

Flexible cables for use at mines and quarries

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Committees responsible for this British Standard

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- Association of British Mining Equipment Companies
- British Cable Makers' Confederation
- Health and Safety Executive
- Quarry Products Association

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Contents

	Page
Committees responsible	Inside front cover
Foreword	iv
1 Scope	1
2 Normative references	1
3 Definitions	1
4 Abbreviations	2
5 Voltage designation	2
6 Cables with individual metallic screens, rated voltage 640/1100 V, for use with coalcutters and for similar purposes (types 7, 7M, 7S, 11, 14 and 16) and flat cables for use on overhead catenary systems and for similar purposes (type FS4)	2
7 Cables with galvanized steel pliable wire armouring, rated voltages up to 1900/3300 V (types 20, 21, 62, 63, 64, 70, 71, 201, 211, 321 and 331)	13
8 Cables with galvanized steel pliable wire armouring having up to 24 individual screened cores, rated voltage 320/550 V (types 506, 512, 518 and 524)	26
9 Cables with galvanized steel pliable wire armouring having individual metallic screened or unscreened cores, rated voltage 3800/6600 V (types 621, 630 and 631)	29
10 Cable with individual metallic screens, rated voltage 600/1000 V, for use with drills (type 44)	34
11 Cable with individual non-metallic screens, rated voltage 600/1000 V, for use with drills (type 43)	36
12 Cable with individual metallic screened cores, non-armoured, rated voltage 3800/6600 V (type 730)	38
13 Cable with metallic screened cores, non-armoured, rated voltage 6350/11000 V (type 830)	39
14 Cables with individual metallic screens, rated voltage 1900/3300 V, for use with coalface cutters and for similar purposes (types 307, 307M and 307S)	44
Annexes	
A (informative) Approved codes of practice and conductivities	51
B (informative) Recommended current ratings	51
C (informative) Short circuit current carrying capability of flexible cable screens	52
D (normative) Measurement of insulation and sheath thickness	55
E (normative) Protective screens: form, method of application and material	56
F (normative) Voltage and insulation resistance tests	57
G (normative) Tests for galvanized steel wire taken from completed cables	58
H (normative) Electrical test for conducting elastomeric screen for type 43 cable	58
Tables	
1 Clause 6 cable types and construction	3
2 Sequence of colours	4
3 Constructional details of type 7 cable	6
4 Constructional details of type 7M cable	7
5 Constructional details of type 7S cable	8
6 Constructional details of type 11 cable	9
7 Constructional details of type 14 cable	10

	Page
8 Constructional details of type 16 cable	11
9 Constructional details of type FS4 cable	12
10 Insulation resistance	13
11 Clause 7 cable types and construction	14
12 Core identification	16
13 Minimum wire diameters	17
14 Constructional details of type 20 cable	18
15 Constructional details of type 21 cable	19
16 Constructional details of cable types 62, 63, 64, 70 and 71	20
17 Constructional details of type 201 cable	21
18 Constructional details of type 211 cable	22
19 Constructional details of type 321 cable	23
20 Constructional details of type 331 cable	24
21 Test voltage on core	25
22 Insulation resistance	25
23 Test voltage on completed cable	25
24 Constructional details of cable types 506, 512, 518 and 524	27
25 Clause 9 cable types and construction	30
26 Constructional details of type 621 cable	31
27 Constructional details of type 630 cable	32
28 Constructional details of type 631 cable	33
29 Insulation resistance	34
30 Clause 10 cable type and construction	34
31 Constructional details for type 44 cable	35
32 Clause 11 cable type and construction	36
33 Constructional details for type 43 cable	38
34 Clause 12 cable type and construction	38
35 Constructional details of type 730 cable	40
36 Insulation resistance	41
37 Clause 13 cable type and construction	41
38 Constructional details of type 830 cable	43
39 Insulation resistance	43
40 Clause 14 cable types and construction	44
41 Constructional details of type 307 cable	47
42 Constructional details of type 307M cable	48
43 Constructional details of type 307S cable	49
44 Insulation resistance	50
A.1 Cables with conductivities of between 50 % and 99 %	51
B.1 Current ratings of cables of clauses 6, 7, 9, 10, 11, 12, 13 and 14	52
B.2 Current ratings for cables of clause 8	52
B.3 Current de-rating factors	52
B.4 Voltage drop and current rating	52
C.1 Short circuit current ratings	53
E.1 Protective screenbraid thickness and width	57

