Contents

1. Rules for protection of cables against penetration

Cables embedded in a wall or partition can be vulnerable to penetration by nails, screws and the like, which can lead to the dangers of electric shock or fire. It is therefore important that cable runs are properly planned and that the cables are installed in such a manner as to afford compliance with the requirements of *BS 7671*.

Regulation 522-06-06 (as revised by *Amendment No 2 to BS 7671: 2001*) requires that where a cable is concealed in a wall or partition at a depth of less than 50 mm from any surface of the wall or partition, the cable must:

(i) incorporate an earthed metallic covering which complies with the requirements of the Regulations for a protective conductor of the circuit concerned, the cable complying with *BS 5467*, *BS 6346*, *BS 6724*, *BS 7846*, *BS EN 60702-1* or *BS 8436*, or

(ii) be of insulated concentric construction complying with *BS 4553-1*, *BS 4553-2* or *BS 4553-3*, or

(iii) be either:

  (a) enclosed in earthed conduit, trunking or ducting satisfying the requirements of the Regulations for a protective conductor, or

  (b) mechanically protected sufficient to prevent penetration of the cable by nails, screws and the like, or

(iv) be installed in a zone:

  (a) within 150 mm from the top of the wall or partition, or

  (b) within 150 mm of an angle formed by two adjoining walls or partitions, or

  (c) either horizontally or vertically, to the point, accessory or switchgear on the surface of the wall or partition, to which the cable is connected*. Where the location of the accessory, point or switchgear can be determined from the reverse side, a zone formed on one side of a wall or partition of 100 mm thickness or less extends to the reverse side.

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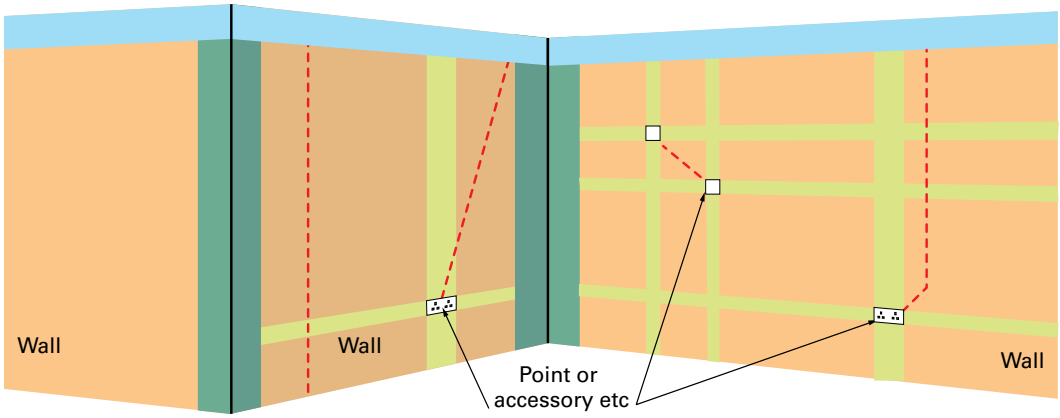
* The installation of a cable in such a zone, but passing through the box of an accessory rather than connecting to the accessory, is generally considered acceptable.

Conditions (i) to (iv) are illustrated in Fig 1 and explained in items 1.1 to 1.5. Condition (iv) is explained first, as this is probably the most commonly used method of protecting cables against penetration.

Conditions applying to cables embedded in a wall or partition at a depth of less than 50 mm from surfaces



Condition (iv)		Zone within 150 mm of the top of the wall - see condition (iv)(a).
		Zone within 150 mm of an angle formed by adjacent walls - see condition (iv)(b).
		In a zone either horizontally or vertically to a point, accessory or switchgear to which the cable is connected - see condition (iv)(c)
Condition (i) - (iii)		Example of route where protection is required for cable - see conditions (i) to (iii)

Fig 1

1.1 Condition (iv) – 'safe zones'

To meet condition (iv), cables concealed in a wall or partition at a depth of less than 50 mm from any of its surfaces must be installed in at least one of the permitted zones, namely:

- within 150 mm of the top of the wall or partition – condition (iv)(a),
- within 150 mm of an angle formed by adjoining walls or partitions – condition (iv)(b), or
- either horizontally or vertically, to the point, accessory or switchgear on the wall or partition – condition (iv)(c).

Generally, a zone created on one side of a wall or partition does **not** extend to the reverse side. There is only one exception.

The exception relates to condition (iv)(c), concerning a horizontal or vertical zone to an accessory, point or switchgear on a wall or partition. If the location of the accessory, point or switchgear can be determined from the reverse side, a zone formed on one side of a wall or partition of 100 mm thickness or less extends to the reverse side. An example of this situation is shown in Fig 2.

