^2	mm	mm	mm	MΩ·km
1.5	0.8	3.0	3.7	0.012
2.5	0.9	3.6	4.5	0.011
4	1.0	4.3	5.4	0.010
6	1.0	4.8	6.0	0.008
10	1.2	6.0	7.6	0.008
16	1.2	7.1	8.9	0.006
25	1.4	8.8	11.0	0.005
35	1.4	10.1	12.6	0.005
50	1.6	11.9	14.9	0.004
70	1.6	13.6	17.0	0.004
95	1.8	15.5	19.3	0.004
120	1.8	17.1	21.4	0.003
150	2.0	19.0	23.8	0.003
185	2.2	21.0	26.3	0.003
240	2.4	23.9	29.9	0.003

Table 6 — 110 °C heat resisting rubber insulated cable, 300/500 V, single core unsheathed

Harmonized code designation: H05G-U

Construction:

Conductor — class 1 copper, plain or tinned.

Insulation — compound type EI 3.

A separator of suitable material shall be applied around the conductor if the conductor is plain. If the conductor is tinned the use of a separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Marking:

At least the mandatory marking "G" shall be printed, indented or embossed on the insulation.

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter		Minimum insulation resistance at 110 °C
		Lower limit	Upper limit	
mm^2	mm	mm	mm	MΩ·km
0.5	0.6	1.9	2.4	0.015
0.75	0.6	2.1	2.6	0.013
1	0.6	2.2	2.8	0.012

Table 7 — 110 °C heat resisting rubber insulated cable, 300/500 V, single core unsheathed

Harmonized code designation: H05G-K

Construction:

Conductor — class 5 copper, plain or tinned.

Insulation — compound type EI 3.

A separator of suitable material shall be applied around the conductor if the conductor is plain. If the conductor is tinned the use of a separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Marking:

At least the mandatory marking "G" shall be printed, indented or embossed on the insulation.

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter		Minimum insulation resistance at 110 °C
		Lower limit	Upper limit	
mm^2	mm	mm	mm	MΩ·km
0.5	0.6	2.1	2.6	0.014
0.75	0.6	2.2	2.8	0.012
1	0.6	2.4	2.9	0.011

Table 8 — Braided, 180 °C silicone rubber insulated cable, 300/500 V, single core unsheathed and twisted twin[a]

Harmonized code designation: H05SJ-K

Construction:

Conductor — class 5 copper, plain or tinned or else protected by a metal other than tin, for example silver.

Insulation — compound type EI 2.

Braid — treated glass fibre.

A separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter of each braided core	
		Lower limit	Upper limit
mm^2	mm	mm	mm
0.5	0.6	2.6	3.3
0.75	0.6	2.8	3.5
1	0.6	2.9	3.7
1.5	0.7	3.4	4.2
2.5	0.8	4.0	5.0
4	0.8	4.5	5.6
6	0.8	5.0	6.2
10	1.0	6.2	7.8
16	1.0	7.3	9.1

[a] Twisted twin is a national type. It comprises two H05SJ-K cables twisted together.

Table 9 — 180 °C silicone rubber insulated cable, 300/500 V, single core unsheathed

Harmonized code designation: H05S-U

Construction:

Conductor — class 1 copper, plain or tinned or else protected by a metal other than tin, for example silver.

Insulation — compound type EI 2.

A separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter	
		Lower limit	Upper limit
mm^2	mm	mm	mm
0.5	0.8	2.3	2.9
0.75	0.8	2.4	3.1
1	0.8	2.6	3.2
1.5	0.9	3.0	3.8
2.5	1.0	3.6	4.5

Table 10 — 180 °C silicone rubber insulated cable, 300/500 V, single core unsheathed

Harmonized code designation: H05S-K

Construction:

Conductor — class 5 copper, plain or tinned or else protected by a metal other than tin, for example silver.

Insulation — compound type EI 2.

A separator is optional.

Core identification:

Green/yellow, blue or other colours (see **5.2**).

Nominal cross-sectional area of conductor	Radial thickness of insulation	Mean overall diameter	
		Lower limit	Upper limit
mm^2	mm	mm	mm
0.5	0.8	2.4	3.1
0.75	0.8	2.6	3.2
1	0.8	2.7	3.4
1.5	0.9	3.2	4.0
2.5	1.0	3.8	4.7

Annex A (informative)

Guide to the use of single core and twisted twin, unsheathed, heat resisting cables for internal wiring

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 insulated 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 completed cables. They may be instituted by the manufacturer at his discretion and should not be regarded as requirements of this standard.

B.1 Tests on completed cables

B.1.1 *General*

Subject completed cables to the tests described in **B.1.2** and **B.1.3**.