	Page
Figures	
1 Core identification: type 506 cable	27
2 Core identification: type 512 cable	28
3 Core identification: type 518 cable	28
4 Core identification: type 524 cable	28
D.1 Positions for first measurement of insulation thickness	55
D.2 Position of point of intersection of the cross-wires of the measuring microscope	55
D.3 Position for measurement of sheath thickness	55
D.4 Position for measurement of sheath thickness for type FS4 cable	56
D.5 Position of point of intersection of the cross-wires of the measuring microscope	56
List of references	Inside back cover

Foreword

This British Standard has been prepared by Technical Committee MRE/3/1. It supersedes BS 6708 : 1991 which is withdrawn. It updates insulation specifications and short circuit current ratings, and now includes a section covering cable types 307, 307M and 307S for rated voltages of 1900/3300 V and having individual metallic screens.

All matters relating to the use of electric cables in mines and quarries are now included in the Electricity at Work Regulations 1989 [1] and the associated Health and Safety Executive (HSE) Approved Codes of Practice, i.e. *The use of electricity in mines* (COP 34) [2] and *The use of electricity at quarries* (COP 35) [3]. Guidance is given in annex A.

Attention is drawn to the Health and Safety at Work etc. Act 1974 [4], the Mines and Quarries Act 1954 [5], the regulations made under these, and also any other appropriate statutory requirements or by-laws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user.

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 58, an inside back cover and a back cover.

1 Scope

This British Standard specifies requirements and dimensions for flexible cables used in mining and quarrying.

Specific types of cable covered in this standard are as follows:

- a) non-armoured cables having individually metallic screened cores and a rated voltage of 640/1100 V, for use:
 - 1) with coalface cutters and other similar machines: types 7, 7M, 7S, 11, 14 and 16;
 - 2) in overhead catenary systems and similar applications: types FS4 (flat form cable);
- b) cables with galvanized steel pliable wire armouring, with:
 - 1) unscreened cores and a rated voltage 640/1100 V: types 20 and 21; or
 - 2) individually metallic screened or unscreened cores and a rated voltage 640/1100 V used primarily for remote control circuits and coalface lighting: types 62, 63, 64, 70 and 71; or
 - 3) individually metallic screened cores and a rated voltage 640/1100 V: types 201 and 211; or
 - 4) a rated voltage 1900/3300 V used as trailing cables in quarries or for mine roadway cable extension purpose: types 321 and 331;
- c) auxiliary cables with galvanized steel pliable wire armouring having up to 24 individually metallic screened cores and a rated voltage 320/550 V, primarily for use on large mining machines where interconnection between machine sections or a machine section and auxiliary equipment is required: types 506, 512, 518 and 524;
- d) cables with galvanized steel pliable wire armouring having individually metallic screened or unscreened cores and a rated voltage 3800/6600 V, used as trailing cables in quarries and rated for roadway extension purposes: types 621, 630 and 631;
- e) non-armoured cable having individually metallic screened cores and a rated voltage 600/1000 V, primarily for use with hand-held drilling machines in mines: type 44;
- f) non-armoured cable having individually non-metallic screened cores and a rated voltage 600/1000 V, primarily for use with hand-held drilling machines in mines: type 43;
- g) non-armoured cable having individually metallic screened cores and a rated voltage 3800/6600 V, primarily for use as trailing cables for large machines at quarries: type 730;
- h) non-armoured cable having individually metallic screened cores and a rated voltage 6350/11000 V, primarily for use as trailing cables for large machines at quarries: type 830;

- i) non-armoured cables having individually metallic screened cores and rated voltage 1900/3300 V, for use with coalface cutters and other similar machines: types 307, 307M and 307S.

NOTE 1. Information on approved codes of practice and conductivities related to the cables in this standard is given in annex A.

NOTE 2. Recommended current ratings are given in annex B.

NOTE 3. Short circuit current carrying capability of flexible cable screens is given in annex C.

2 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of a cited publication apply to this British Standard only when incorporated in the text by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

3 Definitions

For the purposes of this British Standard, the definitions given in BS 4727 apply, together with the following.

NOTE. Unless otherwise specified, voltages and currents are expressed by their r.m.s. values.

3.1 rated voltage U_0

The power-frequency voltage to earth for which the cable is designed.

NOTE. It is assumed that cables may be operated continuously at a power-frequency voltage 10 % above the rated voltage.

3.2 rated voltage U

The power-frequency voltage between conductors for which the cable is designed.

NOTE. It is assumed that cables may be operated continuously at a power-frequency voltage 10 % above the rated voltage.

3.3 flexible cable

Cable designed to be moved while energized.

