British Standard

BRITISH STANDARD

BS 6500:2000
Incorporating
Amendment No. 1

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

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 It supersedes BS 6500:1994 which is withdrawn.

This revision of BS 6500 specifies requirements for flexible cords for domestic, office and similar environments. In addition to the cords specified in BS 6500:1994, it incorporates cords specified in HD 21.12, HD 22.12 and HD 22.14 having conductor sizes up to 2.5 mm^2.

Amendment 1 to BS 6500:2000 deletes cable type H03VH-H following the publication by CENELEC of amendment A2:2001 to HD 21.5, which withdrew this cable type on safety grounds.

BS 6500 complements BS 7919:2001 which specifies requirements for flexible cables for industrial and similar environments.

The following cords which were in BS 6500:1994 have been transferred to other standards.

H07RN-F types (in BS 6500:1994, Table 8) have been transferred to BS 7919.

H05SJ-K types (in BS 6500:1994, Table 10) have been transferred to BS 6007.

H05VV-F types having conductor sizes larger than 2.5 mm^2 (in BS 6500:1994, Table 16) have been transferred to BS 7919.

H05V-K and H05V2-K types (in BS 6500:1994, Table 19) have been transferred to BS 6004.

The following national types have been deleted from BS 6500 as being obsolete:

300/300 V and 300/500 V screened PVC cords (in BS 6500:1994, Tables 17 and 18).

300/300 V varnished glass-fibre insulated cables (in BS 6500:1994, Tables 22 and 23).

The following national type has been superseded by the H05BN4-F harmonized type:

300/500 V rubber insulated, HOFR sheathed flexible cord (in BS 6500:1994, Table 9).

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

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

WARNING. This British Standard calls for 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 57) 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 to iv, pages 1 to 57 and a back cover.

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

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1 Scope

This British Standard specifies requirements for the construction, dimensions and mechanical and electrical properties of insulated flexible cords for operation at voltages up to and including 300 V a.c. to earth and 500 V a.c. between conductors, intended for use with appliances and equipment in domestic or similar environments for light or ordinary duty.

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

Table 10	Light duty rubber insulated, braided flexible cord, circular twin and 3-core. (H03RT-F)	300/300 V;
Table 11	Light duty rubber insulated, braided flexible UDF cord, circular twin and 3-core. (National type)	300/300 V;
Table 12	Ordinary duty rubber insulated and sheathed flexible cord, circular twin, 3-core, 4-core and 5-core. (H05RR-F)	300/500 V;
Table 13	Ordinary duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cord, circular twin and 3-core. (H05RN-F)	300/500 V;
Table 14	Ordinary duty rubber insulated, sheathed, screened and sheathed flexible cord, circular twin, 3-core and 4-core. (National type)	300/500 V;
Table 15	Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cord, circular twin, 3-core, 4-core and 5-core. (H05BB-F)	300/500 V;
Table 16	Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cord, circular twin, 3-core and 4-core. (H05BN4-F)	300/500 V;
Table 17	High flexibility rubber insulated and sheathed cord, circular twin and 3-core. (H03RR-H)	300/300 V;
Table 18	High flexibility rubber insulated, cross-linked PVC (XLPVC) sheathed cord, circular twin and 3-core. (H03RV4-H)	300/300 V;
Table 19	High flexibility cross-linked PVC (XLPVC) insulated and sheathed cord, circular twin and 3-core. (H03V4V4-H)	300/300 V;
Table 24	PVC insulated (tinsel conductors) flexible cord, parallel twin. (H03VH-Y)	300/300 V;
Table 26	Light duty PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core and 4-core. (H03VV-F and H03VVH2-F)	300/300 V;
Table 27	Ordinary duty PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core, 4-core and 5-core. (H05VV-F and H05VVH2-F)	300/500 V;
Table 28	Light duty 90 °C PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core and 4-core. (H03V2V2-F and H03V2V2H2-F)	300/300 V;
Table 29	Ordinary duty 90 °C PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core, 4-core and 5-core. (H05V2V2-F and H05V2V2H2-F)	300/500 V.

In addition, this standard specifies the requirements for PVC insulated extensible leads. Coil profiles of these leads are given in Table 7.

A guide to the use of the cords 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 to 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 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 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 7655-11.1, *Specification for insulating and sheathing materials for cables — Part 11: Miscellaneous insulating compounds — Section 11.1: Harmonized cross-linked PVC.*

BS 7655-12.2, *Specification for insulating and sheathing materials for cables — Part 12: Miscellaneous sheathing compounds — Section 12.2: Harmonized cross-linked PVC.*

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

BS EN 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 60811-1-2:1995, *Insulating and sheathing materials of electric cables — Common test methods — Part 1: General application — Section 1.2: Thermal ageing methods.*

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 cord is suitable

3.2

rated voltage U

nominal power-frequency voltage between phase conductors for which the cord 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 cord 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 cord 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 cord, or components taken from a completed cord, adequate to verify that the finished product meets the design specifications

3.7

routine tests (symbol R)

tests made on all production lengths of cord to demonstrate their integrity

4 Voltage designation

Cords 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 cord 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 cord and the nominal voltage between any conductor and earth shall be not higher than 1.5 times the rated voltage U_0 of the cord.

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

NOTE The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10 %. A cord 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 cords shall be as specified in the appropriate construction table (Tables 10 to 19, 24 or 26 to 29).

Conformity shall be checked by examination.

5.2 Core identification

5.2.1 *General*

Each core shall be identified by its colour 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 cords having an optional proof tape, that tape shall be coloured.

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

On the core with the bi-colour combination green/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.

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 *Clarity and durability of colour*

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.

5.3 Cord markings

5.3.1 *General*

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

5.3.2 ***Indication of origin***

All cords 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 cord;

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 one 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 cord; or

2) 275 mm if the marking is:

i) on the insulation of an unsheathed cord;

ii) on the insulation of a sheathed cord;

iii) on a tape within a sheathed cord.

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 a cord 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 cords. 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 cord 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 cord 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 cord.

5.3.4 ***Identification mark***

Where cords are to be distinguished from cords 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 **5.3.2**.

Conformity shall be checked by measurement.

5.3.5 ***Durability of marking***

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 Cord testing

5.4.1 ***Schedule of tests***

The tests to be performed on cords specified in this standard shall be as specified in Tables 2 and 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 Tables 2 and 5 also indicate which tests relate to the completed cords, 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 cords 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**.

Except for the cords specified in Table 19, plain conductors shall conform to the solderability requirements specified in **6.9.9**.

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

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 4, EI 6 or EI 7 conforming to BS 7655-1.1;

b) type XI 1 conforming to BS 7655-11.1.

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.

6.2.4 *Additional tape*

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

6.3 Core identification

Each core shall be identified by its colour in accordance with **5.2** and the specific requirements specified in the 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 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 used, they shall be of elastomeric compound, natural textiles, synthetic textiles or similar material.

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

6.5 Textile braid

The yarns forming the braid shall be based on natural material (cotton, treated cotton or silk) or on synthetic material (e.g. rayon, polyamide).

The braid shall have a uniform texture without knots or gaps.

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 6 or EM 7 conforming to BS 7655-2.1;

b) type XM 1 conforming to BS 7655-12.2.

6.6.2 *Application*

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.

6.6.3 *Thickness*

The radial thickness of the sheath, when determined by taking the average of a number of measurements in accordance with **K.2**, 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.

6.6.4 *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 cord shall have a black sheath, or where a black sheath is applied to a cord where colour is not specified, the colour shall be throughout the whole of the sheath.

6.6.4.3 *Non-black sheaths*

For all non-black sheaths, 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.

6.7 Screen

The wire braid screen of screened cords shall consist of tinned annealed copper wires as specified in the appropriate construction table. The number of spindles and the number of ends per spindle shall be sufficient to ensure that the filling factor is not less than 0.6. The filling factor, F, shall be calculated from the following formula:

$$F = \frac{mnd_{\mathrm{w}}}{2\pi D}\left(1 + \frac{\pi^2 D^2}{L^2}\right)^{1/2}$$

where

D is the mean diameter of the braid in millimetres (mm);

d_{w} is the diameter of the braiding wire in millimetres (mm);

L is the lay length of the braiding wire in millimetres (mm);

m is the total number of spindles;

n is the total number of ends per spindle.

6.8 Electrical tests

6.8.1 *General*

The electrical tests to be performed on flexible cords 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.

Table 1 — List of tests applicable to the flexible cords specified in clause 6

Clause number	Test	Cord specified in table									
		10	11	12	13	14	15	16	17	18	19
	Electrical tests										
6.8.2	Conductor resistance	X	X	X	X	X	X	X	X	X	X
6.8.3	Voltage test on completed cord at 2 000 V	X	X	X	X	X	X	X	X	X	X
6.8.4	Voltage test on cores at 1 500 V[a]	—	—	X	X	X	X	X	X	X	X
6.8.4	Voltage test on cores at 2 000 V[b]	—	—	X	X	X	X	X	—	—	—
6.8.5	Absence of faults in the insulation	X	X	X	X	X	X	X	X	X	X
6.8.6	Surface resistance of sheath	—	—	X	X	X	X	X	—	—	—
	Constructional and dimensional tests										
5.1	Check on construction	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
6.6.3	Measurement of sheath thickness	—	—	X	X	X	X	X	X	X	X
6.9.2	Measurement of overall diameter	X	X	X	X	X	X	X	X	X	X
6.9.3	Measurement of ovality	—	—	X	X	X	X	X	X	X	X
6.9.4	Pitch of laid-up cores	X	—	—	—	—	—	—	X	X	X
	Mechanical strength of completed cords										
6.9.5	Two pulley flexing test	X	X	X	X	X[c]	X	X	—	—	—
6.9.6	Three pulley flexing test	—	—	—	—	—	—	—	X	X	X
6.9.7	Kink test	—	—	—	—	—	—	—	X	X	X
6.9.8	Wear resistance test	X	X	—	—	—	—	—	—	—	—
	Other tests										
6.9.9	Solderability test	X	X	X	X	X	X	X	X	X	—
6.9.10	Compatibility test	—	—	—	—	—	—	X	—	X	—
6.9.11	Test for resistance to heat of textile braid	X	—	—	—	—	—	—	—	—	—
6.10	Flame propagation of a single cord	—	—	—	X	X	—	X	—	X	X

[a] For insulation thicknesses up to and including 0.6 mm.
[b] For insulation thicknesses exceeding 0.6 mm.
[c] To be performed on cord before application of screen and outer sheath.