B.1.2 *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 radial thickness of insulation[a]		Test voltage	
Above mm	Up to and including mm	a.c. (r.m.s.) kV	d.c. kV
—	0.5	4	6
—	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.1.3 *Conductor resistance*

B.1.3.1 *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.1.3.2 *Recommended test criteria*

Calculate the resistance per unit length from the production length of the completed cable.

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

Annex C (normative)
Electrical tests

C.1 Test conditions

Unless otherwise specified for a particular test, make tests at ambient temperature with an 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. 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

Test	Unit	300/500 V cables	450/750 V cables
Conductor resistance (see **7.2**)			
Length of sample (minimum)	m	1	1
Voltage test on completed cable (see **7.3**)			
Length of sample (minimum)	m	20	20
Period of immersion (minimum)	h	1	1
Temperature of water	°C	20 ± 5	20 ± 5
Applied a.c. voltage (r.m.s.)	V	2 000	2 500
Time of application	min	15	15
Absence of faults in the insulation (see **7.4**)			
Spark test:			
Result to be obtained		No breakdown of the insulation	No breakdown of the insulation
Insulation resistance (see **7.5**)			
Length of sample (previously tested to **C.2**)	m	1.40	1.40
Period in oven (minimum)	h	2	2
Temperature of oven	°C	110 ± 2	110 ± 2

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.

C.2.2 *Procedure*

Immerse the sample in water at the temperature, and for the period, given in Table C.1. Ensure that the ends of the cable 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 Table C.1 between the conductor and the water for the time given in Table C.1.

C.3 Absence of faults in the insulation

C.3.1 *General*

Test all 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.3.2 *Procedure*

C.3.2.1 *General*

Test the cables by the spark test described in **C.3.2.2**.

C.3.2.2 *Spark test*

C.3.2.2.1 *Apparatus*

The spark test equipment shall provide a magnitude and presence of voltage that, together with the electrode system employed and 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.3.2.2.2 *Procedure*

The cable shall be passed through the spark test equipment using the electrode system, voltage levels and operating speed of passage established under **C.3.2.2.1**.

C.4 Insulation resistance test

The test shall be made on the same sample used for the voltage test (see **C.2**).

A sample of 1.40 m length shall be cut from the cable or core to be tested. This sample shall be covered with a semi-conducting layer, and over this layer a metal braid or a metal tape shall be applied in such a way as to obtain an active measuring length of 1.0 m.

At both ends of the active measuring length, leaving a gap 1 mm wide, a protective wire binding of approximately 5 mm length shall be applied.

The sample shall then be wound to form a ring with a diameter of approximately 15D but at least 0.20 m (D = nominal outer diameter of insulation).

The sample shall be maintained in an air oven for at least 2 h at the test temperature specified in the relevant construction table. The clearance between the sample and the walls of the air oven shall be at least 50 mm.

After the conditioning period a d.c. voltage between 80 V and 500 V shall be applied between the conductor and the screen (semi-conducting layer and metal braid/metal tape including the protective wire binding), the sample still being kept in the air oven.

The insulation resistance shall be measured 1 min after application of the voltage and this value shall be used to calculate the insulation resistance of a 1 km length of cable.

Annex D (normative)
Measurement of insulation thickness

D.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.

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.

D.2 Evaluation of results

The mean of the 18 values (expressed in millimetres) obtained from three pieces of insulation from the cable 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.

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.3.2.2**.

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.

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 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.

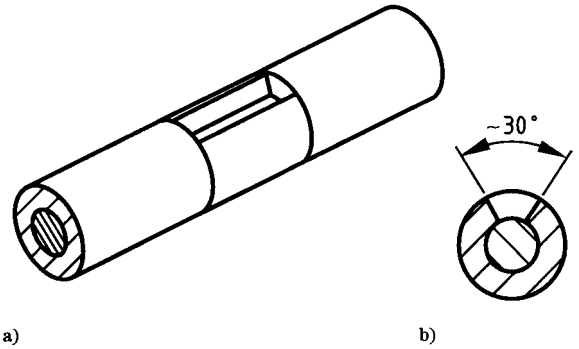

Figure E.1 — Preparation of core for spark test equipment check: removal of insulation

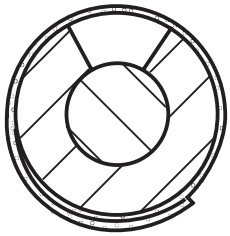

Figure E.2 — Preparation of core for spark test equipment check: covering with tape

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 faults shall be registered by the equipment.

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** to **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.

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.

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.

Bibliography

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BS 6500:2000, *Electric cables — Flexible cords rated up to 300/500 V, for use with appliances and equipment intended for domestic, office and similar environments.*

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HD 22.3 S3:1995, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 3: Heat resistant silicone rubber insulated cables*[2)].

HD 22.7 S2:1995, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 7: Cables with increased heat resistance for internal wiring for a conductor temperature of 110 °C*[2)].

[2)] Referred to in the foreword only.

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