3.4 trailing cable

Cable used to supply apparatus that changes position while energized.

3.5 fixed cable

Cable that does not change position while energized.

3.6 stranded conductor

Conductor made up of a number of wires twisted together.

NOTE. When the conductor consists of more than one layer, alternate layers are twisted in opposite directions.

3.7 bunched conductor

Stranded conductor in which all wires are twisted together in the same direction and with the same lay throughout.

3.8 multiple stranded conductor

Stranded conductor consisting of a number of groups of wires assembled together in one or more helical layers, the wires in each group being either bunched or stranded.

3.9 braid

Plaited protective covering composed of a number of wires.

3.10 metallic screen

Braid enclosing the insulation of each conductor.

3.11 non-metallic screen

Conducting layer enclosing the insulation of each conductor.

3.12 core

Single conductor and its insulation, but not including any mechanical protective cover.

4 Abbreviations

The following abbreviations are used in this standard:

- PCP: polychloroprene;
- ETFE: ethylenetetrafluoroethylene.

5 Voltage designation

The cable shall be designated by the rated voltages U_0 and U expressed in the form U_0/U .

NOTE. The rated voltages recognized for the purposes of this British Standard are 320/550 V, 600/1000 V, 640/1100 V, 1900/3300 V, 3800/6600 V and 6350/11000 V.

6 Cables with individual metallic screens, rated voltage 640/1100 V, for use with coalcutters and for similar purposes (types 7, 7M, 7S, 11, 14 and 16) and flat cables for use on overhead catenary systems and for similar purposes (type FS4)

6.1 Types of cable

Cable types and construction shall be as given in table 1.

Constructional details and dimensions shall be as given in tables 3 to 9.

6.2 Conductors

The conductors shall be composed of round tinned annealed copper wires conforming to BS 6360 for class 5 conductors and shall be multiple stranded for conductors of 16 mm² and larger. Sizes below 16 mm² shall be bunched.

Joints made in the single wires forming the conductor shall be brazed, silver soldered or electrically welded. No joint shall be made in the conductor after it has been stranded.

The conceptual construction shall be as given in tables 3 to 9.

NOTE. At the manufacturer's discretion, a film separator of polyethylene terephthalate or other suitable non-hygroscopic tape may be applied over the conductor. Embrittlement or discoloration of this tape after vulcanization of the core may be disregarded.

6.3 Insulation

The core insulation shall be a close fit on the conductor without adhering, and shall be either type FR1 conforming to BS 7655 : Section 1.5 or type GP4 conforming to BS 7655 : Section 1.2, except that the tensile stress at 100 % elongation for GP4 shall be 2.0 N/mm² minimum.

For type 7 and type 14 cables, an additional layer of insulation shall be applied to the earth core and to the pilot core, as appropriate, of a thickness such that the finished outside diameters of the cores are the same as that of a screened power core. The additional layer of insulation on the pilot conductor shall be readily separable from the primary insulation.

NOTE 1. For the earth core, the additional layer of insulation may be separable from the primary insulation or, alternatively, the insulation may be applied in a homogeneous layer.

NOTE 2. If insulation colouring is used for identification purposes, it may be restricted to the outer layer.

6.4 Thickness of insulation

The radial thickness of core insulation shall be determined in accordance with the method described in annex D, and the average value shall be not less than the nominal value given in tables 3 to 9. The smallest of the measured values shall not fall below the nominal value by more than 0.1 mm plus 10 % of the nominal value.

6.5 Core tape

The insulation of each conductor shall be lapped with a tape of closely woven textile approximately 0.15 mm thick, without selvedge, proofed on one side with rubber or comparable material. The tape shall be applied with an overlap. The proofed side of the tape shall be coloured for identification purposes (see 6.6) and shall be on the outside.

Table 1. Clause 6 cable types and construction			
Type	System	Construction	Sectional diagram
7	3-phase	5-core. Three power cores each having a protective metallic screen and one pilot core unscreened, laid around a bare earth conductor with which the screens are in electrical contact, sheathed overall	
7M	3-phase	5-core. Three power cores and one pilot core having the same nominal cross-sectional area, each having a protective metallic screen, laid around a bare earth conductor with which the screens are in electrical contact, sheathed overall	
7S	3-phase	7-core. Three power cores each having a protective metallic screen, and one unscreened sheathed pilot unit containing three pilot cores, laid around a bare earth conductor with which screens are in electrical contact, sheathed overall	
11	3-phase	4-core. Three power cores and one pilot core having the same nominal cross-sectional area, each having a protective metallic screen, laid around an elastomeric centre, sheathed overall. The combined screens shall function as the cable earth conductor	
14	3-phase	5-core. Three power cores each having a protective metallic screen, one unscreened earth core and one unscreened pilot core, laid around an elastomeric centre, sheathed overall	
16	3-phase	6-core. Three power cores each having a protective metallic screen, one unscreened pilot core and two unscreened earth cores. The power cores laid around an elastomeric centre with the pilot and earth cores in the interstices, sheathed overall	
FS4	3-phase	4-core. Three power cores and one neutral core each having a protective screen, laid flat, sheathed overall	