Table 2 — Schedule of tests applicable to the flexible cords specified in clause 6

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 -11.1	T
application	**6.2.2**	Visual examination	S
thickness	**6.2.3**	**K.1**	S
Core identification:			
colour	**6.3**	Visual examination	S
clarity and durability of colour	**5.2.3**	**5.2.3**	S
Pitch of laid-up cores	**6.9.4**	Visual examination and measurement	S
Fillers and binders	**6.4**	Visual examination	S
Textile braid	**6.5**	Visual examination	T
Screen	**6.7**	Visual examination and measurement	S
Sheath:			
physical properties	**6.6.1**	BS 7655-2.1 and -12.2	T
application	**6.6.2**	Visual examination	S
thickness	**6.6.3**	**K.2**	S
Tests on completed cords			
Cord markings	**5.3**	Visual examination and measurement	R
Durability of marking	**5.3.5**	**5.3.5**	S
Conductor resistance test	**6.8.2**	BS 6360	S
Voltage test on completed cord	**6.8.3**	**C.2**	S
Voltage test on cores	**6.8.4**	**C.3**	T[a]
Absence of faults in the insulation	**6.8.5**	**C.6**	R
Surface resistance of sheath	**6.8.6**	**C.7**	T
Mean overall diameter	**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**	**D.1**	T
Three pulley flexing test	**6.9.6**	**D.2**	T
Kink test	**6.9.7**	**D.3**	T
Wear resistance test	**6.9.8**	**D.4**	T
Solderability test	**6.9.9**	Annex F	T
Compatibility test	**6.9.10**	Annex G	T
Heat resistance of textile braid	**6.9.11**	Annex J	T
Flame propagation of a single cord	**6.10**	BS EN 50265-2-1	T

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

[a] For cords specified in Tables 17, 18 and 19 the test category is R.

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 cord not less than 1 m in length. The resistance of each conductor of all cords, except those specified in Table 10, shall not exceed the relevant value specified in BS 6360. The d.c. resistance of each conductor specified in Table 10 shall not exceed the relevant value given in BS 6360 by more than 3 %.

6.8.3 *Voltage test on completed cord*

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

6.8.6 *Surface resistance of sheath*

This test shall be carried out on cords with sheaths made of compounds EM 2, EM 3 (except for cords specified in Table 17), EM 6 and EM 7.

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

6.9 Non-electrical tests

6.9.1 *General*

The non-electrical tests to be performed on flexible cords 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 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.

6.9.2 *Mean overall diameter*

The mean overall diameter of the cord 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 cord 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.

6.9.3 *Ovality*

Except for the cords specified in Tables 10 and 11, the difference between any two values of the overall diameter of sheathed cords 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 cord, covering the maximum and minimum values.

6.9.4 *Pitch of laid-up cores*

The pitch of the laid-up cores, for the cords specified in Tables 10, 17, 18 and 19, shall be determined by measuring the length of 10 pitches and dividing this length by 10. The value obtained shall not exceed that given in the relevant construction table.

6.9.5 *Two pulley flexing test*

Cords specified in Tables 10, 11, 12, 13, 15 and 16 shall be tested in accordance with **D.1** and 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 cord and the pulley wheels (the flexing apparatus).

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

For screened cords specified in Table 14, the tests shall be carried out before the application of the screen and sheath.

6.9.6 *Three pulley flexing test*

Cords specified in Tables 17, 18 and 19 shall be tested in accordance with **D.2** and shall conform to the following requirements.

During the test with 1 000 cycles, i.e. 2 000 single movements, there shall be:

— no interruption of the current;

— no short circuit between the conductors;

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

After the required number of cycles the sheath of the cord, if any, shall be removed. The cores shall then be subjected to the voltage test described in **C.3**. No breakdown of the insulation shall occur.

6.9.7 *Kink test*

Cords specified in Tables 17, 18 and 19 shall be subjected to the test specified in **D.3**. During the test neither interruption of the current, nor short circuit between the conductors shall occur. Also there shall be no damage (cracking or tears) to the sheath.

After the test, no breakdown of the insulation shall occur in any of the cores from the four samples of cord when subjected to the voltage test at 2 000 V in accordance with **C.3**.

6.9.8 *Wear resistance test*

For cords specified in Tables 10 and 11, when the cord is tested as described in **D.4**, no insulation shall be visible in any of the fixed cord samples over a total length of more than 10 mm. After the test, no breakdown of the insulation shall occur in any of the cores from the fixed cord samples when subjected to the voltage test specified in **C.2**.

6.9.9 *Solderability test*

For the cords specified in Tables 10 to 18, to assess any possible interaction between the insulation and any plain conductor, the cord 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 cords 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.

6.9.10 *Compatibility*

For cords specified in Tables 16 and 18, after a sample of completed cord 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.

6.9.11 *Test for resistance to heat of textile braid*

When a cord specified in Table 10 is tested as described in annex J, no melting or charring of the braid or any component of the braid shall occur.

6.10 Flame propagation of a single cord

Cords specified in Tables 13, 14, 16, 18 and 19 shall be tested in accordance with BS EN 50265-2-1. The test shall be carried out on a sample of the completed cord.

After the test, the cord shall conform to the performance requirements recommended in BS EN 50265-2-1:1999, annex A.

Table 3 — Compatibility requirements for the flexible cords specified in clause 6

Component	Parameter	Requirement for material type			
		EI 7	EI 4	EM 7	XM 1
Insulation	Minimum tensile strength (N/mm^2)	5.0	4.2	—	—
	Minimum percentage elongation at break	—	200	—	—
	Maximum percentage variation[a] of tensile strength	±30	±25	—	—
	Maximum percentage variation[a] of elongation at break	±30	±25	—	—
Sheath	Minimum tensile strength (N/mm^2)	—	—	—	10
	Minimum percentage elongation at break	—	—	—	150
	Maximum percentage variation[a] of tensile strength	—	—	±30	±25
	Maximum percentage variation[a] of elongation at break	—	—	±40	±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.

7 Flexible cords 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**.

Tinsel conductors shall conform to the requirements specified in Table 24.

7.2 Insulation

7.2.1 *Type of insulation*

The insulation shall be either type TI 2 or type TI 3 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.

For cores other than those of tinsel cords specified in Table 24, 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 in accordance with **5.2** and the specific requirements specified in the appropriate construction table.

NOTE It is not necessary to identify the cores of non-sheathed parallel twin flexible cords.

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 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 used, they shall be of thermoplastic compound, natural textiles, synthetic textiles or similar material.

It shall be possible to remove the 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 either type TM 2 or type TM 3 conforming to BS 7655-4.1, as specified in the appropriate construction table.

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 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.

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 cords 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 cord not less than 1 m in length. The resistance of each conductor of all cords shall not exceed the relevant value given in BS 6360.

7.8.3 ***Voltage test on completed cord***

When the cord 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.

7.8.5 ***Absence of faults in the insulation***

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

7.8.6 ***Insulation resistance***

When the cord 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.

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

7.9.3 ***Ovality of circular cords***

The difference between any two values of the overall diameter of circular sheathed cords 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 cord, covering the maximum and minimum values.

7.9.4 ***Two pulley flexing test***

Cords specified in Tables 26 to 29 shall be tested in accordance with **D.1** and 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 cord and the pulley wheels (the flexing apparatus).

After the required number of cycles the sheath of the cord, 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.

7.9.5 *Spare*

7.9.6 ***Bending test on tinsel cords***

For cords specified in Table 24, no open circuit shall occur in either core during flexing when the cord is tested as described in **I.1** for 60 000 bending cycles i.e. 120 000 single strokes.

The cord shall subsequently be subjected to the voltage test specified in **I.1**. The insulation shall not break down.

If a test sample fails the test, two further samples of the same cord shall be tested. If both these samples conform to both of the aforementioned requirements the cord shall be deemed to have passed the test.

7.9.7 ***Snatch test on tinsel cords***

Cords specified in Table 24 shall be subjected to the test as described in **I.2**. During the test no interruption of the current shall occur in either core of the cord.

7.9.8 ***Compatibility***

When a sample of completed cord specified in Tables 27 and 29 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 cord

Cords specified in Tables 24 and 26 to 29 shall be tested in accordance with BS EN 50265-2-1. The test shall be carried out on a sample of the completed cord. After the test, the cord shall conform to the performance requirements recommended in BS EN 50265-2-1:1999, annex A.

Table 4 — List of tests applicable to the flexible cords specified in clause 7

Clause number	Test	Cord specified in table				
		24	26	27	28	29
	Electrical tests					
7.8.2	Conductor resistance	X	X	X	X	X
7.8.3	Voltage test on completed cord at 2 000 V	X	X	X	X	X
7.8.4	Voltage test on cores at 1 500 V[a]	—	X	X	X	X
7.8.4	Voltage test on cores at 2 000 V[b]	—	—	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	—	—
7.8.6	Insulation resistance at 90 °C	—	—	—	X	X
7.8.7	Long term resistance of insulation 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
7.9.2	Measurement of overall dimensions	X	X	X	X	X
7.9.3	Measurement of ovality of circular cords	—	X	X	X	X
	Mechanical strength of completed cords					
7.9.4	Two pulley flexing test	—	X	X	X	X
7.9.5	Separation test	—	—	—	—	—
7.9.6	Bending test	X	—	—	—	—
7.9.7	Snatch test	X	—	—	—	—
	Other tests					
7.9.8	Compatibility test	—	—	X	—	X
7.10	Flame propagation of a single cord	X	X	X	X	X

[a] For insulation thicknesses up to and including 0.6 mm.
[b] For insulation thicknesses exceeding 0.6 mm.

Table 5 — Schedule of tests applicable to the flexible cords specified in clause 7

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	S
thickness	**7.2.3**	**K.1**	S
Core identification:			
colour	**7.3**	Visual examination	S
clarity and durability of colour	**5.2.3**	**5.2.3**	S
Fillers and binders	**7.4**	Visual examination	S
Sheath:			
physical properties	**7.6.1**	BS 7655-4.1	T
application	**7.6.2**	Visual examination	S
thickness	**7.6.3**	**K.2** or **K.3**	S
Tests on completed cords			
Cord 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 cord	**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 of circular cords	**7.9.3**	BS EN 60811-1-1:1995, **8.3**	S
Two pulley flexing test (except tinsel cords)	**7.9.4**	**D.1**	T
Bending test on tinsel cords	**7.9.6**	**I.1**	T
Snatch test on tinsel cords	**7.9.7**	**I.2**	T
Compatibility test	**7.9.8**	Annex G	T
Flame propagation of a single cord	**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.

Table 6 — Compatibility requirements for the flexible cords specified in clause 7

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

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

8 Extensible leads

8.1 Type

NOTE These extensible leads are for use with portable apparatus or other movable equipment, with the exception of shaver cord sets, either as connecting or extension leads.

Extensible leads shall be manufactured from 2- or 3-core flexible cord conforming to clause **7**. The conductors shall have a nominal cross-sectional area of between 0.5 mm^2 and 1.5 mm^2 inclusive.

For use with shaver cord sets, extensible leads shall be of tinsel conductor construction conforming to Table 24.

8.2 Requirements prior to coiling

Prior to coiling into extensible leads, the cords shall conform to the requirements specified in the following tables for the size range specified in **8.1**:

a) tinsel cords, to be coiled to give tinsel extensible leads: Table 24;
b) light cords, to be coiled to give light extensible leads: Tables 26 and 28;
c) ordinary cords, to be coiled to give ordinary extensible leads: Tables 27 and 29.

8.3 Coiling

The cords shall be coiled to produce helical leads (see Figure 1).

