

BRITISH STANDARD 6195 : 1969

UDC 621.315.21+621.315.342

Confirmed June 1983

SPECIFICATION FOR
INSULATED FLEXIBLE
CABLES AND CORDS
FOR COIL LEADS

BRITISH STANDARDS INSTITUTION

**SPECIFICATION FOR
INSULATED FLEXIBLE
CABLES AND CORDS
FOR COIL LEADS**

BS 6195 : 1969

Incorporating amendments issued October 1975 (AMD 2139),
June 1982 (AMD 3989) and March 1984 (AMD 4433)
Confirmed June 1983

BRITISH STANDARDS INSTITUTION

Incorporated by Royal Charter

2 PARK STREET, LONDON, W1A 2BS

Telex: 266933

Telephone: 01-629 9000

BS 6195 : 1969

This British Standard, having been approved by the Electrical Industry Standards Committee, was published under the authority of the Executive Board on 31 December, 1969.

SBN: 580 05814 X

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9000, fully indexed and with a note of the contents of each, will be found in the British Standards Catalogue. The BS Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards and BSI special publications.

*As amended
June 1982*

BS 2844. Memorandum on conditioning of solid electrical insulating materials prior to and during testing.
BS 3218. Test tubes and boiling tubes.

BS 4066. Tests on electric cables under fire conditions.
Part 1. Method of test on a single vertical insulated wire or cable.



*Amended
June 1982*

BS 4727. Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms.
BS 6360. Specification for conductors in insulated cables and cords.
BS 6746. PVC insulation and sheath of electric cables.
BS 6746C. Colour chart for PVC insulation and sheath of electric cables.

*As amended
Oct., 1976*

BS 6899. Rubber-insulation and sheath of electric cables.
PD 2379. Register of colours and manufacturers' identification threads for electric cables and cords.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:
Committee references ELE/3 and ELE/3/23.

Draft for comment 69/6970

CONTENTS

	Page
Co-operating organizations	6
Foreword	7

SPECIFICATION

1. GENERAL

1.1	Scope	7
1.2	Definitions	8
1.3	Types of coil lead	8
1.4	Operating temperatures	9
1.5	Voltage categories	10
1.6	Identification of manufacturer	10
1.7	Information to be supplied when ordering	11

2. REQUIREMENTS

2.1	Type 1, polyvinyl chloride (PVC) insulated	11
2.1.1	Types of coil lead	11
2.1.2	Conductor	11
2.1.3	Insulation	12
2.1.4	Dimensions and tolerances	12
2.1.5	Performance tests	12
2.1.6	Production tests	13
2.2	Type 3, oil resisting and flame retardant rubber insulated	14
2.2.1	Types of coil lead	14
2.2.2	Conductor	14
2.2.3	Insulation	15
2.2.4	Dimensions and tolerances	15
2.2.5	Performance tests	15
2.2.6	Production tests	16
2.2.7	Test under fire conditions.	16

*As amended
March 1984*

BS 6195 : 1969

CONTENTS—*contd.*

	Page
<i>As amended March 1984</i>	
2.3 Type 4, flame retardant composite rubber insulated	18
2.3.1 Type of coil lead	18
2.3.2 Conductor	18
2.3.3 Semi-conducting tape	18
2.3.4 Insulation	18
2.3.5 Dimensions and tolerances	19
2.3.6 Performance tests	19
2.3.7 Production tests	20
<i>As amended Oct., 1976</i>	
2.3.8 Test under fire conditions.	20
2.4 Type 5, 150 °C rubber-insulated	22
2.4.1 Types of coil lead	22
2.4.2 Conductor	22
2.4.3 Insulation	22
2.4.4 Dimensions and tolerances	22
2.4.5 Performance tests	23
2.4.6 Production tests	24
2.5 Type 7, varnished polyethylene terephthalate (PTP) fabric insulated	24
2.5.1 Types of coil lead	24
2.5.2 Conductor	25
2.5.3 Insulation	25
2.5.4 Performance tests on insulation	25
2.5.5 Braiding	26
2.5.6 Dimensions and tolerances	26
2.5.7 Performance tests	27
2.5.8 Production test	27
2.6 Type 8, varnished glass fabric insulated	28
2.6.1 Types of coil lead	28
2.6.2 Conductor	29