The open doorway in Fig 2 means that a person intending to drive a nail, screw or the like into the wall can reasonably determine the location of the accessory from the reverse side of the wall. A mirror image of the permitted cross-shaped zone created in the room with the accessory is therefore considered to exist in the other room. Thus, the concealed wiring connected to the accessory is permitted to be within 50 mm of surface of the reverse side of the wall (just as it is permitted to be within 50 mm of the surface with the accessory), provided it is within the mirror image zone.

An example of where the location of an accessory can be determined from the reverse side of a wall

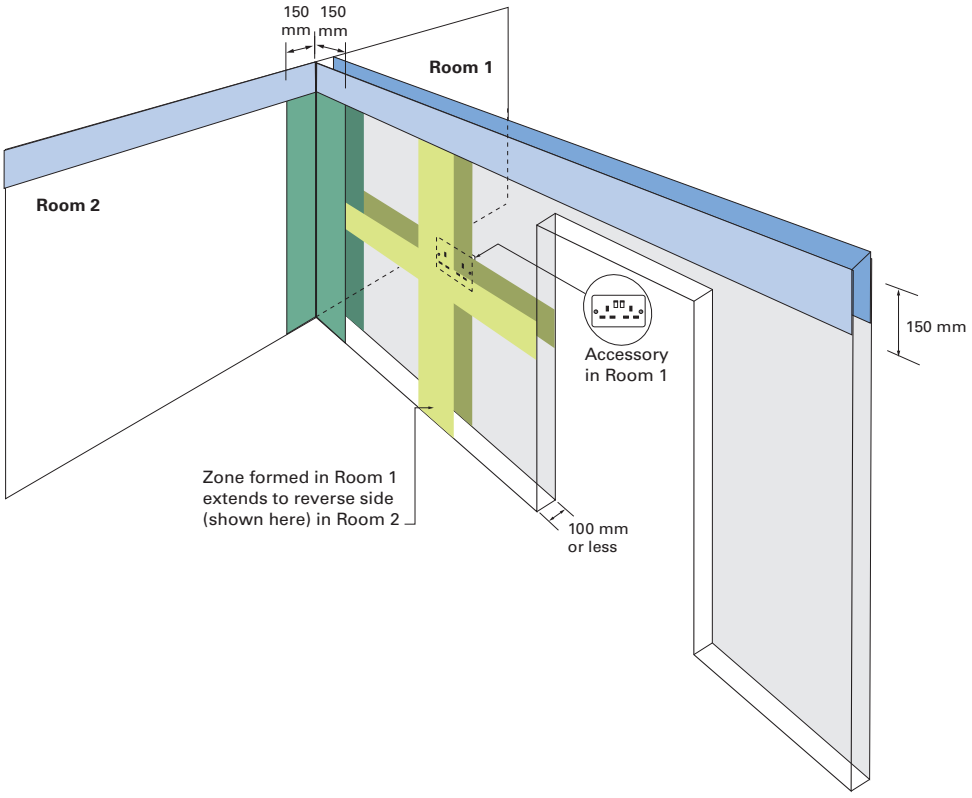


Fig 2

Apart from the exception relating to condition (iv)(c), in order to meet condition (iv), a cable that is concealed at a depth of less than 50 mm from either side of a wall or partition has to be in at least one of the permitted zones with respect to that side.

Where a cable concealed in a wall or partition at a depth of less than 50 mm does not meet condition (iv), it needs to incorporate, or be provided with, protection which meets at least one of conditions (i), (ii) or (iii).

1.2 Condition (i) – incorporate an earthed metallic covering

Condition (i) involves the use of a cable having an earthed metallic covering meeting the requirements of the Regulations for a protective conductor. Regulation 543-02-05 permits the metallic covering of a cable to be used as a protective conductor provided it is suitable for the purpose and satisfies the requirements of indents (i) and (ii) of Regulation 543-02-04, relating to electrical continuity and cross-sectional area respectively (see Topics ***C225-5*** and ***P157-7***).

The use of the metallic covering of a cable to satisfy condition (i) is intended to ensure that it will not be possible for a nail, screw or the like to make contact with a phase conductor of the cable without first coming into good electrical contact with the earthed metallic covering (by piercing). A direct path is thus provided for earth fault current to flow and cause automatic disconnection of the circuit concerned.

A metallic covered cable used to meet condition (i) has to be of one of the types recognized in Regulation 522-06-06 for that purpose; these are listed in Table 1.

Table 1 Type of metallic covered cables that may be used to meet condition (i)

British Standard	Description of cable
BS 5467	Armoured cables having thermosetting insulation
BS 6346	Armoured cables having pvc insulation
BS 6724	Armoured cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS 7846	Armoured fire-resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS EN 60702-1	Mineral insulated cables with a rated voltage not exceeding 750 V
BS 8436	300/500 V screened cables having low emission of smoke and corrosive gases when affected by fire, for use in thin partitions and building voids

Note: In order to be used to satisfy condition (i), the metallic covering of the cables listed in Table 1 has to be earthed. The metallic covering must also meet the requirements of Regulation 543-02-05 for a circuit protective conductor of the circuit concerned (that is, be suitable for that purpose and satisfy the requirements of indents (i) and (ii) of Regulation 543-02-04, relating to electrical continuity and cross-sectional area respectively).