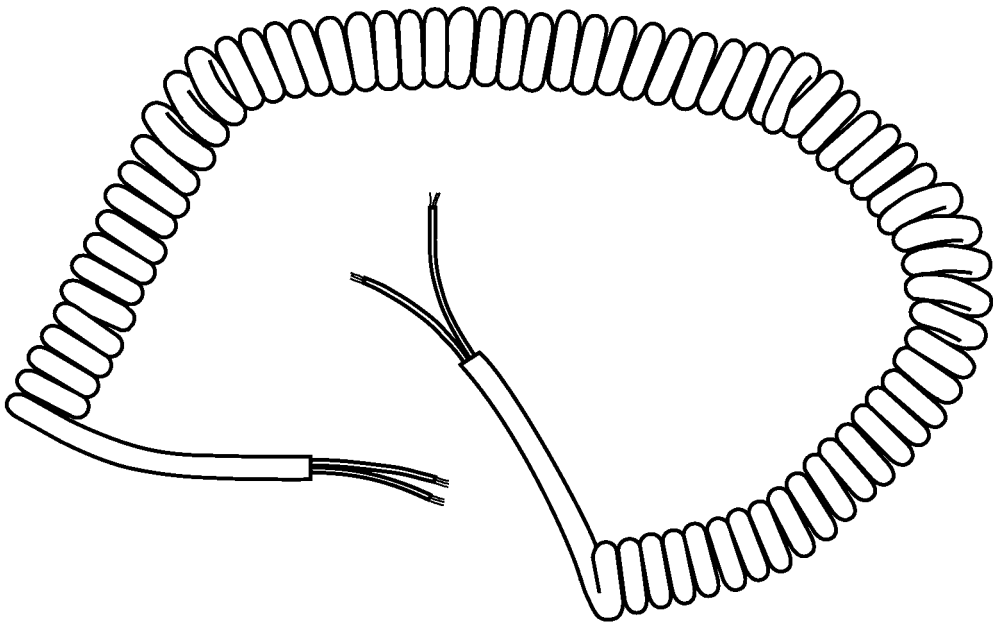


Figure 1 — Typical 2-core extensible lead

8.4 Requirements after coiling

8.4.1 *Dimensions*

The radial thickness of the insulation and of the sheath shall conform to **7.2.3** and **7.6.3** respectively.

Three test samples shall be taken, one from each of the extremities of the coiled section and one from the middle of the coiled section.

Test samples taken from the extremities shall consist of approximately 50 mm of straight cable with at least one adjacent complete turn.

The test sample taken from the middle of the coiled section shall consist of at least one complete turn.

Slight deformation of the insulation and sheath, caused by the coil forming process, shall be permissible provided that the insulation and sheath thickness conform to **7.2.3** and **7.6.3**, respectively.

The minimum internal diameter of the coiled lead shall conform to Table 7 except that for PVC insulated extensible tinsel leads forming part of a shaver cord set, the minimum internal diameter of the completed coil shall be 5.0 mm.

8.4.2 *Marking*

Any marking on the outside of the coil shall be legible after the coiling process.

NOTE It is permissible for any marking on the inside surface of the coil to be affected by the coiling process.

After the coiling process, both tails of the extensible lead shall be marked by embossing or ink printing, or a heat shrinkable sleeve bearing the marking. The marking shall include the manufacturer's name or trademark, the word "Coil" and, if applicable, the mark of the approvals organization which has certified the coiling operation. The marking shall be at approximately the mid-point of the tail.

NOTE In the case of coiled tinsel cords used as part of a cord set, and only where coiling and incorporation into the cord set are carried out by one manufacturer at a single manufacturing location, this marking is not required, providing full evidence of relevant testing is recorded.

8.5 Mechanical tests for extensible leads

8.5.1 *Extension test*

The coiled lead shall be tested in accordance with **H.1**. After the test, and within 30 s of the fifth extension, the sample shall return to $\leq$150 % of its original closed length for the sample tested before ageing and to $\leq$180 % of its original closed length for the sample tested after ageing.

8.5.2 *Flexing test*

The coiled lead shall be tested in accordance with **H.2**.

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 cord and the pulley wheels (the flexing apparatus).

The same coiled lead shall then be tested in accordance with **C.2**. No breakdown of the insulation shall occur.

8.6 Flame propagation of a single extensible cord

The cord used to make the extensible lead shall conform to **7.10**. In addition, the coiled lead shall be tested in accordance with BS EN 50265-2-1 with the following differences.

a) *Test sample*. The test sample shall be a complete extensible lead, from which the tail at one end shall be cut off, and the tail at the other end cut to leave a length of approximately 15 mm.

If the length of the closed coiled lead, excluding the remaining tail, exceeds 500 mm, a portion of the coiled lead shall be cut off from the end where the tail has been completely removed to leave a closed length of approximately 500 mm.

b) *Clamping of test sample*. The test sample shall be clamped by the short tail and allowed to hang vertically.

c) *Test procedure*. The burner shall be set up so that the axis of the burner tube is at an angle of 45° to the central axis of the helix of the coiled lead sample. When the burner is in use the tip of the inner blue cone of the flame shall impinge upon the outside of the first coil at the bottom of the sample. The flame shall be essentially perpendicular to the outer surface of the coil and not tangential.

The flame shall be applied for a continuous period of 60^{+2}_{0} s.

After the removal of the gas burner the flames shall extinguish completely within 15 s.

Table 7 — Requirements after coiling

Tabulated[a] overall cord diameter (upper limit) mm	Minimum internal diameter of completed coil mm
Up to 8.0	8.0
8.1 to 11.0	12.0
NOTE It is recommended that the length of the straight section at each end of the lead should be sufficient to allow at least one rewiring operation.	
[a] See relevant construction table.	

Table 8 — *Spare*

Table 9 — *Spare*

Table 10 — Light duty rubber insulated, braided flexible cord, circular twin and 3-core, 300/300 V

Harmonized code designation: H03RT-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type EI 4.

The d.c. resistance of the conductor shall not exceed the values in BS 6360 by more than 3 %.

An optional separator may be applied over the conductor.

Two or three cores shall be twisted together with natural or synthetic textile fibres to form an assembly of practically circular cross-section.

A centre filler may be used.

The pitch of the laid-up cores shall not exceed 40 mm.

The assembly of the cores and fillers shall be covered by a textile braid.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Number and cross-sectional area of conductors mm^2	Radial thickness of insulation mm	Mean overall diameter	
		Lower limit[c] mm	Upper limit mm
2×0.5[a]	0.8	5.2	6.8
2×0.75	0.8	5.5	7.2
2×1	0.8	5.7	7.6
2×1.25[b]	0.8	6.0	7.9
2×1.5	0.8	6.2	8.2
3×0.5[a]	0.8	5.6	7.3
3×0.75	0.8	5.9	7.7
3×1	0.8	6.2	8.2
3×1.25[b]	0.8	6.5	8.5
3×1.5	0.8	6.7	8.8

[a] National type.
[b] National type, intended for use on appliances fitted with 13 A plugs conforming to BS 1363-1.
[c] See **6.9.2**.

Table 11 — Light duty rubber insulated, braided flexible UDF cord, circular twin and 3-core, 300/300 V

National type

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type EI 4.
Rubber layer — compound rubber.
Textile braid — continuous filament of regenerated cellulose (semi-embedded).

An optional separator may be applied over the conductor.

Two or three cores shall be twisted together with natural or synthetic textile fibres to form an assembly of practically circular cross-section.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Mean overall diameter	
		Lower limit[a]	Upper limit
mm^2	mm	mm	mm
2 × 0.5	0.6	5.3	7.0
2 × 0.75	0.6	5.6	7.3
2 × 1	0.6	5.8	7.7
2 × 1.5	0.6	7.1	9.2
3 × 0.5	0.6	5.6	7.4
3 × 0.75	0.6	5.9	7.8
3 × 1	0.6	6.2	8.2
3 × 1.5	0.6	7.6	9.8

[a] See **6.9.2**.

Table 12 — Ordinary duty rubber insulated and sheathed flexible cord, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05RR-F

Construction:

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

An optional separator may be applied over the conductor.

Optional coloured proofed tape may be applied over the insulation.

A centre filler may be used.

Two to five cores shall be twisted together with the outer interstices filled with the sheathing compound (or textile or the like[a]), to form an assembly of practically circular cross-section.

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

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.
5-core — green/yellow, black, blue, brown and black.

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[c]	Upper limit
mm^2	mm	mm	mm	mm
2×0.5[a]	0.6	0.8	5.4	7.1
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
3×0.5[a]	0.6	0.8	5.1	7.5
3×0.75	0.6	0.9	6.2	8.1
3×1	0.6	0.9	6.5	8.5
3×1.25[b]	0.8	1.0	7.8	10.2
3×1.5	0.8	1.0	8.0	10.4
3×2.5	0.9	1.1	9.6	12.4
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
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] National type.
[b] National type, intended for use on appliances fitted with 13 A plugs conforming to BS 1363-1.
[c] See **6.9.2**.

Table 13 — Ordinary duty rubber insulated, PCP or equivalent synthetic elastomer sheathed flexible cord, circular twin and 3-core, 300/500 V

Harmonized code designation: H05RN-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type EI 4.
Sheath — compound type EM 2.

An optional separator may be applied over the conductor.

Optional coloured proofed tape may be applied over the insulation.

A centre filler may be used.

Two or three cores shall be twisted together with the outer interstices filled with the sheathing compound (or textile or the like[a]), to form an assembly of practically circular cross-section.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Colour of sheath — Not specified.

Outer marking:

At least the mandatory marking "RN" shall be printed, indented or embossed on the sheath.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit[c]	Upper limit
mm^2	mm	mm	mm	mm
2×0.5[a]	0.6	0.8	5.4	7.1
2×0.75	0.6	0.8	5.7	7.4
2×1	0.6	0.9	6.1	8.0
3×0.5[a]	0.6	0.8	5.7	7.5
3×0.75	0.6	0.9	6.2	8.1
3×1	0.6	0.9	6.5	8.5
3×1.25[b]	0.8	1.0	7.8	10.2

[a] National type.
[b] National type, intended for use on appliances fitted with 13 A plugs conforming to BS 1363-1.
[c] See **6.9.2**.

Table 14 — Ordinary duty rubber insulated, sheathed, screened and sheathed flexible cord, circular twin, 3-core and 4-core, 300/500 V

National type

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type EI 4.
Sheath — compound type EM 3.
Screen — tinned annealed copper wire braid.
Sheath — compound type EM 2.

An optional separator may be applied over the conductor.

Optional coloured proofed tape may be applied over the insulation.

Two to four cores shall be twisted together with the outer interstices filled with sheathing compound, textile or the like, 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 and fillers, if any.

Screening — Tinned annealed copper wire braid.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.

Colour of sheath — Black.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of inner sheath	Tinned copper wire diameter for braid (nominal)	Radial thickness of outer sheath	Mean overall diameter	
					Lower limit[a]	Upper limit
mm^2	mm	mm	mm	mm	mm	mm
2 × 0.5	0.6	0.8	0.2	1.0	8.2	10.7
2 × 0.75	0.6	0.8	0.2	1.1	8.7	11.3
2 × 1	0.6	0.9	0.2	1.1	9.2	11.9
2 × 1.5	0.8	1.0	0.2	1.2	10.8	13.9
2 × 2.5	0.9	1.1	0.2	1.2	12.5	15.7
3 × 0.5	0.6	0.8	0.2	1.0	8.6	11.1
3 × 0.75	0.6	0.9	0.2	1.1	9.3	12.0
3 × 1	0.6	0.9	0.2	1.1	9.6	12.4
3 × 1.5	0.8	1.0	0.2	1.2	11.3	14.5
3 × 2.5	0.9	1.1	0.2	1.3	13.0	16.7
4 × 0.5	0.6	0.9	0.2	1.1	9.5	12.2
4 × 0.75	0.6	0.9	0.2	1.1	9.8	12.7
4 × 1	0.6	0.9	0.2	1.2	10.4	13.4
4 × 1.5	0.8	1.1	0.2	1.2	12.3	15.7
4 × 2.5	0.9	1.2	0.2	1.3	14.2	18.1

[a] See **6.9.2**.