CONTENTS—*contd.*

	Page
2.6.3 Insulation	29
2.6.4 Performance tests on insulation	29
2.6.5 Braiding	31
2.6.6 Dimensions and tolerances	31
2.6.7 Performance tests	31
2.6.8 Production test	32

APPENDICES

A. Measurement of average overall diameter and thickness of insulation	33
B. Electric strength proof test on bent samples	34
C. Voltage test of coil leads at manufacturer's works (production tests)	36
D. Spark test at manufacturer's works (production test Types 1, 3, 4 and 5)	36

TABLES

1. Types 1a and 1b, PVC insulated coil leads	14
2. Type 3, oil resisting and flame retardant rubber insulated coil leads	17
3. Type 4, flame retardant composite rubber insulated coil leads	21
4. Type 5, 150 °C rubber-insulated coil leads	24
5. Type 7, varnished polyethylene terephthalate (PTP) fabric insulated coil leads	28
6. Type 8, varnished glass fabric insulated coil leads	32
7. Diameters of mandrels for performance (bend) tests	35
8. Proof test voltages for performances tests	35
9. Spark test voltages	37

*As amended
March 1984*

BS 6195 : 1969

CO-OPERATING ORGANIZATIONS

The Electrical Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

- Associated Offices' Technical Committee
- *Association of Consulting Engineers
- Association of Mining Electrical and Mechanical Engineers
- *Association of Supervising Electrical Engineers
- *British Electrical and Allied Manufacturer's Association
- *British Railways Board
- British Radio Equipment Manufacturer's Association
- *Crown Agents for Oversea Governments and Administrations
- Department of Employment and Productivity
- *Electric Cable Makers' Confederation
- *Electrical Contractors' Association (Incorporated)
- *Electrical Contractors' Association of Scotland
- *Electrical Research Association
- *Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
- Electronic Engineering Association
- *Engineering Equipment Users' Association
- *Institution of Electrical Engineers
- Lighting Industry Federation Limited
- Ministry of Defence
- Ministry of Defence, Army Department
- *Ministry of Defence, Navy Department
- *Ministry of Power
- *Ministry of Public Building and Works
- *Ministry of Technology
- *Municipal Passenger Transport Association (Incorporated)
- National Inspection Council for Electrical Installation Contracting
- National Physical Laboratory (Ministry of Technology)
- Oil Companies Materials Association
- *Post Office
- Public Transport Association (Incorporated)
- South of Scotland Electricity Board

The Government departments and scientific and industrial organizations marked with an asterisk in the above list together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

- Aluminium Federation
- Association of Electrical Machinery Trades
- British Plastics Federation
- Covered Conductors Association
- Institute of Iron and Steel Wire Manufacturers
- London Transport Board
- National Coal Board
- Society of Motor Manufacturers and Traders Ltd.
- Telecommunication Engineering and Manufacturing Association
- Telephone Manufacturers Technical Development Committee

BRITISH STANDARD SPECIFICATION FOR

INSULATED FLEXIBLE CABLES AND CORDS FOR COIL LEADS

FOREWORD

This British Standard is a revision in metric units of BS 4195 : 1967 and applies to flexible cables and cords used for coil leads. A coil lead is an insulated flexible conductor connected directly and permanently to a coil winding or other component of electrical apparatus, and usually connected to some form of terminal. The coil lead usually has to withstand the same treatment as the parts to which it is connected, often including immersion in varnish or compound and exposure to high temperatures. Some degree of flexibility is necessary, but flexing in service is usually restricted to a short period of time or a small degree of movement.

Six types of coil lead are recognized, distinguished by the material used for the insulation. Each type is further subdivided into a number of voltage categories. Types 2, 5b and 6 have been omitted from this revision, in the interests of rationalization and economic production. Voltage category B has also been omitted, but the numbers and letters used for denoting the types and voltage categories in the 1967 edition have been retained. Plain copper conductors are now specified for Type 1 coil leads, instead of tinned conductors.