6.6 Core identification

6.6.1 General

The core tapes described in 6.5 shall be coloured for identification purposes as follows:

- power cores: red, yellow and brown;
- pilot core (except type 7S, see 6.6.2): blue;
- earth core(s): green/yellow.

6.6.2 Type 7S pilot unit and pilot cores

The pilot unit core tape described in 6.5 shall be coloured blue.

The pilot cores shall be identified either by the application of a coloured core tape in accordance with 6.5 or by the colour of the insulation in accordance with 6.3. The identifying colours shall be black, white and blue.

6.7 Protective screen

The form of screen, method of application and materials shall be as given in annex E.

6.8 Central filler

For types 11, 14 and 16, the cores shall be laid around a centre of elastomeric compound that may include a textile carrier.

6.9 Laying-up of cores

6.9.1 Types 7 and 7M

The cores shall be laid around a bare earth conductor with a length of lay that permits the screens enclosing each power core to make electrical contact with the bare central earth conductor. The lay of the earth conductor strands shall be in the same direction as that of the laid-up cores, i.e. right hand.

6.9.2 Type 7S

The three pilot cores of the pilot unit shall be laid up with a right hand direction of lay with the length of lay not exceeding nine times the pitch circle diameter.

The power cores and pilot unit shall be laid around a bare earth conductor with a length of lay that permits the screens enclosing each power core to make electrical contact with the bare central earth conductor. The lay of the earth conductor strands shall be in the same direction as that of the laid-up cores, i.e. right hand.

6.9.3 Types 11 and 14

The cores shall be laid around an elastomeric compound centre.

6.9.4 Type 16

The power cores shall be laid around an elastomeric compound centre with the pilot and two earth cores laid up in the interstices of the power cores.

6.9.5 Length and direction of lay

The cores of all types of cable, with the exception of type FS4 and the pilot cores of cable type 7S (see 6.9.2), shall be laid up with a right hand direction of lay with the length of lay not exceeding 15 times the pitch circle diameter.

The cores of type FS4 shall be laid parallel in flat configuration.

6.9.6 Sequence of colours

The laid-up cores shall be in the sequences given in table 2.

Table 2. Sequence of colours	
Cable type	Sequence
7	red, yellow, brown (power); blue (pilot)
7M	red, yellow, brown (power); blue (pilot)
7S	red, yellow, brown (power); blue (pilot unit)
11	red, yellow, brown (power); blue (pilot)
14	red, yellow, brown (power); green/yellow (earth); blue (pilot)
16	red, yellow, brown (power); with green/yellow (earth, two in number); blue (pilot); one in each interstice, i.e. red, green/yellow, yellow, blue, brown, green/yellow
FS4	red, yellow, brown, blue

6.10 Sheath of pilot unit and outer sheath

6.10.1 Sheath of pilot unit (type 7S)

The assembled cores of the pilot unit shall be sheathed with a black compound conforming to BS 7655 : Section 2.1 for a type EM2 sheath. The sheath shall be of such thickness that the diameter of the taped sheath is the same as that of a screened power core.

6.10.2 Outer sheath

The assembled cores shall be filled and sheathed in one operation with a compound conforming to BS 7655 : Section 2.3 for a type RS6 sheath.

NOTE. If no colour is specified in the purchase order, black sheaths should normally be supplied.

The radial thickness of the outer sheath shall be determined in accordance with the method given in annex D, and the average value shall be not less than the nominal value given in tables 3 to 9. The smallest of the measured values shall not fall below the nominal value by more than 0.1 mm plus 15 % of the nominal value.

6.11 Marking

6.11.1 All cables shall be durably and legibly marked with the manufacturer's name, together with the year and month of manufacture, on rubber-proofed or other comparable non-hygroscopic tape or tapes inside the cable. The marking shall be at intervals of not more than 300 mm throughout the length of the cable.

NOTE. The month of manufacture may be indicated by number.

