

Cold pour resin compound and heat-shrink cable joints in the voltage range up to 1000 V a.c. and 1500 V d.c. —

Part 1: Specification for materials

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Committees responsible for this British Standard

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- Aluminium Federation
- Association of Consulting Engineers
- Association of Manufacturers of Domestic Electrical Appliances
- British Approvals Service for Electric Cables
- British Plastics Federation
- British Railways Board
- British Shipbuilders
- British Telecommunications plc
- Department of Energy (Electricity Division)
- Department of the Environment (Property Services Agency)
- Department of Trade and Industry (Consumer Safety Unit, C A Division)
- ERA Technology Ltd.
- Electric Cable Makers' Confederation
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Institution of Electrical Engineers
- London Regional Transport

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- Department of Transport (Highways)
- Electrical Contractors' Association
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Health and Safety Executive
- Institution of Mechanical Engineers
- Ministry of Defence

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Foreword

This Part of BS 6910 has been prepared under the direction of the General Electrotechnical Engineering Standards Committee. It is based on a joint proposal submitted by the Electricity Supply Industry in England and Wales and the Engineering Equipment and Materials Users' Association.

BS 6910-2, which is in preparation, will be a code of practice for making cable joints on site using these materials.

This Part of BS 6910 may be used for the purchase of both complete joint kits and separate items.

It has been assumed in the preparation of this Part of BS 6910 that the execution of its provisions will be entrusted to appropriately qualified and experienced people.

This Part of BS 6910 requires 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.

Purchasers ordering to this Part of BS 6910 are advised that BS 5750 is the specification that identifies the requirements of the quality management system applicable to the manufacturer. Reference to BS 5750-2 in the purchase order or contract and acknowledgement of this fact by the manufacturer will provide confidence that the quality management system operated by the supplier incorporates the controls necessary to ensure consistent quality of the product.

Appendix A gives information to be supplied by the purchaser.

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 6910 specifies requirements for materials supplied in kits for making cable joints in the voltage range up to 1 000 V a.c. and 1 500 V d.c., in which the cable insulation reinstatement is effected by cold pour resin compound and special-purpose insulating and sealing tapes and mastic, or heat-shrink components.

The joints covered include those suitable for cables having conductors of copper or aluminium with paper or polymeric insulation, which can have metallic protection against ingress of moisture in the form of extruded aluminium or lead sheaths, steel tape or wire, aluminium strip or wire armouring (including combined neutral and earth (CNE) cables). The oversheath of these cables will normally be a polymeric or bitumenized hessian covering. The joints are suitable for use when buried, provided that the conditions are within the operating limits of the cable.

In order to verify compliance it is necessary to assemble and test sample joints in accordance with this Part of BS 6910.

This Part of BS 6910 does not cover all the requirements for joints used on submarine cables or the requirements necessary for use in explosive or otherwise hazardous situations (e.g. where jointing of cables such as fire retardant cables is necessary or where seismic performance is required). Neither does it include material for joints normally requiring the use of hot pour insulating and sealing compounds, lead sleeves and cast iron or alternative outer boxes.

Unless otherwise stated by the manufacturer in the jointing instructions, the joints covered by this Part of BS 6910 are not intended to be made while the cables are energized.

NOTE 1 For details of jointing procedures and practices see BS 6910-2¹⁾.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 6910 the following definitions apply.

2.1

cold pour resin compound

a resin system capable of being poured at ambient temperature and that cures to a solid state by an irreversible chemical reaction without the application of external heat

2.2

gel time

the period required for a cold pour resin to reach a level of cure as determined in accordance with Appendix B

2.3

pot life

the period from commencement of adding the reactive agents of the cold pour resin compound during which it may be poured without affecting its performance

2.4

mains cable

a cable in which each phase conductor has a cross-sectional area greater than or equal to 70 mm² or its imperial equivalent

2.5

armour and/or metallic screen continuity and earthing connections

connections between the earth potential components of the cables in the joint

2.6

heat-shrinkable components

expanded polymeric extruded tubings or moulded parts that undergo thermally activated recovery when heated to an appropriate temperature

2.7

recovery (of heat-shrink material)

the thermally activated retraction of heat-shrink extruded tubing or moulded parts

NOTE Recovery may be complete and unimpeded (full recovery) or may take place on to a solid substrate such as a cable core.

2.8

service cable

a cable in which each phase conductor has a cross-sectional area less than or equal to 50 mm² or its imperial equivalent

2.9

CNE (combined neutral and earth) cable

a cable in which the neutral conductor is also the earth continuity conductor

2.10

SNE (separate neutral and earth) cable

a cable in which the neutral conductor is separate from and insulated from the earth continuity conductor

¹⁾ In preparation.