The designer of the electrical apparatus will decide upon the type of coil lead and the thickness of insulation appropriate to each application, taking into account such considerations as the type of apparatus, mechanical and electrical conditions, processing and operating temperatures and dimensional requirements.

NOTE. Attention is drawn to certification facilities offered by BSI; see the back cover of this standard.

SPECIFICATION

1. GENERAL

1.1 SCOPE

This British Standard specifies requirements, types of insulation, voltage categories and dimensions for a standard range of insulated flexible cables and flexible cords, of cross-sectional area 0.22 mm² and larger, which are intended to

BS 6195 : 1969

be connected directly and permanently to a coil winding or other component of electric apparatus.

For the purposes of this British Standard these are referred to as coil leads.

1.2 DEFINITIONS

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

Coil lead. An insulated flexible conductor intended to be connected directly and permanently to a coil winding or other component of electrical apparatus.

Room temperature. A temperature of $20 \pm 15^{\circ}\text{C}$.

NOTE. This is the temperature in Standard ambient 5 given in BS 2844 †.

1.3 TYPES OF COIL LEAD

The following types of coil lead are recognized:

Type	Insulation	Protective covering	Continuous operating temperature	
			Minimum	Maximum
1	Polyvinyl chloride (PVC)		$^{\circ}\text{C}$	$^{\circ}\text{C}$
	1a. General purpose insulation for 70°C insulation	None	- 20	+ 70
	1b. Heat resisting insulation for 85°C insulation	None	- 20	+ 85
3	Oil resisting and flame retardant rubber insulation	None	- 30	+ 90
4	Flame retardant composite rubber insulation	None	30	+ 90
5	150°C rubber-insulation	None	- 60	+ 150

* BS 4727, 'Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms'.

† BS 2844, 'Memorandum on conditioning of solid electrical insulating materials prior to and during testing'.

Type	Insulation	Protective covering	Continuous operating temperature	
			Minimum	Maximum
7	Varnished polyethylene terephthalate (PTP) fabric	PTP braid; synthetic varnish	°C — 50	°C + 110
8	Varnished glass fibre fabric treated with:			
	8a. Synthetic varnish	Glass fibre braid; synthetic varnish	— 50	+ 130
	8b. Silicone varnish	Glass fibre braid; silicone varnish	— 50	+ 180

1.4 OPERATING TEMPERATURES

The types of coil lead described in 1.3 are normally suitable for continuous operation when the temperature of the insulation is not greater than the appropriate maximum given in 1.3. These temperatures are not related to the 'hot spot' temperature of a machine or apparatus to which the leads are attached, or to the temperature involved during manufacturing process which may, for short periods, exceed the maximum specified in 1.3. In certain favourable conditions of service it may be possible to operate the coil leads at temperatures greater than the maxima indicated in 1.3, but attention should be paid to:

- (1) the possible effects of temperature on the softening of insulation and on its dielectric properties, and
- (2) the fact that some insulants can break down chemically after prolonged exposure to high temperatures. When this occurs, corrosive substances will be formed, which attack the cable conductor or even the metal of nearby enclosures, especially if moisture from condensation is present when the circuit cools after normal operation.

The minimum temperatures given in 1.3 are the values for insulated conductors which may be subject to slight flexing during their normal operating life.

BS 6195 : 1969

1.5 VOLTAGE CATEGORIES

The flexible cables and flexible cords have been divided into the following voltage categories which are defined by the appropriate maximum voltage between conductors or between conductor and earth, to which the cable or cord is liable to be subjected during a 1 minute test of the equipment to which it is connected.

Voltage category	Maximum equipment test voltage (a.c., r.m.s.)
	kV
A	2.5
C	4.0
D	9.5
E	17
F	27

The voltage categories for each type are as follows:

Type	Voltage category
1	A
3	A,C,D
4	A,C,D,E,F
5	A
7	C,D,E,F
8	A,C,D,E.