1.3 Condition (ii) – Cables of insulated concentric construction

The use of an insulated concentric cable in accordance with condition (ii) effectively provides the same method of protection as a cable having an earthed metallic covering. In order for a nail or screw to make contact with the phase conductor, it would first have to penetrate the combined protective and neutral (PEN) conductor† (or, if the cable is of the split concentric type, either the neutral or protective conductor).

† It is not permitted to install a PEN conductor in a consumer's installation, due to the requirements of regulation 8.(4) of *The Electricity Safety, Quality and Continuity Regulation 2002*.

An insulated concentric cable used to meet condition (ii) has to be of one of the types recognized in Regulation 522-06-06 for that purpose; these are listed in Table 2.

Table 2 Type of insulated concentric cable that may be used to meet condition (ii)

British Standard	Description of cable
BS 4553-1	600/1000 V single-phase split concentric electric cables having pvc insulation
BS 4553-2	600/1000 V single-phase split concentric electric cables having thermosetting insulation
BS 4553-3	600/1000 V single-phase split concentric electric cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire

1.4 Condition (iii)(a) – enclosure in earthed conduit, trunking or ducting

In principle, an earthed steel conduit, trunking or ducting as described in condition (iii)(a) utilizes the same method of protection as a cable with an earthed metallic covering and, by construction, provides a higher degree of protection against mechanical damage.

1.5 Condition (iii)(b) – mechanical protection sufficient to prevent penetration

Condition (iii)(b) provides for a cable to have mechanical protection sufficient to prevent penetration of the cable by nails, screws and the like.

Regulation 522-06-06 does not require the mechanical protection to be earthed. However, it has to be recognized that, in some circumstances, mechanical protection may not be sufficient to ensure that a cable cannot be penetrated (for example where fixing methods of other trades include shot-fired nails). In such circumstances, this method of protection could not be considered to afford compliance with Regulation 522-06-06 and would therefore be unacceptable.

2. Cables enclosed in hollow metal sections of partitions

Where cables are enclosed in a hollow metal section of a partition, such as a box channel (for example, to connect to a switch or other accessory on the partition), the requirements referred to in item 1 of this topic still have to be met.

Therefore, unless the cables are of suitable metallic-covered or insulated concentric construction (conditions (i) or (ii)), or are enclosed in earthed metal conduit (condition (iii)(a)), or are installed within the 'safe zones' (condition (iv)), then the hollow metal section containing the cables must perform at least one of Functions 1 and 2, as follows:

Function 1 Provide protection equivalent to that afforded by earthed conduit, trunking or ducting meeting condition (iii)(a). In order to do this, the metal section must comply with Regulations 543-01-01 and 543-02-05 for cross-sectional area and continuity respectively (see Topics ***C225-5*** and ***P157-7***), and must be connected by a circuit protective conductor to the main earthing terminal of the installation.

Function 2 Provide mechanical protection sufficient to prevent penetration of a cable by nails, screws and the like (condition (iii)(b)).

Note: For reasons of protection against indirect contact, the requirements for Function 1 have to be met if the metal section contains either non-sheathed cables or cores of sheathed cables from which the sheath has been removed.

The compliance of the hollow metal section with the requirements for Functions 1 or 2, as applicable, must be checked at the design, construction and verification stages of the electrical installation. It is insufficient to rely on statements from the partitioning manufacturer or erector. Any work which may be necessary to ensure compliance, such as providing additional protective conductors to ensure continuity of a metal section suitable for Function 1 must be complete before the installation is put into service.

3. Protection against damage during construction works

The protection of cables fixed to walls that will subsequently be plastered, against damage during construction works (such as damage caused by a plasterer's trowel), is covered in Topic ***C5-45***.

4. Locations containing a bath or shower

In zones 0,1 or 2 of a location containing a bath or shower, surface wiring systems and concealed wiring systems which do not meet conditions (i), (ii) or (iii) are subject to certain limitations given in Regulation Group 601-07 of *BS 7671*, as explained in Topic ***S205-45***.

Topics referred to in this text:

C5-45	CABLES: In walls, wet plastered
C225-5	CROSS-SECTIONAL AREA (CSA): Of protective conductors
P157-7	PROTECTIVE CONDUCTORS: Types of conductor permitted for use as
S205-45	SPECIAL INSTALLATIONS OR LOCATIONS: Locations containing a bath or shower

Topics not referred to in this text, which are related and may be of interest:

C5-35	CABLES: In cavity walls
C5-37	CABLES: In thermal insulation
G21-1	GROUPING: Of cables
P177	PROXIMITY TO OTHER SERVICES

***BS 7671* (Requirements for electrical installations)**

Some of the most important requirements are found in:

Selection and erection in relation to external influences	Section 522
Protective conductors	Section 543