2.11
single-phase cable

a twin or concentric cable consisting of one phase conductor and one neutral conductor (e.g. CNE) or consisting of one phase, one neutral and one earth continuity conductor (e.g. SNE)

2.12
three-phase cable

a cable having three phase conductors with or without a neutral conductor, or a combined neutral and earth continuity conductor

2.13
mains straight joint

a connection between two mains cables

2.14
mains branch joint

a connection of a branch mains cable to a mains cable

2.15
mains service joint

a connection of one or more branch service cables to a mains cable

2.16
service cable joint

a connection between two or more service cables

2.17
transition joint

a connection between cables having different types of insulation

2.18
stop end

an accessory providing a means of insulating an energized buried cable end

2.19
compression connector

a device for making a connection between a conductor and a connector by pressure-forming or reshaping the connector barrel

2.20
mechanical connector

a device for making a connection between a conductor and a connector solely by means of a screw or bolt

2.21
backfill time

the time after which a joint may be subjected to the mechanical stresses of backfill/consolidation without deleterious effect

3 Classification of joints and cables**3.1 Joints**

For the purposes of this Part of BS 6910 the following joints are classified in accordance with the types of cables to be connected:

- a) mains cable joints: straight joints and branch joints on mains cables;
- b) mains service joints: service cables connected to mains cables;
- c) service cable joints: straight joints and branch joints on service cables;
- d) stop ends: mains or service cables.

NOTE 1 Unless otherwise stated, jointing kits supplied for each of the above types of joint are suitable for joining cables of the same type only.

NOTE 2 The designation "transition" when applied to the above types of joint indicates that they are suitable for joining cables of different types.

3.2 Cable types

For the purposes of this Part of BS 6910 the following cable types are classified:

- a) paper insulated, lead sheathed, single-core or multicore type, armoured or unarmoured cables to BS 6480;
- b) PVC insulated, single-core or multicore type, armoured or unarmoured cables to BS 6346;
- c) extruded cross-linked polyethylene (XLPE) or ethylene propylene rubber (EPR) insulated, CNE cables to ESI Standard 09-9²⁾;
- d) paper insulated, aluminium sheath/neutral conductor (Consac) cables to BS 5593 (use as mains cable only);
- e) thermosetting insulated, armoured cables to BS 5467 and BS 6724;
- f) cables generally to ESI Standard 09-7²⁾ having either PVC or XLPE insulation (use as service cable only).

NOTE The extent to which tests on one cable type can be extended to another cable type is given in 6.2.1.

²⁾ Available from the Engineering Document Unit, CEGB, 18 Warwick Lane, London EC4P 4EB.

4 Health and safety

The manufacturer shall make available to the purchaser such information concerning the cold pour resin compound as will enable the purchaser and his employees:

- a) to be aware of the recommended immediate action in the case of the compounds coming in contact with skin, eyes or clothing;
- b) to transport the compound outside the purchaser's premises in a manner complying with any regulations relevant to the mode of transport to be used.

The manufacturer shall ensure that all the packages in which the compounds are supplied and the information given on these packages comply with the Classification, Packaging and Labelling of Dangerous Substances Regulations 1984, where applicable.

The manufacturer shall also make available such information as will enable the purchaser to use the compound in a safe manner in accordance with the Health and Safety at Work etc. Act 1974 and to dispose of any unwanted compound and used containers in accordance with the Control of Pollution Act 1974.

5 Materials, design and manufacture

5.1 Conducting metal parts

5.1.1 Core conductor connections: soldered connectors. Soldered connectors shall only be used if the short circuit performance requirement limits the temperature to 160 °C maximum. Weak back ferrules to ESI Standard 12-15²⁾ shall be used for the connection of copper and aluminium conductors.

5.1.2 Armour and/or metallic screen continuity and earthing connections. The components of the armour continuity connections shall not cause damage to the cable components. In joints for metallic sheathed or wire-armoured cables all the metallic earth parts shall be bonded together.

5.1.3 Mechanical and electrical protection for heat-shrink joints. Joints of the heat-shrink type between armoured or metal-sheathed cables shall incorporate a metallic screen surrounding the insulated conductors for the full length of the joint. The metallic screen shall be bonded to the armour and/or metallic sheath of the cables.

NOTE The metallic screen may form all or part of the armour/ sheath continuity bond.

5.2 Resin system

5.2.1 Cold pour resin compound

5.2.1.1 General. Resin compounds shall comply with 6.1.2 and their packaging shall comply with 7.2.

NOTE The resin compound may be either a two-part or a three-part system, e.g. a filler medium may be integrated with the basic resin to form a two-part system.