1.6 IDENTIFICATION OF MANUFACTURER

A means of identifying the manufacturer shall be provided, where practicable, throughout the length of the coil lead. Where coloured identification threads are used the colours shall be in accordance with the register* maintained by the British Standards Institution.

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

1.7 INFORMATION TO BE SUPPLIED WHEN ORDERING

When ordering coil leads the following information should be given:

	Example
(1) Conductor	0.5 mm ²
(2) Type	1a
(3) Voltage category	A
(4) Colour (if required)	Black
(5) The number of this British Standard	BS 6195
(6) Varnish resistance tests (if required)	(See Note 1)

The following is an example of a complete description:

0.5 mm² Type 1a/A. Black coil lead, BS 6195

NOTE 1. If the coil leads are required to undergo a varnish resistance test (as specified, for example, in 2.1.5.4) it is necessary for the purchaser to state this requirement and to reach agreement with the supplier on the varnish to be used, the baking temperature and the duration of the test.

NOTE 2. When a colour other than the preferred colour given in Section 2 is required, it should be specified when ordering.

2. REQUIREMENTS

2.1 TYPE 1, POLYVINYL CHLORIDE (PVC) INSULATED

2.1.1 Types of coil lead. This clause deals with the requirements for two types of coil lead, insulated with polyvinyl chloride (PVC), for voltage category A.

Type 1a. Suitable for operation at temperatures from -20°C to + 70°C (see 1.4).

Type 1b. Suitable for operation at temperatures from -20°C to + 85°C (see 1.4).

2.1.2 Conductor

2.1.2.1 Material. The conductor shall be made from plain annealed high conductivity copper wires and shall comply with the requirements of BS 6360*.

2.1.2.2 Sizes. The standard conductor sizes shall be those given in Table 1.

2.1.2.3 Form of conductor. The conductor shall be bunched.

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

BS 6195 : 1969

2.1.3 Insulation

2.1.3.1 Material. The material of the insulation shall be as follows:

Type 1a. Polyvinyl chloride compound complying with the requirements of BS 6746* for Type T 12.

Type 1b. Polyvinyl chloride compound complying with Type 4 of BS 6746*.

2.1.3.2 Colour. The preferred colour is black. When other colours are required they should be specified when ordering and it is recommended that they be chosen from the range of colours given in BS 6746C†

2.1.3.3 Application. The insulation shall be applied by extrusion and shall form a compact homogeneous body. The conductor shall be centred accurately in the insulation and it shall be possible to remove the insulation cleanly and without difficulty.

2.1.4 Dimensions and tolerances

2.1.4.1 Thickness of insulation. The average radial thickness of the insulation, when determined by the method described in Appendix A, shall be not less than the value given in Table 1.

The minimum radial thickness of the insulation, when determined by the method described in Appendix A, shall be not less than the value given in Table 1 by more than 5% + 0.1 mm.

2.1.4.2 Overall diameter. The overall diameter shall be not greater than the maximum overall diameter given in Table 1.

2.1.5 Performance tests. The coil leads shall be capable of complying with the requirements of 2.1.5.1, 2.1.5.2 and 2.1.5.3. When requested by the purchaser the leads shall also be capable of complying with the requirements of 2.1.5.4.

2.1.5.1 Bend test as received. A specimen as received by the purchaser, when prepared and tested by the method described in Appendix B shall, on visual examination, show no signs of cracks or other deterioration of the insulation and shall withstand for 1 minute the appropriate proof voltage given in Table 8.

2.1.5.2 Test for effect of heating. A specimen shall be prepared by the method described in Appendix B, heated for 48 hours at a temperature of 100°C for Type 1a and 140°C for Type 1b, allowed to cool to room temperature and bent as described in Appendix B. It shall, on visual examination, show no signs of cracks, adhesion of the insulation to the conductor or other deterioration of the insulation and shall withstand for 1 minute the appropriate proof voltage given in Table 8 when tested by the method described in Appendix B.

* BS 6746, 'PVC insulation and sheath of electric cables'.

† BS 6746C, 'Colour chart for PVC insulation and sheath of electric cables'.