6.11.2 Type 7S cable shall have, in addition to the marking specified in **6.11.1**, an external identifying mark in the form of a blue stripe not less than 12 mm wide applied longitudinally along the cable.

NOTE. At the manufacturer's discretion, the stripe material may be the same as that of the outer sheath, or a similar material compatible with it.

6.12 Tests on cores

6.12.1 General

All cores shall be subjected to the spark test specified in **6.12.2**, the voltage test in **6.12.3** and the insulation resistance test in **6.12.4**.

6.12.2 Spark test

Cores shall be tested in accordance with the method given in BS 5099, and shall withstand the appropriate test voltage in clause 5 of BS 5099 : 1992.

6.12.3 Voltage test

When cores are tested in accordance with the method given in **F.1**, **F.2.1** and **F.2.2**, they shall withstand a test voltage of 3000 V, with the exception of the earth and pilot cores in type 16, which shall withstand 1500 V, and the pilot cores in type 7S, which shall withstand 2500 V.

6.12.4 Insulation resistance

When cores are tested in accordance with the method given in **F.1**, **F.2.1** and **F.2.3**, the insulation resistance between the conductor and the water in which the core is immersed shall be not less than the appropriate value given in table 10.

6.13 Tests on completed cable

6.13.1 Conductor resistance

The d.c. resistance at 20 °C shall not exceed the appropriate value given in tables 3 to 9.

6.13.2 Resistance of earth conductor and screens

For types 7, 7M and 7S, the combined d.c. resistance of the earth conductor and the core screens in parallel at 20 °C shall not exceed the appropriate value given in tables 3 to 5. For types 11, 14, 16 and FS4, the d.c. resistance of the core screens in parallel at 20 °C shall not exceed the appropriate value given in tables 6 to 9.

6.13.3 Voltage test

All completed cables shall be subjected to the voltage test in accordance with **F.1** and **F.3.1**. All cores shall withstand a test voltage of 3000 V, with the exception of the earth and pilot cores in type 16, which shall withstand 1500 V, and the pilot cores in type 7S, which shall withstand 2500 V.

6.13.4 Insulation resistance

Immediately after completion of the voltage test (see **6.13.3**), the insulation resistance of all cores shall be measured in accordance with **F.1** and **F.3.2**. The insulation resistance shall be not less than the appropriate value given in table 10.

6.13.5 Test for flame propagation of single cable

The finished cable shall conform to BS 4066 : Part 1 for tests under fire conditions.

Table 3. Constructional details of type 7 cable

Nominal cross sectional area of conductor (mm ²)	power	16	25	35	50	70	95	120
	earth	16	16	18	25	35	50	50
	pilot	16	16	16	25	35	50	70
Conceptual construction of conductor (mm)	power	126/0.40	196/0.40	276/0.40	396/0.40	360/0.50	475/0.50	608/0.50
	earth ¹⁾	126/0.40	126/0.40	147/0.40	196/0.40	276/0.40	396/0.40	396/0.40
	pilot	126/0.40	126/0.40	126/0.40	196/0.40	276/0.40	396/0.40	360/0.50
Maximum diameter of wires in conductor (mm)	power	0.41	0.41	0.41	0.41	0.51	0.51	0.51
	earth	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	pilot	0.41	0.41	0.41	0.41	0.41	0.41	0.51
Radial thickness of core insulation (mm)	power	1.5	1.5	1.6	1.7	1.8	2.0	2.2
	pilot ²⁾	1.5	1.5	1.5	1.6	1.6	1.7	1.8
Radial thickness of outer sheath (mm)		5.0	5.0	5.0	5.3	5.8	6.4	6.9
Overall diameter of cable (mm)								
minimum		35.8	39.7	43.1	48.5	55.1	62.4	68.0
maximum		38.6	42.9	46.3	51.8	58.8	66.1	72.5
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power	1.24	0.795	0.565	0.393	0.277	0.210	0.164
	pilot	1.24	1.24	1.24	0.795	0.565	0.393	0.277
Maximum resistance of earth and screens in parallel per 1000 m of cable at 20 °C (Ω)	3 screens plus earth conductor in parallel	0.66	0.56	0.54	0.44	0.30	0.26	0.24
Minimum cross-sectional area of earth and screens in parallel (mm ²) ³⁾	3 screens plus earth conductor in parallel	41.4	41.4	43.4	58	68	100	100
Area of earth and screens in parallel, expressed as a percentage of the area of the largest current carrying conductor (%)	3 screens plus earth conductor in parallel	258	165	124	116	97	106	83
Minimum conductivity ⁴⁾ of earth and screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	3 screens plus earth conductor in parallel	187	141	104	89	92	80	68

¹⁾ See 6.9.1.²⁾ See clause 6.3.³⁾ Design minimum, for information only.⁴⁾ See annex A.