5.2.1.2 Pouring and setting properties. When a joint is tested in accordance with Appendix C, the joint box shall be completely filled (less natural shrinkage) and no part of the resin compound shall be liquid.

5.2.2 Joint shells. Joint shells shall be made from insulating material and designed to withstand the weight and exotherm of the compound without undue distortion, such that when supported in accordance with the manufacturer's instructions the design clearances are maintained during setting. Joint shells shall be provided with filling apertures to allow easy filling with resin compound and shall be designed such that the filling operation does not entrap air within the joint.

Joint shells shall be made in two halves but if these halves are joined it shall be possible for one half to be offered to the joint to inspect the related joint dimensions and clearances. The shells shall be designed to permit a minimum of 10 mm thickness of cured compound over each joint component and cable component involved in the jointing procedure. The shell design shall allow the longitudinal seal on each cable sheath or oversheath to be a minimum of 40 mm in length. The radial thickness over the electrical conducting part at the cut-back shall be a minimum of 10 mm (see Figure 1).

5.3 Joint accessories

Accessories including core separators, insulation for conducting metal parts, tapes, primers and mastics shall be provided, if required, to ensure compliance with 6.2.

5.4 Heat-shrinkable component

5.4.1 General. Components shall be capable of being stored without deterioration within the temperature range of – 10 °C to 45 °C and shall have an unlimited shelf life.

Adhesives and sealants shall be used if necessary in conjunction with heat-shrinkable components to effect environmental seals within the completed joint. The seals shall be able to accommodate creep or relaxations that may occur with recovered heat-shrink materials.

The heat-shrinkable components used as insulation and joint covering shall comply with Table 1.

NOTE The tests are applicable to both extruded tubings and moulded parts.

Full recovery of the components shall be possible on heating to 150 °C.

Table 1 — Requirements for heat-shrinkable components

Property	Requirement	Subclause in Appendix D describing test method
Electric strength	8 MV/m minimum	D.1
Heat shock	No splitting, cracking, dripping or flowing	D.2
Low temperature flexibility	No cracking	D.3
Secant modulus	250 MPa maximum	D.4
Prior to thermal ageing		D.5
tensile strength	12 MPa minimum	D.6
ultimate elongation	200 % minimum	
After thermal ageing		D.7
tensile strength	10 MPa minimum	
ultimate elongation	100 % minimum	
Water absorption	0.5 % maximum, 24 h at 25 °C 1.0 % maximum, 24 h at 50 °C	

5.4.2 Insulation. The reinstated insulation of each core within the conductor connection area shall consist of a single length of heat-shrinkable tubing re-covered over the conductor connector with final overlap of 30 mm minimum on the core insulation. The minimum insulation thickness shall be as given in Table 2.

Table 2 — Minimum insulation thickness

Conductor cross-sectional area	Minimum insulation thickness
mm ²	mm
16 ≤ 50	1.5
> 50 ≤ 150	2.0
> 150 ≤ 300	2.5

6 Performance

6.1 Materials

6.1.1 Conducting metal parts

6.1.1.1 Core conductor connections

6.1.1.1.1 Compression connectors. Compression connectors shall comply with the British Standard appropriate to the conductors, as follows:

- a) for copper conductors, BS 4579-1;
- b) for aluminium conductors, BS 4579-3;
- c) for copper to aluminium conductors, BS 4579-3.

The tensile strength of connections in item c) and of connections between cables of dissimilar sizes in items a) and b) shall be the lower of the two appropriate tensile strength values.

6.1.1.1.2 Mechanical connectors. Mechanical connectors shall comply with the requirements appropriate to the conductors, as follows:

- a) for copper conductors, the requirements for compression type connectors specified in BS 4579-1;
- b) for aluminium conductors, BS 4579-3;
- c) for copper to aluminium conductors, BS 4579-3.

The tensile strength of connections in item c) and of connections between cables of dissimilar sizes in items a) and b) shall be the lower of the two appropriate tensile strength values.

6.1.1.2 Armour and/or metallic screen continuity and earthing connections

6.1.1.2.1 General. The connections shall be tested in accordance with Appendix E and shall comply with **6.1.1.2.2** to **6.1.1.2.5**.

6.1.1.2.2 Short circuit performance. The short circuit performance of the total connection A to A' (see Figure 2) shall be not less than the earth fault rating of the cable.

6.1.1.2.3 Initial resistance of a connection. The initial resistance A to B or A' to B (see Figure 2) of each specimen shall not differ by more than 50 % from the mean resistance of the six specimens when measured in accordance with **E.2.2**.