Table 15 — Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and sheathed flexible cord, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designation: H05BB-F

Construction:

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

A separator tape may be applied over the conductor.

Two to five 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:

Twin — blue and brown.
3-core — green/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.
5-core — green/yellow, black, blue, brown and black.

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.

Outer marking:

At least the mandatory marking "BB" shall be printed, indented or embossed on the sheath.

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
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
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
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

Table 16 — Ordinary duty heat resisting 90 °C EPR or equivalent synthetic elastomer insulated and CSP or equivalent synthetic elastomer sheathed flexible cord, circular twin, 3-core and 4-core, 300/500 V

Harmonized code designation: H05BN4-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type EI 7.
Sheath — compound type EM 7.

A separator tape may be applied over the conductor.

A centre filler may be used.

Two to four 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:

Twin — blue and brown.
3-core — green/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.

Colour of sheath — Not specified.

Outer marking:

At least the mandatory marking "BN4" shall be printed, indented or embossed on the sheath.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter	
			Lower limit[b]	Upper limit
mm^2	mm	mm	mm	mm
2 × 0.5[a]	0.6	0.8	5.4	7.1
2 × 0.75	0.6	0.8	5.7	7.4
2 × 1.0	0.6	0.9	6.1	8.0
2 × 1.5[a]	0.8	1.0	7.6	9.8
2 × 2.5[a]	0.9	1.1	9.0	11.6
3 × 0.5[a]	0.6	0.8	5.7	7.5
3 × 0.75	0.6	0.9	6.2	8.1
3 × 1.0	0.6	0.9	6.5	8.5
3 × 1.5[a]	0.8	1.0	8.0	10.4
3 × 2.5[a]	0.9	1.1	9.6	12.4
4 × 0.75[a]	0.6	0.9	6.8	8.8
4 × 1.0[a]	0.6	0.9	7.1	9.3
4 × 1.5[a]	0.8	1.1	9.0	11.6
4 × 2.5[a]	0.9	1.2	10.7	13.8

[a] National types.
[b] See **6.9.2**.

Table 17 — High flexibility rubber insulated and sheathed cord, circular twin and 3-core, 300/300 V

Harmonized code designation: H03RR-H

Construction:

Conductors — class 6 copper, flexible.
Insulation — compound type EI 4.
Sheath — compound type EM 3.

Two or three cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section. The direction of lay shall be the same for the conductors and for the cores.

A centre filler may be used.

A tape is permitted over the assembly of cores.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Colour of sheath — Not specified.

Outer marking:

The mandatory marking "-H141-" shall be printed, indented or embossed on the sheath.

NOTE Legibility may be achieved by using contrasting colours, or by using contrasting shades of the same colour, as agreed between the manufacturer and the purchaser.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Pitch of laid-up cores (max.)	Radial thickness of sheath	Mean overall dimensions	
				Lower limit	Upper limit
mm^2	mm	mm	mm	mm	mm
2×0.75	0.6	35	0.8	5.7	7.4
2×1	0.6	35	0.8	5.9	7.8
2×1.5	0.7	40	0.8	6.8	8.9
3×0.75	0.6	35	0.8	6.0	7.9
3×1	0.6	40	0.8	6.3	8.3
3×1.5	0.7	45	0.9	7.2	9.4

Table 18 — High flexibility rubber insulated, cross-linked PVC (XLPVC) sheathed cord, circular twin and 3-core, 300/300 V

Harmonized code designation: H03RV4-H

Construction:

Conductors — class 6 copper, flexible.
Insulation — compound type EI 4.
Sheath — compound type XM 1.

Two or three cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section. The direction of lay shall be the same for the conductors and for the cores.

A centre filler may be used.

A tape is permitted over the assembly of cores.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Colour of sheath — Not specified.

Outer marking:

The mandatory marking "-H142-" shall be printed, indented or embossed on the sheath.

NOTE Legibility may be achieved by using contrasting colours, or by using contrasting shades of the same colour, as agreed between the manufacturer and the purchaser.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Pitch of laid-up cores (max.)	Radial thickness of sheath	Mean overall dimensions	
				Lower limit	Upper limit
mm^2	mm	mm	mm	mm	mm
2×0.75	0.6	35	0.8	5.7	7.4
2×1	0.6	35	0.8	5.9	7.8
2×1.5	0.7	40	0.8	6.8	8.9
3×0.75	0.6	35	0.8	6.0	7.9
3×1	0.6	40	0.8	6.3	8.3
3×1.5	0.7	45	0.9	7.2	9.4

Table 19 — High flexibility cross-linked PVC (XLPVC) insulated and sheathed cord, circular twin and 3-core, 300/300 V

Harmonized code designation: H03V4V4-H

Construction:

Conductors — class 6 copper, flexible.
Insulation — compound type XI 1.
Sheath — compound type XM 1.

Two or three cores shall be twisted together with the outer interstices filled with the sheathing compound, to form an assembly of practically circular cross-section. The direction of lay shall be the same for the conductors and for the cores.

A centre filler may be used.

A binder tape is permitted over the assembly of cores.

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.

Colour of sheath — Not specified.

Outer marking:

The mandatory marking "-H143-" shall be printed, indented or embossed on the sheath.

NOTE Legibility may be achieved by using contrasting colours, or by using contrasting shades of the same colour, as agreed between the manufacturer and the purchaser.

Number and nominal cross-sectional area of conductors	Radial thickness of insulation	Pitch of laid-up cores (max.)	Radial thickness of sheath	Mean overall dimensions	
				Lower limit	Upper limit
mm^2	mm	mm	mm	mm	mm
2 × 0.75	0.6	35	0.8	5.7	7.4
2 × 1	0.6	35	0.8	5.9	7.8
2 × 1.5	0.7	40	0.8	6.8	8.9
3 × 0.75	0.6	35	0.8	6.0	7.9
3 × 1	0.6	40	0.8	6.3	8.3
3 × 1.5	0.7	45	0.9	7.2	9.4

Table 20 — *Spare*
Table 21 — *Spare*
Table 22 — *Spare*
Table 23 — *Spare*

Table 24 — PVC insulated (tinsel conductors) flexible cord, parallel twin, 300/300 V

Harmonized code designation: H03VH-Y

Construction:

Conductors — tinsel.
Insulation — compound type TI 2.

Each tinsel conductor shall comprise a number of strands or groups of strands, twisted together, each strand being composed of one or more flattened wires of copper or copper alloy, helically wound on a thread of cotton, polyamide or similar material.

The conductors shall be laid parallel and covered with PVC insulation.

The insulation shall be provided with a groove on each side between the conductors to facilitate separation of the cores.

Maximum resistance	Radial thickness of insulation	Mean overall dimensions		Minimum insulation resistance at 70 °C
		Lower limit	Upper limit	
Ω/km	mm	mm	mm	MΩ·km
270	0.8	2.2 × 4.4	3.5 × 7.0	0.019

Table 25 — *Spare*

Table 26 — Light duty PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core and 4-core, 300/300 V

Harmonized code designations: Parallel cords: H03VVH2-F
Circular cords: H03VV-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type TI 2.
Sheath — compound type TM 2.

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

A centre filler may be used.

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

For flat cords, the two cores shall be laid parallel.

A separator may be applied over the laid up 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/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.

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	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5	0.5	0.6	4.6	5.9	0.011
2 × 0.5	0.5	0.6	3.0 × 4.9	3.7 × 5.9	0.011
2 × 0.75	0.5	0.6	4.9	6.3	0.010
2 × 0.75	0.5	0.6	3.2 × 5.2	3.8 × 6.3	0.010
3 × 0.5	0.5	0.6	4.9	6.3	0.011
3 × 0.75	0.5	0.6	5.2	6.7	0.010
4 × 0.5	0.5	0.6	5.4	6.9	0.011
4 × 0.75	0.5	0.6	5.7	7.3	0.010

Table 27 — Ordinary duty PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designations: Parallel cords: H05VVH2-F
Circular cords: H05VV-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type TI 2.
Sheath — compound type TM 2.

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

A centre filler may be used.

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

For flat cords, the two cores shall be laid parallel.

A separator may be applied over the laid up 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/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.
5-core — green/yellow, black, blue, brown and black.

Colour of sheath — Not specified.

Number and 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[c]	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5[a]	0.6	0.8	5.4	6.8	0.013
2 × 0.75	0.6	0.8	5.7	7.2	0.011
2 × 0.75	0.6	0.8	3.7 × 6.0	4.5 × 7.2	0.011
2 × 1	0.6	0.8	5.9	7.5	0.010
2 × 1	0.6	0.8	3.9 × 6.2	4.7 × 7.5	0.010
2 × 1.25[b]	0.7	0.8	6.3	8.0	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 5
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 × 1.25[b]	0.7	0.9	6.9	8.7	0.010
3 × 1.5	0.7	0.9	7.4	9.4	0.010
3 × 2.5	0.8	1.0	9.2	11.4	0.009 5
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 5
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

[a] National type.
[b] National type, intended for use on appliances fitted with 13 A plugs conforming to BS 1363-1.
[c] See **7.9.2**.

Table 28 — Light duty 90 °C PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core and 4-core, 300/300 V

Harmonized code designations: Circular cords: H03V2V2-F
Flat cords: H03V2V2H2-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type TI 3.
Sheath — compound type TM 3.

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

A centre filler may be used.

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

For flat cords the two cores shall be laid parallel.

A separator may be applied over the laid up cores.

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

Core identification and sequence:

Twin — blue and brown.
3-core — green/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.

Colour of sheath — Not specified.

Outer marking:

At least the mandatory marking "V2V2" shall be printed, indented or embossed on the sheath.

Number and cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter or dimensions		Minimum insulation resistance at 90 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5	0.5	0.6	4.6	5.9	0.011
2 × 0.5	0.5	0.6	3.0 × 4.9	3.7 × 5.9	0.011
2 × 0.75	0.5	0.6	4.9	6.3	0.010
2 × 0.75	0.5	0.6	3.2 × 5.2	3.8 × 6.3	0.010
3 × 0.5	0.5	0.6	4.9	6.3	0.011
3 × 0.75	0.5	0.6	5.2	6.7	0.010
4 × 0.5	0.5	0.6	5.4	6.9	0.011
4 × 0.75	0.5	0.6	5.7	7.3	0.010

Table 29 — Ordinary duty 90 °C PVC insulated and sheathed flexible cord, parallel twin, circular twin, 3-core, 4-core and 5-core, 300/500 V

Harmonized code designations: Circular cords: H05V2V2-F
Flat cords: H05V2V2H2-F

Construction:

Conductors — class 5 copper, flexible.
Insulation — compound type TI 3.
Sheath — compound type TM 3.

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

A centre filler may be used.

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

For flat cords the two cores shall be laid parallel.

A separator may be applied over the laid up 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/yellow, blue and brown.
4-core — green/yellow, black, blue and brown.
5-core — green/yellow, black, blue, brown and black.