Table 4. Constructional details of type 7M cable

Nominal cross-sectional area of conductor (mm ²)	power	16	25	35	50	70	95	120
	earth	16	16	18	25	35	50	50
	pilot	16	25	35	50	70	95	120
Conceptual construction of conductor (mm)	power	126/0.40	196/0.40	276/0.40	396/0.40	360/0.50	475/0.50	608/0.50
	earth ¹⁾	126/0.40	126/0.40	147/0.40	196/0.40	276/0.40	396/0.40	396/0.40
	pilot	126/0.40	196/0.40	276/0.40	396/0.40	360/0.50	475/0.50	608/0.50
Maximum diameter of wires in conductor (mm)	power	0.41	0.41	0.41	0.41	0.51	0.51	0.51
	earth	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	pilot	0.41	0.41	0.41	0.41	0.51	0.51	0.51
Radial thickness of core insulation (mm)	power	1.5	1.6	1.6	1.7	1.8	2.0	2.2
	pilot	1.5	1.6	1.6	1.7	1.8	2.0	2.2
Radial thickness of outer sheath (mm)		5.0	5.0	5.0	5.3	5.8	6.4	6.9
Overall diameter of cable (mm)								
minimum		35.8	39.7	43.1	48.5	55.1	62.4	68.0
maximum		38.6	42.9	46.3	51.8	58.8	66.1	72.5
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power	1.24	0.795	0.565	0.393	0.277	0.210	0.164
	pilot	1.24	0.795	0.565	0.393	0.277	0.210	0.164
Maximum resistance of earth and screens in parallel per 1000 m of cable at 20 °C (Ω)	4 screens plus earth conductor in parallel	0.58	0.47	0.45	0.38	0.27	0.23	0.21
Minimum cross-sectional area of earth and screens in parallel (mm ²) ²⁾	4 screens plus earth conductor in parallel	49.9	49.9	62.1	69.1	85.9	117.9	117.9
Area of earth and screens in parallel, expressed as a percentage of the area of the largest current carrying conductor (%)	4 screens plus earth conductor in parallel	321	200	177	138	123	124	98
Minimum conductivity ³⁾ of earth and screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	4 screens plus earth conductor in parallel	213	169	125	103	102	91	78
See 6.9.1.								
Design minimum, for information only.								
See annex A.								

Table 5. Constructional details of type 7S cable					
Nominal cross-sectional area of conductor (mm ²)	power	50	70	95	120
	earth	25	35	50	50
	pilot	4	6	6	10
Conceptual construction of conductor (mm)	power	396/0.40	360/0.50	475/0.50	608/0.50
	earth ¹⁾	196/0.40	276/0.40	396/0.40	396/0.40
	pilot	56/0.30	84/0.30	84/0.30	80/0.40
Maximum diameter of wires in conductor (mm)	power	0.41	0.51	0.51	0.51
	earth	0.41	0.41	0.41	0.41
	pilot	0.31	0.31	0.31	0.41
Radial thickness of core insulation (mm)	power	1.7	1.8	2.0	2.2
	pilot	1.4	1.5	1.5	1.5
Radial thickness of outer sheath (mm)		5.3	5.8	6.4	6.9
Overall diameter of cable (mm)					
minimum		48.5	55.1	62.4	68.0
maximum		51.8	58.8	66.1	72.5
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power	0.393	0.277	0.210	0.164
	pilot	5.47	3.60	3.60	2.09
Maximum resistance of earth and screens in parallel per 1000 m at 20 °C (Ω)	3 screens plus earth conductor in parallel	0.44	0.30	0.26	0.24
Minimum cross-sectional area of earth and screens in parallel (mm ²) ²⁾	3 screens plus earth conductor in parallel	58	68	100	100
Area of earth and screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	3 screens plus earth conductor in parallel	116	97.1	105	83.3
Minimum conductivity ³⁾ of earth and screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	3 screens plus earth conductor in parallel	89	92	80	68
¹⁾ See 6.9.2. ²⁾ Design minimum, for information only. ³⁾ See annex A.					