NOTE The initial resistance value of each specimen is measured to demonstrate that a number of connections can be seen to have a consistent performance.

6.1.1.2.4 Initial resistance of a total connection. The initial resistance of an armour and/or metallic screen continuity connection A to A' (see Figure 2) shall not exceed the resistance of an equivalent length of armour or metallic screen by more than 50 % when measured in accordance with **E.2.2**.

6.1.1.2.5 Values measured during electrical loading tests. The mean resistance value A to B or A' to B (see Figure 2) of the test specimen taken over the last 500 cycles [see **E.2.1 k**] shall not exceed the average equivalent armour resistance, taken over the same period, by more than 50 % when measured in accordance with **E.2.2**.

The mean resistance value A to B or A' to B (see Figure 2) of the test specimen taken over the last 500 cycles shall not exceed the initial resistance of the test specimen as measured immediately before the start of the electrical load cycling test by more than 50 %.

The graph of resistance A to B or A' to B against number of cycles shall demonstrate with a reasonable probability as shown in Appendix B of BS 4579-3:1976 that the change (rise or fall) of resistance over the last 500 cycles is not more than 20 % of the average resistance over the same period.

The temperature of the connection to the screen shall not exceed the temperature of the screen of the control cable by more than 5 °C at any time during the test.

6.1.2 Cold pour resin system

6.1.2.1 Thermal conductivity. The resin compound shall have a thermal conductivity of at least 0.20 W/(m K) as determined in accordance with BS 874.

6.1.2.2 Exotherm temperature. A 5 L sample of the resin compound shall have an exotherm temperature during curing of less than 80 °C when tested in accordance with Appendix F.

6.1.2.3 Dielectric strength. The resin compound shall have a dielectric strength of at least 5 MV/m in both cured and uncured states when tested in accordance with Appendix G.

6.1.2.4 Stability. The resin compound shall be capable of being mixed and of complying with this Part of BS 6910 one year after manufacture following storage in dry conditions at a temperature of 10 °C to 25 °C.

6.2 Joints

6.2.1 General. In order to comply with 6.2.2 to 6.2.6, sample joints shall be tested in accordance with Appendix H on the cable types classified in 3.2.

Compliance of mains branch joints with 6.2.2 to 6.2.6 shall give type approval for mains straight joints and stop ends that incorporate seals and that are of measurements and construction not inferior to those of the branch joint (see H.2.2).

Compliance of mains service joints incorporating single-phase cables with 6.2.2 to 6.2.6 shall give type approval for joints incorporating three-phase service cables (see H.2.3).

Compliance of service branch joints with 6.2.2 to 6.2.6 shall give type approval for service straight joints that incorporate seals and that are of measurements and construction not inferior to those of the branch joint (see H.2.5).

Compliance of joints incorporating cables with silane-cured XLPE insulation with 6.2.2 to 6.2.6 shall give type approval for joints incorporating cables with steam-cured XLPE insulation.

Compliance of joints incorporating cables with XLPE insulation with 6.2.2 to 6.2.6 shall give type approval for joints incorporating cables with PVC or EPR insulation.

Compliance of joints using any cable in 3.2 a), b) and e) with 6.2.2 to 6.2.6 shall give type approval for all cables in 3.2 a), b) and e).

NOTE Compliance of joints using any cable in 3.2 c), d) or f) with 6.2.2 to 6.2.6 applies only for that particular cable.

6.2.2 Impact. When tested in accordance with H.4.1, the insulation resistance of joint samples before the impact and after the voltage test shall be greater than 50 MΩ, and the cores shall withstand the specified test voltage after the impact.

6.2.3 Heat shock. When tested in accordance with H.4.2, the insulation resistance before the test and after the voltage test shall be greater than 50 MΩ, and the cores shall withstand the specified test voltage after the application of the heat shock.

6.2.4 Electrical heat cycling: part 1. When tested in accordance with H.4.3, the insulation resistance of joint samples before the test and after the voltage test shall be greater than 50 MΩ, and the cores shall withstand the specified test voltage after the cycling test.

6.2.5 Electrical heat cycling: part 2. When tested in accordance with H.4.4, the insulation resistance of joint samples before the test and after the voltage test shall be greater than 50 MΩ, and the cores shall withstand the specified test voltage after the cycling test.

6.2.6 Examination. When examined in accordance with H.4.5, the joint sample shall not show any of the following:

- a) cracking of filling media and/or heat-shrinkable components;
- b) moisture ingress along the moisture seals;
- c) active corrosion, which would in time lead to failure of the joint.