Colour of sheath — Not specified.

Outer marking:

At least the mandatory marking "V2V2" shall be printed, indented or embossed on the sheath.

Number and cross-sectional area of conductors	Radial thickness of insulation	Radial thickness of sheath	Mean overall diameter or dimensions		Minimum insulation resistance at 90 °C
			Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ·km
2 × 0.5[a]	0.6	0.7	5.2	6.6	0.013
2 × 0.5[a]	0.6	0.7	3.4 × 5.5	4.1 × 6.6	0.013
2 × 0.75	0.6	0.8	5.7	7.2	0.011
2 × 0.75	0.6	0.8	3.7 × 6.0	4.5 × 7.2	0.011
2 × 1	0.6	0.8	5.9	7.5	0.010
2 × 1	0.6	0.8	3.9 × 6.2	4.7 × 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 5
3 × 0.5[a]	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	1.1	9.2	11.4	0.009 5
4 × 0.5[a]	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	0.9	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 5
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

[a] National types for which harmonization has been agreed.

Annex A (informative)

Guide to use of insulated flexible cords

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

Annex B (informative)

Guidance on procedure for routine tests on rubber and PVC insulated flexible cords of rated voltages U_0/U up to 300/500 V

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

[a] See relevant construction table.

B.2 Tests on completed cords

B.2.1 *General*

Subject completed cords to the tests described in **B.2.2** to **B.2.6**.

B.2.2 *Conductor resistance*

B.2.2.1 *Procedure*

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

B.2.3 *Voltage test*

B.2.3.1 *Procedure*

Subject completed twin and multicore cords 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 and screen if any.

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 it at the full r.m.s value given in Table B.2 for 5 min.

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

[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 to the cord for 1 min and measure the insulation resistance between each conductor and all other conductors connected together and the metallic covering, where provided.

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 and XI 1, 700 MΩ·km for insulation type EI 4 and 3 500 MΩ·km for insulation type EI 7.

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

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

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 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 cords with thermosetting insulation specified in clause 6

Test	Unit	300/300 V and 300/500 V cords
Conductor resistance (see **6.8.2**)		
Length of sample (minimum)	m	1
Voltage test on completed cord (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.)	V	2 000
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.) according to the specified thickness of insulation:		
for insulation thickness up to and including 0.6 mm[a]	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 **6.8.5**)		
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
Surface resistance test on EM 2, EM 3, EM 6 and EM 7 sheath (see **6.8.6**)		
Surface resistance (min.)	Ω	1×10^9

[a] Also applies to cords specified in Tables 17, 18 and 19 where insulation thicknesses exceed 0.6 mm.

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

Test	Unit	300/300 V and 300/500 V cords
Conductor resistance (see **7.8.2**)		
Length of sample (minimum)	m	1
Voltage test on completed cord (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 a.c. voltage (r.m.s.) 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.2** or **C.3**)	m	5
Period of immersion (minimum)	h	2
Temperature of water (compound type TI 2)	°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

C.2 Voltage test on completed cord

C.2.1 *Test sample*

Take a sample of cord, 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.

For cords specified in Table 14 connect the metallic screen to the water at all times.

C.3 Voltage test on cores

NOTE This test is not applicable to the cords specified in Tables 10 and 11 except for its use as part of the flexing test given in **D.1** (see **6.9.5**).

C.3.1 *Test sample*

Prepare a sample of cord 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 cord.

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 thermoplastic insulated cord of the length given in Table C.2, previously submitted to the test specified in **C.3** or, for cords specified in Table 24, on a sample previously submitted to the test specified in **C.2**.

C.4.2 *Procedure*

Immerse the sample in water previously heated to the temperature given in Table C.2, 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.2.

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 thermoplastic insulated cord of the length given in Table C.2, from which all coverings have been removed.

Take care to avoid damage to the cores during removal of the coverings. The cores of parallel twin cords in accordance with Table 24 shall not be separated.

C.5.2 *Procedure*

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

C.6 Absence of faults in the insulation

C.6.1 *General*

Test all flexible cord 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 parallel twin unsheathed cords by both the spark test and the voltage test in accordance with **C.6.2.2** and **C.6.2.3**, respectively. Test other cords 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 cord 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 parallel twin unsheathed cord 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 cord 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 cords with sheaths made of type EM 2, EM 3 (except for cords specified in Table 17), EM 6 and EM 7 compounds.

C.7.1 *Test samples*

Carry out the test on three samples of completed cord, 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 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.

Annex D (normative)
Mechanical tests

D.1 Two pulley flexing test

D.1.1 *General*

This test is not applicable to:

— cords with tinsel conductors;

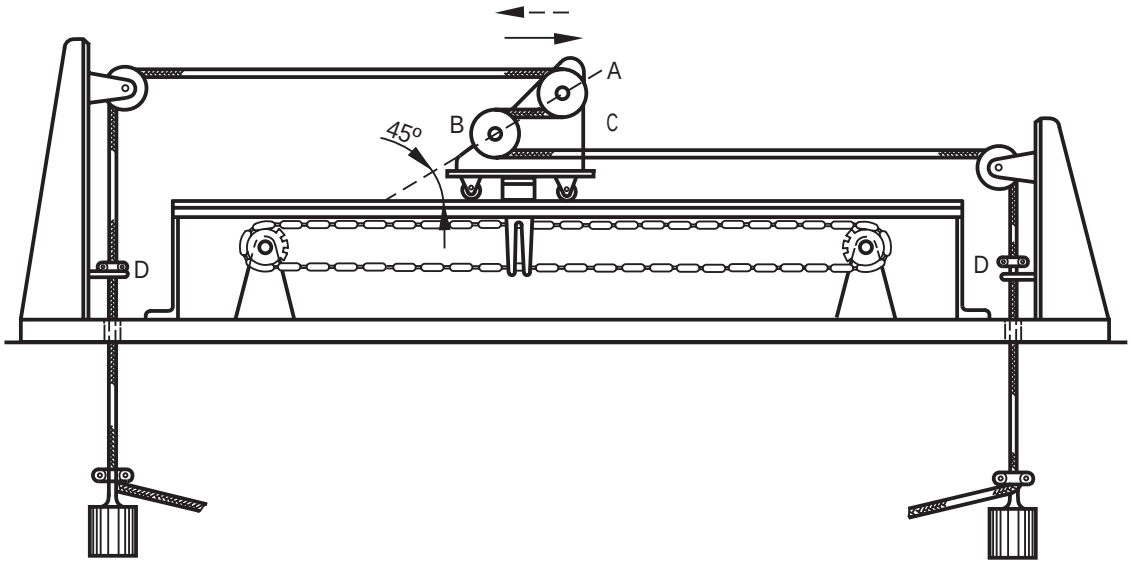
— high flexibility cords.

D.1.2 *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 cord 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 movement 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 cords and pulley wheels with a flat groove for testing flat cords. 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.



Key

A and B	Pulley wheels
C	Carrier
D	Restraining clamps

Figure D.1 — Flexing apparatus

D.1.3 ***Sample preparation***

A sample of flexible cord 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 these weights and the diameter of pulley wheels A and B shall be as given in Table D.1 for cords with thermoplastic insulation or as given in Table D.2 for cords with thermosetting insulation.

D.1.4 ***Current loading of cores***

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

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

— 4 and 5 core cords: 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 of about 230/400 V shall be used. On cores which are not loaded, a signal current shall be applied.

D.1.5 *Voltage between cores*

For all two-core cords and for light duty, thermoplastic insulated cords (specified in Tables 26 and 28), the voltage between the conductors shall be 230 V a.c. For all other cords 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.

D.1.6 *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).

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

Type of flexible cord	Number of cores	Nominal cross-sectional area of conductors mm^2	Mass of each weight kg	Diameter of pulley wheels A and B[a] mm	Current (I_3) A
Cords specified in Tables 26, 27, 28 and 29	2	0.5	0.5	60	1.5
		0.75	1.0	80	3
		1	1.0	80	5
		1.25	1.0	80	6.5
		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
		1.25	1.0	80	6.5
		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	0.75	1.0	80	3
		1	1.0	120	5
		1.5	1.5	120	8
		2.5	2.0	120	12.5

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

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

Type of flexible cord	Number of cores	Nominal cross-sectional area of conductors mm^2	Mass of each weight kg	Diameter of pulley wheels[a] mm	Current (I_3) A
Cords specified in Tables 10 and 11	2 or 3	0.5	1.0	80	3
		0.75	1.0	80	6
		1.0	1.0	80	10
		1.25	1.0	80	13
		1.5	1.0	80	16
Cords specified in Tables 12 to 16	2	0.5	1.0	80	3
		0.75	1.0	80	6
		1.0	1.0	120	10
		1.5	1.0	120	16
		2.5	1.5	120	25
	3	0.5	1.0	120	3
		0.75	1.0	120	6
		1.0	1.0	120	10
		1.25	1.5	120	13
		1.5	1.5	120	16
		2.5	2.0	160	25
	4	0.5	1.0	120	3
		0.75	1.0	120	6
		1.0	1.5	120	10
		1.5	1.5	120	16
		2.5	2.5	160	25
	5	0.75	1.5	120	6
		1.0	1.5	120	10
		1.5	2.5	160	16
		2.5	3.0	160	25

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

D.2 Three pulley flexing test

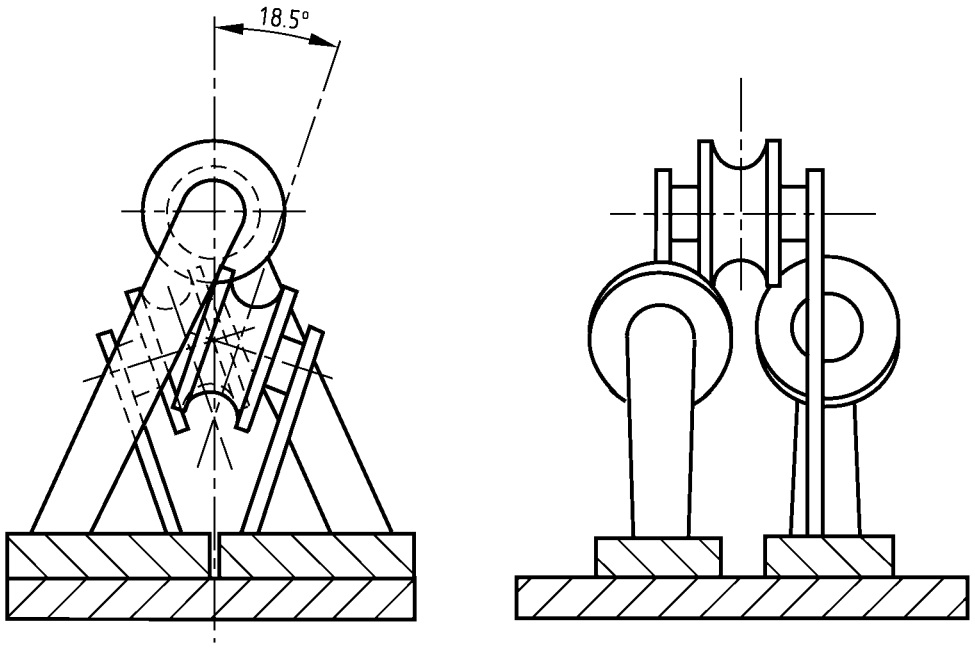
The test shall be carried out in accordance with **D.1** with the following modifications.

a) *Carrier*. The apparatus described in **D.1.2** shall have a modified carrier (C), as shown in Figure D.2.

b) *Pulley wheels and current loading of cores*. The three pulley wheels of modified carrier (C) shall be of equal diameter to each other in accordance with Table D.3. Each core shall be fully loaded with the current given in Table D.3.