Table 6. Constructional details of type 11 cable

Nominal cross-sectional area of conductor (mm ²)	power	16
	pilot	16
Conceptual construction of conductor (mm)	power	126/0.40
	pilot	126/0.40
Maximum diameter of wires in conducton (mm)	power	0.41
	pilot	0.41
Radial thickness of core insulation (mm)	power	1.5
	pilot	1.5
Radial thickness of outer sheath (mm)		3.0
Overall diameter of cable (mm)		
minimum		30.9
maximum		33.0
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power	1.24
	pilot	1.24
Maximum resistance of screens in parallel per 1000 m of cable at 20 °C (Ω)	4 screens in parallel	1.05
Minimum cross-sectional area of screens in parallel (mm ²) ¹⁾	4 screens in parallel	33.9
Area of screens in parallel, expressed as a percentage of the area of the largest current carrying conductor (%)	4 screens in parallel	211
Minimum conductivity ²⁾ of screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	4 screens in parallel	118
¹⁾ Design minimum, for information only.		
²⁾ See annex A.		

Table 7. Constructional details of type 14 cable ¹⁾						
Nominal cross-sectional area of conductor (mm ²)	power and earth pilot	25 16	35 16	50 25	70 35	95 50
Conceptual construction of conductor (mm)	power and earth pilot	196/0.40 126/0.40	276/0.40 126/0.40	396/0.40 196/0.40	360.0.50 276/0.40	475/0.50 396/0.40
Maximum diameter of wires in conductor (mm)	power and earth pilot	0.41 0.41	0.41 0.41	0.41 0.41	0.51 0.41	0.51 0.41
Radial thickness of core insulation (mm)	power and earth pilot ²⁾	1.6 1.5	1.6 1.5	1.7 1.6	1.8 1.6	2.0 1.7
Radial thickness of outer sheath (mm)		5.0	5.2	5.7	6.3	7.0
Overall diameter of cable (mm)						
minimum		43.2	47.3	53.7	61.2	69.3
maximum		46.6	50.7	57.6	65.0	73.9
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power and earth pilot	0.795 1.24	0.565 1.24	0.393 0.795	0.277 0.565	0.210 0.393
Maximum resistance of screens in parallel, per 1000 m of cable at 20 °C (Ω)	3 screens in parallel	1.10	1.20	1.40	0.70	0.85
Minimum cross-sectional area of screens in parallel (mm ²) ³⁾	3 screens in parallel	25.4	25.4	33	35	53.0
Area of screens in parallel, expressed as a percentage of the area of the largest current carrying conductor (%)	3 screens in parallel	101	72	66	50	55
¹⁾ All cables in this table contain a full size earth conductor.						
²⁾ See 6.3.						
³⁾ Design minimum, for information only.						

Table 8. Constructional details of type 16 cable

Nominal cross-sectional area of conductor (mm ²)	power earth (2) and pilot	25 10	35 10	50 16	70 25	95 35
Conceptual construction of conductor (mm)	power	196/0.40	276/0.40	396/0.40	360/0.50	475/0.50
	earth and pilot	80/0.40	80/0.40	126/0.40	196/0.40	276/0.40
Maximum diameter of wires in conductor (mm)	power	0.41	0.41	0.41	0.51	0.51
	earth and pilot	0.41	0.41	0.41	0.41	0.41
Radial thickness of core insulation (mm)	power	1.6	1.6	1.7	1.8	2.0
	earth and power	1.0	1.0	1.0	1.0	1.0
Radial thickness of outer sheath (mm)		5.0	5.0	5.0	5.4	6.0
Overall diameter of cable (mm)						
minimum		36.5	39.5	43.9	49.6	56.2
maximum		39.2	42.7	47.0	53.3	63.0
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power	0.795	0.565	0.393	0.277	0.210
	earth and pilot	1.95	1.95	1.24	0.795	0.565
Maximum resistance of screens in parallel, per 1000 m of cable at 20 °C (Ω)	3 screens in parallel					
		1.10	1.20	1.40	0.70	0.85
Minimum cross-sectional area of screens in parallel (mm ²) ¹⁾	3 screens in parallel	25.4	25.4	33	35	53
Area of screens in parallel, expressed as a percentage of the area of the largest current carrying conductor (%)	3 screens in parallel	101	72	66	50	55
Minimum conductivity ²⁾ of earth and screens in parallel, expressed as a percentage of the largest current carrying conductor (%)	3 screens plus 2 earth conductors in parallel	152	103	90	107	98

¹⁾ Design minimum, for information only.²⁾ See annex A.

Table 9. Constructional details of type FS4 cable			
Nominal cross-sectional area of conductor (mm ²)	power and neutral	2.5	4
Conceptual construction of conductor (mm)	power and neutral	50/0.25	56/0.30
Maximum diameter of wires in conductor (mm)	power and neutral	0.26	0.31
Radial thickness of core insulation (mm)	power and neutral	1.0	1.0
Nominal diameter of wires in screen (mm)	power and neutral	0.2	0.2
Number of cores		4	4
Radial thickness of outer sheath		3.8	3.8
Minimum overall dimension of cable (mm)			
major		18.1	32.2
minor		12.4	13.3
Maximum overall dimension of cable (mm)			
major		20.1	34.1
minor		14.4	15.3
Maximum conductor resistance per 1000 m of cable at 20 °C (Ω)	power and neutral	7.82	4.85
Maximum resistance of one screen per 1000 m of cable at 20 °C (Ω)	1 screen	7.4	8.48
Minimum cross-sectional area of one screen (mm ²) ¹⁾	1 screen	2.65	2.25
Area of one screen, expressed as a percentage of the largest current carrying conductor (%)	1 screen	106	56
Minimum conductivity ²⁾ of one screen, expressed as a percentage of the largest current carrying conductor (%)	1 screen	105	57
¹⁾ Design minimum, for information only.			
²⁾ See annex A.			

Table 10. Insulation resistance		
Nominal cross-sectional area of conductor mm ²	Minimum insulation resistance for 1000 m at 20 °C	
	FR1 ¹⁾ MΩ	GP4 ¹⁾ MΩ
4 ²⁾	600	760
6 ²⁾	530	670
10 ²⁾	440	560
10 ³⁾	320	400
16 ³⁾	250	310
25 ³⁾	200	250
35 ³⁾	170	220
6	390	490
10	440	560
16	350	435
25	300	375
35	260	325
50	230	285
70	210	260
95	200	250
120	200	250
¹⁾ See 6.3.		
²⁾ Pilot cores for type 7S.		
³⁾ Pilot and earth cores for type 16.		

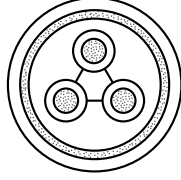
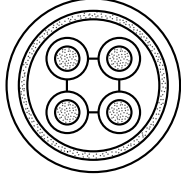
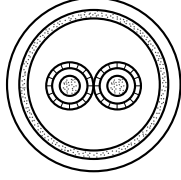
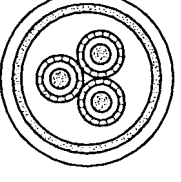
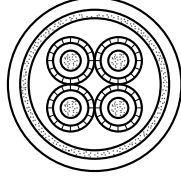
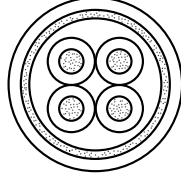
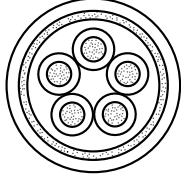
7 Cables with galvanized steel pliable wire armouring, rated voltages up to 1900/3300 V (types 20, 21, 62, 63, 64, 70, 71, 201, 211, 321 and 331)

7.1 Types of cable

Cable types and construction shall be as given in table 11.

Constructional details and dimensions shall be as given in tables 14 to 20.

NOTE. Type 201 cables conforming to this standard are not necessarily suitable for supplying portable equipment because of the absence of an earth conductor.

Table 11. Clause 7 cable types and construction			
Type	System	Construction	Sectional diagram
20	Single phase a.c. or d.c. 640/1100 V	3-core. Two power cores and one earth core each unscreened, laid around an elastomeric cradle centre, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
21	3-phase 640/1100 V	4-core. Three power cores and one earth core each unscreened, laid around an elastomeric cradle centre, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
62	Single phase a.c. and d.c. 640/1100 V	2-core. Two power cores each having a protective metallic screen, laid up, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
63	Single phase a.c. and d.c. 640/1100 V	3-core. Three power cores each having a protective metallic screen, laid up, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
64	3-phase a.c. or d.c. 640/1100 V	4-core. Three power cores and one pilot core each having a protective metallic screen, laid around an elastomeric centre sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
70	3-phase 320/550 V	4-core. Three power cores and one earth core each unscreened, laid around an elastomeric centre, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
71	3-phase 320/550 V	5-core. Three power cores, one pilot core and one earth core each unscreened, laid around an elastomeric centre, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	
201	3-phase 640/1100 V	3-core. Three power cores each having a protective metallic screen, laid around an elastomeric centre, sheathed with ordinary duty compound, galvanized steel strand armoured and heavy duty sheathed overall	