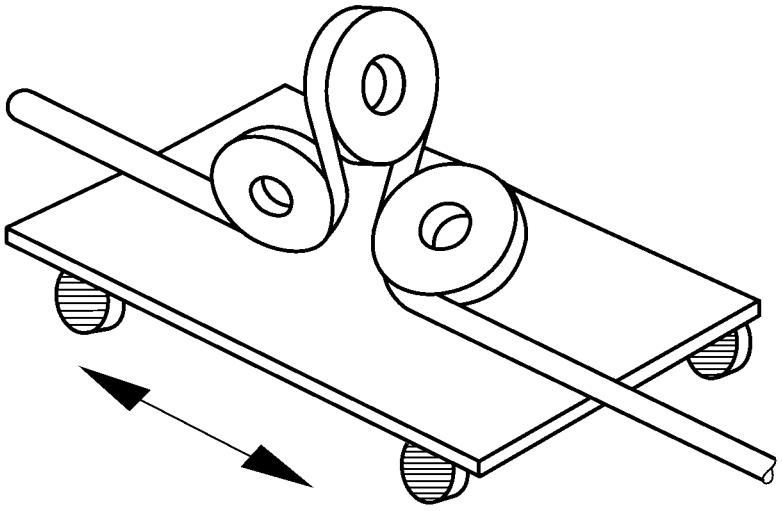
c) *Speed of carrier*. The constant speed of the modified carrier (C) shall be approximately 0.1 m/s.

d) *Mass of weights*. The mass of the weights applied to stress the conductor as described in **D.1.3** shall be such as to apply a force of 28 N/mm^2 of conductor cross-section.



a) End view

b) Side view



c) Schematic arrangement of cable around pulley wheels (supports not shown)

Figure D.2 — Modified carrier (C)

Table D.3 — Diameter of pulley wheels and current loading

Cord type (number and nominal cross-sectional area of conductors)	Diameter of pulley wheels mm	Current (I_3) A
$2 \times 0.75\ mm^2$	40	6
$2 \times 1\ mm^2$	40	10
$2 \times 1.5\ mm^2$	45	16
$3 \times 0.75\ mm^2$	40	6
$3 \times 1\ mm^2$	45	10
$3 \times 1.5\ mm^2$	50	16

D.3 Kink test

D.3.1 *Applicability*

The test is applicable to 2- and 3-core sheathed cords, with conductor cross-sectional areas up to and including 1.5 mm^2.

D.3.2 *Apparatus*

The test shall be carried out by means of a tensile strength testing machine or equivalent apparatus.

There shall be two clamps for fixing the cord. The upper clamp shall be capable of upwards and downwards movement. The lower clamp shall allow free movement in the vertical direction, but shall be prevented from twisting about its vertical axis so that no change to the torsion in the cord is introduced during the test. The arrangement is shown in Figure D.3.

D.3.3 *Sample*

The test cord sample shall have a length of approximately 1 m. The cord shall be twisted three times, as shown in position 1 (starting position only) of Figure D.3, and then fixed in the upper and lower clamps such that the starting distance between the clamps is 200 mm. The total extended length of cord between the two clamps shall be approximately 800 mm, as shown in position 2 (extended position) of Figure D.3.

Four samples shall be prepared for testing, two with the twists applied in a clockwise direction and two in an anticlockwise direction.

D.3.4 *Test procedure*

The lower clamp shall be loaded with a weight, sufficient to exert the tensile force given in Table D.4.

Each conductor of the cord shall be loaded with a current, as specified in Table D.4. The current may be at a low voltage.

The moveable upper clamp shall make upwards and downwards movements at the rate of nine complete cycles per minute (one complete cycle equals one upwards and one downwards movement). The distance of travel for each movement (upwards and downwards) shall be 650 mm.

When the upper clamp is fully raised, the weight attached to the bottom clamp shall have been raised by about 50 mm (see Figure D.3, position 2).

Each sample shall be subjected to a total of 3 000 cycles.

At the conclusion of the test the sheath and any outer covering shall be removed from the test sample, and the cores shall be subjected to the voltage test at 2 000 V in accordance with **C.3**.

Table D.4 — Tensile force exerted by the weight, and current loading

Nominal cross-sectional area of conductor	Tensile force exerted by the weight		Current (I_3)
	2-core cords	3-core cords	
mm^2	N	N	A
0.75	30	50	6
1.0	50	70	10
1.5	70	100	16

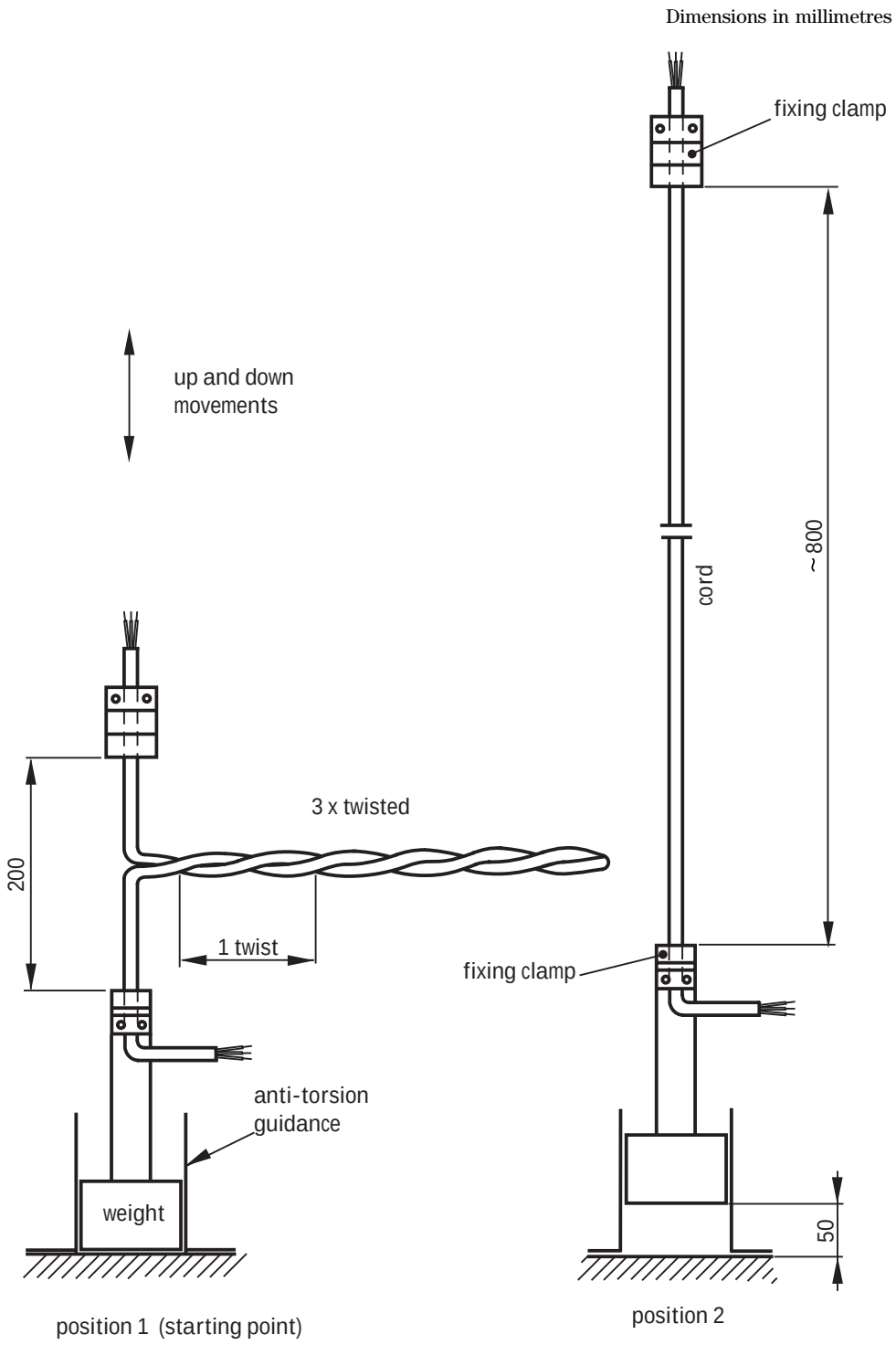


Figure D.3 — Kink test apparatus

D.4 Wear resistance test

D.4.1 *Test sample*

Carry out the test on three pairs of braided circular and UDF cord samples, each sample being about 1 m in length.

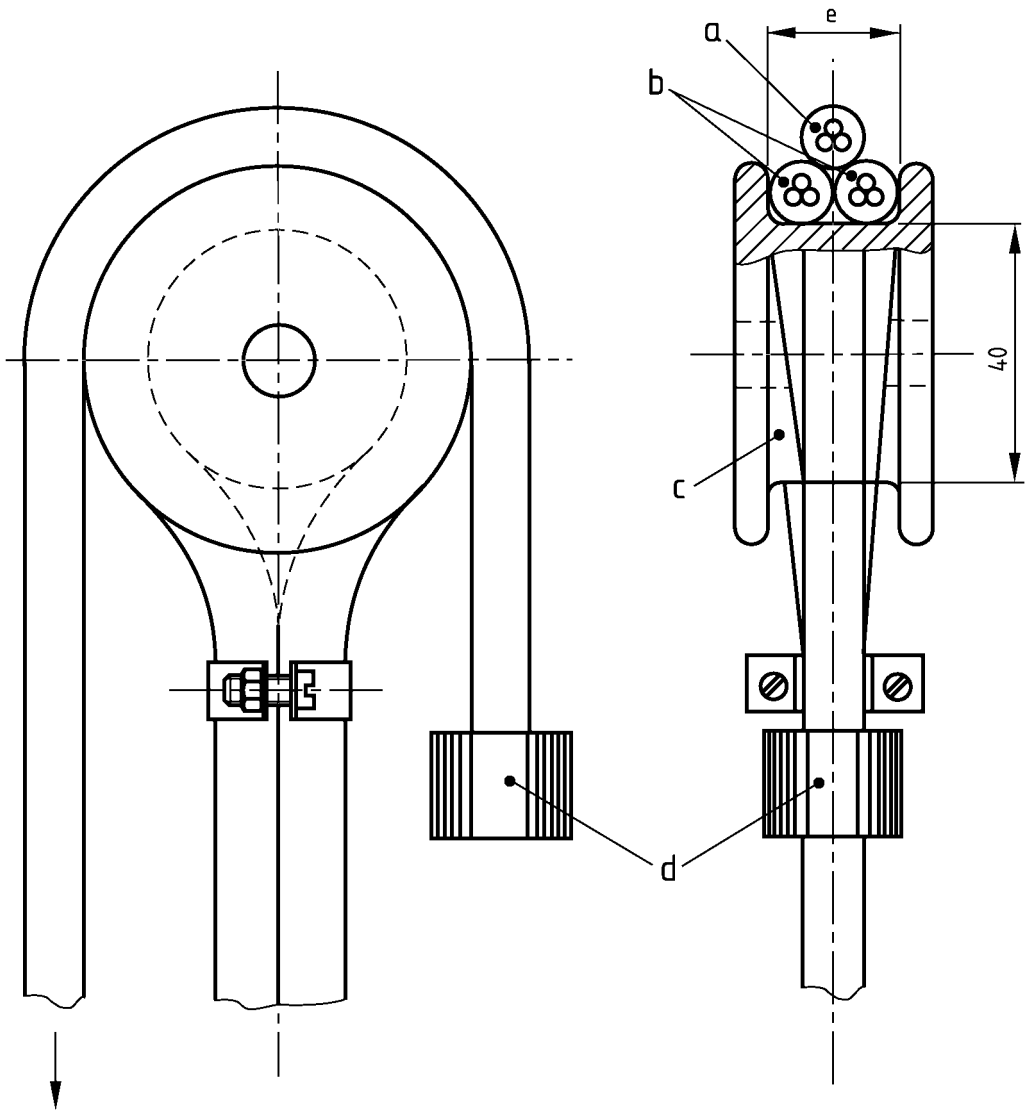
D.4.2 *Procedure*

Test each pair of samples as follows. Wind one sample in such a way as to form nearly two turns on a fixed pulley wheel having a diameter of 40 mm at the bottom of the groove as shown in Figure D.4. The distance between the two sides of the pulley wheel shall be set to twice the measured diameter of the sample, using spacers if necessary, ensuring that the turns are tight to prevent any displacement of the sample relative to the pulley wheel. Although it is important that this sample cannot move relative to the pulley, it is equally important that no over-compression or distortion of the coils occurs as this can cause excessive abrasion due to buckling of the braid.

Locate the second sample in the groove formed by the turns of the first sample and attach a weight of 500 g to one end of this sample. Subject the other end to a vertical to-and-fro movement with a travel of 0.1 m at a rate of about 40 single movements per minute for 20 000 single movements.

After completion of the specified number of movements subject the fixed sample to the voltage test described in **C.2**.

Dimensions in millimetres



Key

a Test piece moving in the space between the turns of the fixed test piece
b Fixed test piece
c Fixed pulley
d Weight
e Distance set at twice measured diameter of sample

Figure D.4 — Arrangement of wear resistance test

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 cord; the other core shall have the largest insulation thickness of the relevant types of cord.

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.

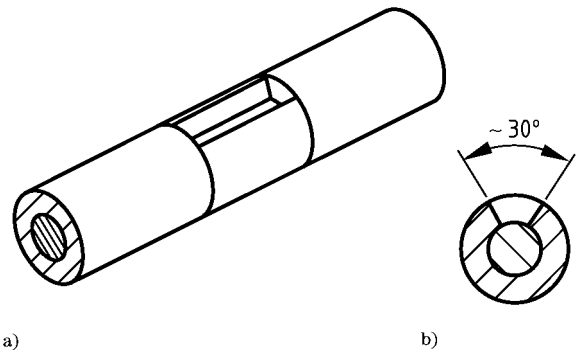


Figure E.1 — Preparation of core for spark test equipment check: removal of insulation

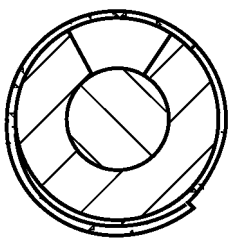


Figure E.2 — Preparation of core for spark test equipment check: covering with tape

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 the 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 cord, 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.

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 cords.

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 times and temperatures as follows:

— insulation types EI 4, EI 7, sheath types EM 7 and XM 1: 7 days at (100 ± 2) °C;
— insulation type TI 2 and sheath type TM 2: 7 days at (80 ± 2) °C;
— insulation type TI 3 and sheath type TM 3: 14 days at (100 ± 2) °C.

Place a sheet of clean white blotting paper under the test sample in the oven to detect any exudate which might drip from the sample.

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 (normative)
Tests for extensible leads

H.1 Extension test

H.1.1 *Test samples*

Two test samples shall be used, each comprising a 30-coil length of extensible lead or a whole assembly if it contains less than 30 coils in total.

Calculate the total length of cord in the coiled section, L, in millimetres, from the following equation:

$$L = n\pi(D - d)$$

where:

n is the number of turns in the coiled section;

D is the outer diameter of the coil in millimetres (mm);

d is the diameter of the cord in millimetres (mm).

H.1.2 *Procedure (before ageing)*

The test shall be carried out at a temperature of (20 ± 5) °C, after the test sample has been maintained at that temperature for 24 h.

Suspend one test sample vertically, from the first turn, by means of a clamp. Measure the closed length of the test sample.

Then extend the test sample to 60 % of the length L (calculated in accordance with **H.1.1**) and release it. Do this a total of five times within (15 ± 2) s. Measure the closed length of the test sample 30 s after release from the fifth extension.

H.1.3 *Procedure (after ageing)*

An oven with natural airflow shall be used, conforming to BS EN 60811-1-2:1995, **8.1.2**.

Suspend the second test sample horizontally in the middle of the oven by means of its two ends. Maintain it in the oven at 70 °C for 168 h.

Remove the sample from the oven, allow it to cool to ambient temperature and then subject it to the procedure given in **H.1.2**.

H.2 Flexing test

H.2.1 *Apparatus*

Flexing apparatus of a type similar to that shown in Figure D.1 shall be used. The movable carrier shall have a travel of approximately 1 m at a rate of 0.33 m/s, modified as follows (see Figures H.1 and H.2).

Remove the pulley wheels from the movable carrier on the machine shown in Figure D.1. Attach the sample to the pulley represented at point E in Figures H.1 and H.2. The attachment may be made by any method which avoids excessive stress concentration on the cable.

Make electrical connections between the individual cores at one end of the extensible lead and one set of electrical connections on the machine. Thread a support through the coiled section of the lead.

This support may be made of any reasonably low-friction material (such as PTFE) of a diameter which does not cause a groove to be cut into the sheath material during operation of the machine. The support is represented in Figures H.1 and H.2 by a dotted line. The support is secured at one end of the machine near to point E and at a point on the opposite end of the machine which allows the machine to operate without contact between the carrier and the support.

Connect the free end of the extensible lead to either the movable carrier, or a cable leading from the carrier, again avoiding stress concentration. Connect a length of cable of at least the same current carrying capacity and number of cores as the lead under the test between the individual cores of the remaining unconnected end of the extensible lead and the remaining electrical connections on the machine. It is essential that this cable is of sufficient length to allow the machine to operate without the lead becoming stretched, and may be supported by any convenient means which allows movement without interference by the carrier. Where the extensible lead is connected as illustrated in Figure H.2, it will be necessary to ensure that the coiled section of the lead is returned to its original closed length at the point in the cycle nearest to end E by means of an adjustable device mounted on the movable carrier F.

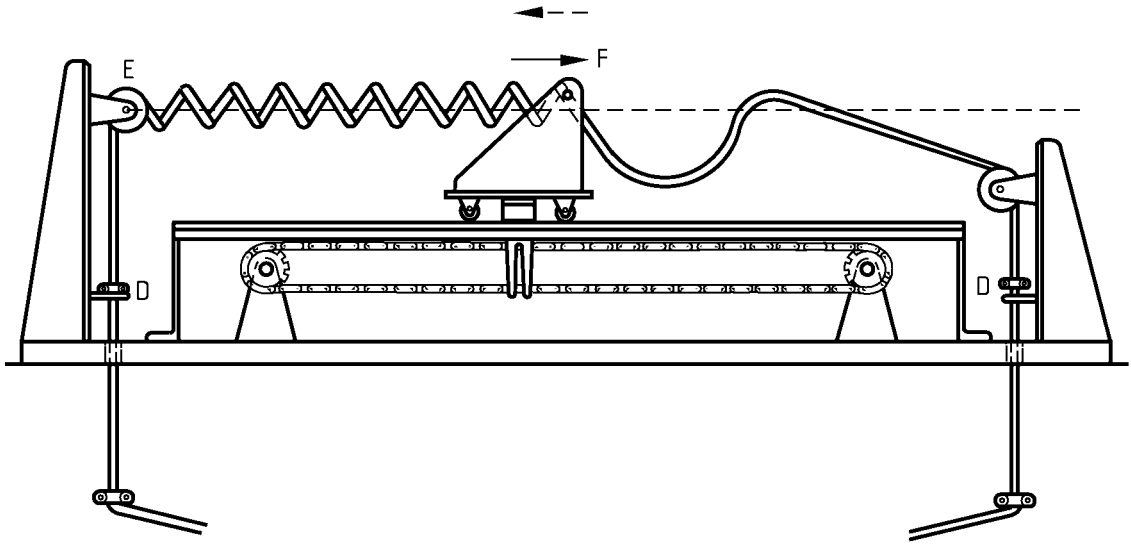


Figure H.1 — Flexing apparatus for extensible leads

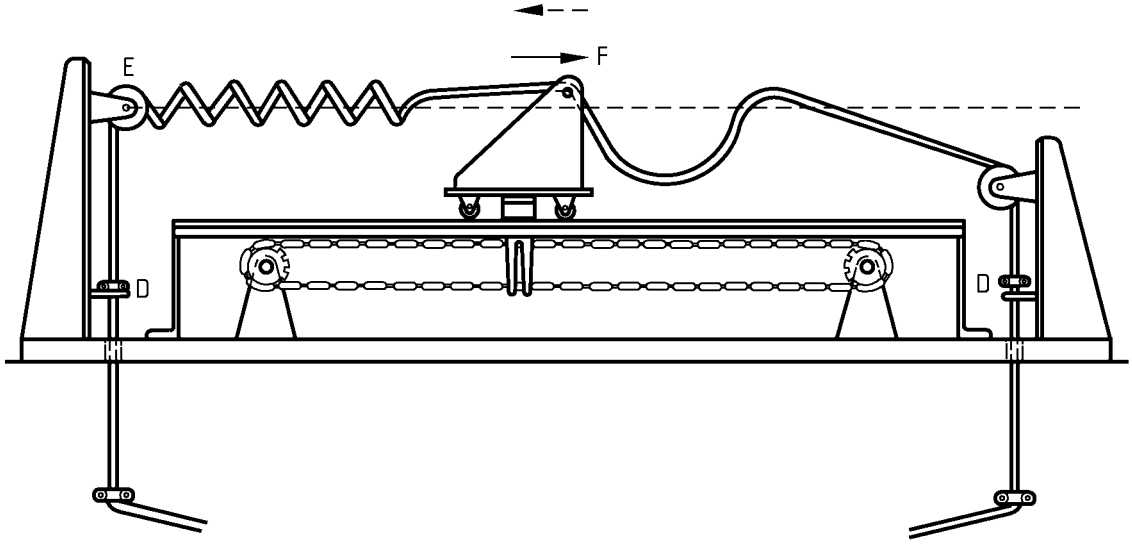


Figure H.2 — Flexing apparatus for short extensible leads

H.2.2 ***Test sample***

Arrange a sample so that the operation of the machine causes the section under test to be stretched to three times its closed length, and returned to its closed length during each single cycle of machine operation. Where possible fix a complete cord or section of cord between point E and the movable carrier, point F. Where this is not possible due to the short length of the finished cord, the sample shall be attached at point E and a length of similar cable shall be attached between the remaining unconnected end and the movable carrier, the length of this cable being such that the operation of the machine causes stretching of the extensible lead to three times its closed length.

H.2.3 ***Procedure***

Secure one end of the test sample to the fixed post and the other end to the moving post situated at carrier F. Load the cores with the current in accordance with Table D.1.

For all two-core cords for light duty, thermoplastic insulated cords (specified in Tables 26 and 28) the voltage between the conductors shall be 230 V a.c. For all other cords having three cores, a three-phase voltage of 400 V shall be applied to the conductors, any additional conductors being connected to the neutral.

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

Extend the cord for 30 000 cycles, i.e. 60 000 backwards and forwards movements.

Annex I (normative)
Tests on tinsel cords

I.1 Bending test on tinsel cords

I.1.1 *Test sample*

Carry out the test on a sample of parallel twin tinsel cord of convenient length.

I.1.2 *Procedure*

The sample of cord shall be fixed in the apparatus as shown in Figure I.1 and loaded with a 0.5 kg weight. A current of about 0.1 A shall be passed through the conductors.

The sample shall be bent backwards and forwards in a direction perpendicular to the plane of the axes of the conductors, the two extreme positions making an angle of 90° on each side of the vertical.

One bending cycle shall comprise two single strokes, i.e. two consecutive movements through 180°. The rate of bending shall be 60 single strokes (30 bending cycles) per minute.

After this test, the sample shall be subjected to the voltage test specified in **C.2**, the voltage however being 1 500 V and applied only between the conductors connected together and the water.

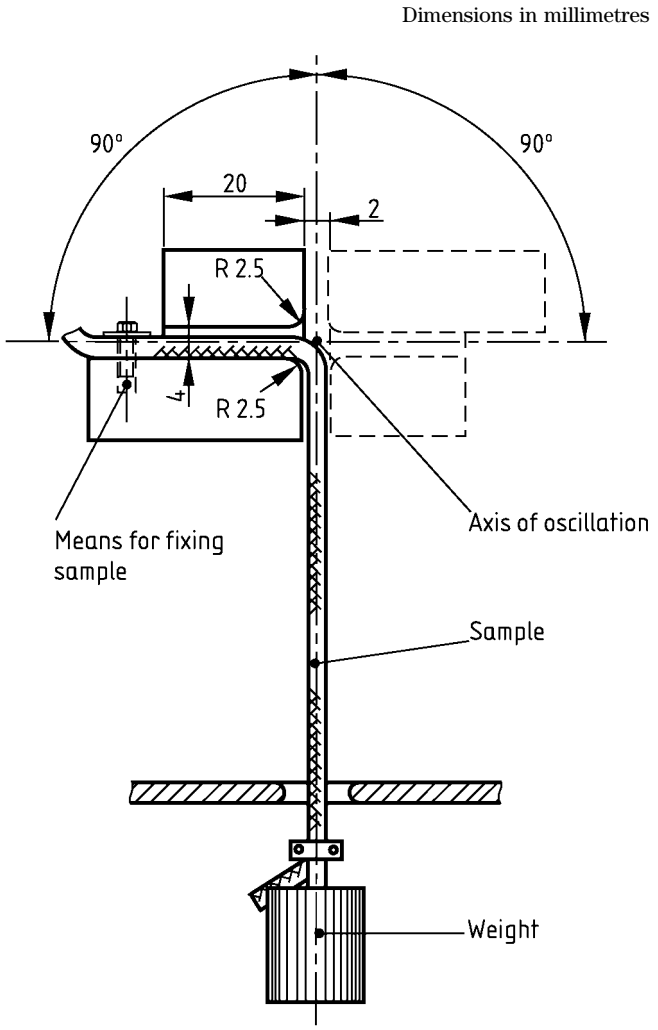


Figure I.1 — Bending test apparatus

I.2 Snatch test on tinsel cords

I.2.1 *Test sample*

Carry out the test on a sample of cord of convenient length.

I.2.2 *Procedure*

The sample of cord shall be attached by one end to a rigid support and a weight having a mass of 0.5 kg shall be secured to the sample 0.5 m below the point of attachment. A current of about 0.1 A shall be passed through the conductors. The weight shall be raised to the point of attachment and then dropped. The weight shall be dropped a total of five times.

Annex J (normative)
Test for resistance to heat of textile braids

J.1 General

This test is designed to determine whether the textile braid has adequate resistance to heat.

J.2 Apparatus

J.2.1 *Electrically heated oven*, with natural air flow.

J.2.2 *Aluminium block*, as shown in Figure J.1, of mass (1 000 ± 50) g, with smooth flat surfaces with a surface roughness value, R_a, of 50 μm.

J.2.3 *Steel base plate and upright*, with guide rods, as shown in Figure J.1, so designed that the aluminium block can slide between the guide rods without impediment and that any lateral tilting is avoided.

J.2.4 *Timer*, e.g. a stop-watch.

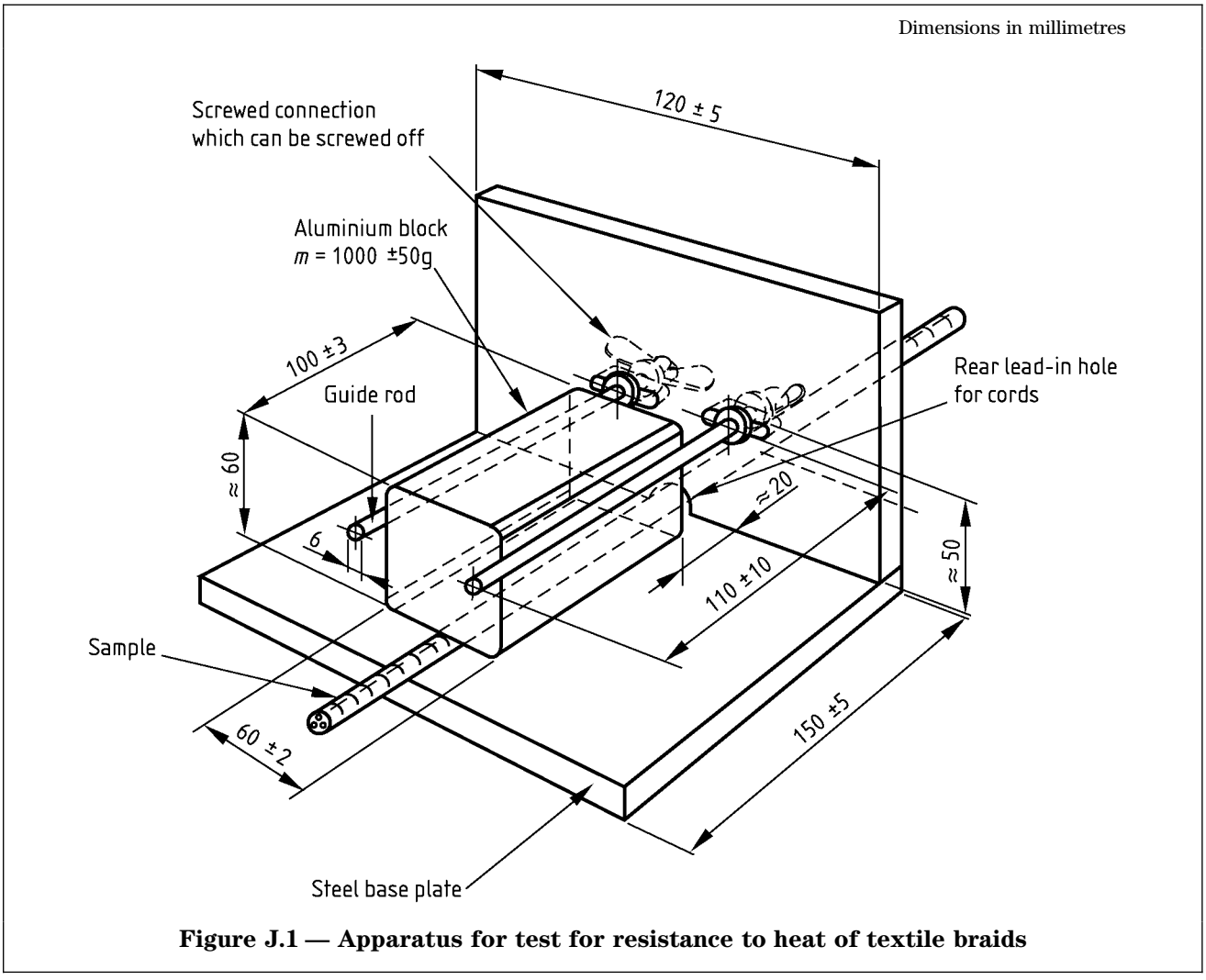


Figure J.1 — Apparatus for test for resistance to heat of textile braids

J.3 Test sample

The test sample shall be a length of completed cord, approximately 300 mm long.

J.4 Preparation for testing

Straighten the test sample and place it as close as possible to the longitudinal axis of the steel base plate as shown in Figure J.1, so that one end of the sample protrudes approximately 100 mm from the rear lead-in hole. Place the aluminium block (**J.2.2**) in the oven (**J.2.1**) at a temperature of (260 ± 5) °C and keep it there for at least 4 h.

J.5 Test procedure

Take the aluminium block out of the oven and immediately place it on the test sample. Keep it on the test sample for 60^{+3}_{0} s. Then remove the block and examine the test sample for any signs of melting or charring of the braid.

Annex K (normative)
Measurement of thicknesses

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 cord; 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.

The cores of flat non-sheathed cords shall not be separated.

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.

K.2 Measurement of sheath thickness for circular cords

K.2.1 *Procedure*

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

One sample of cord 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 cords

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 cord 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 cord. If the sheath carries 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 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 the values obtained shall be taken as the minimum thickness of sheath at any place.

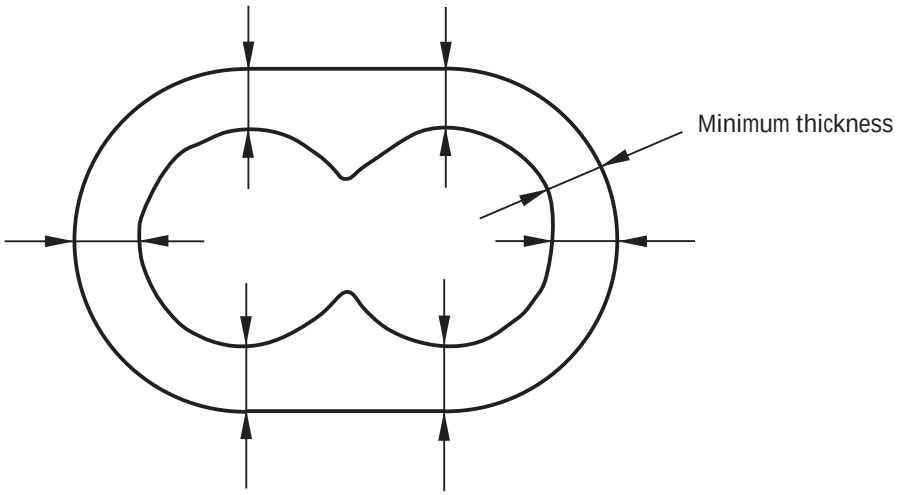


Figure K.1 — Measurement of sheath thickness

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