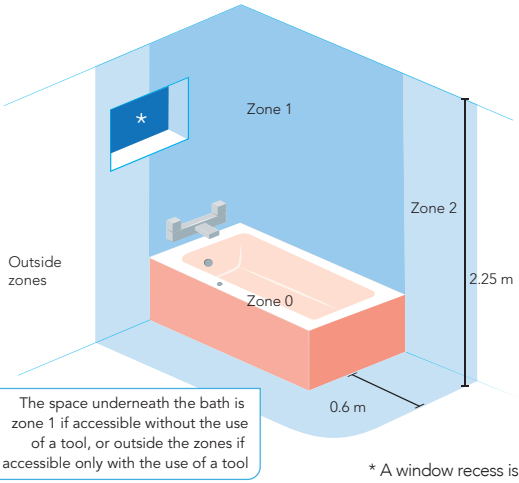
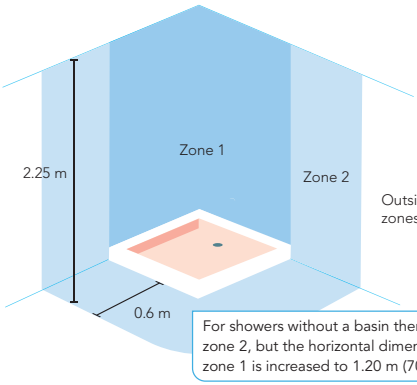
GUIDE TO SITING EQUIPMENT IN A LOCATION CONTAINING A BATH OR SHOWER

The general requirements in Parts 1 to 6 of the Regulations are applicable within the zones of a location containing a bath or shower but are supplemented by the additional requirements in Part 701 of *BS 7671*.



The space underneath the bath is zone 1 if accessible without the use of a tool, or outside the zones if accessible only with the use of a tool

* A window recess is zone 2



For showers without a basin there is no zone 2, but the horizontal dimension of zone 1 is increased to 1.20 m (701.32.3 (ii) (b))

Notes:

- All low voltage circuits either serving the location or passing through zones 1 and/or 2 but not serving the location must have additional protection provided by one or more RCDs that have a rated residual operating current ($I_{\Delta n}$) not exceeding 30 mA (701.411.3.3).
- Providing all final circuits of the location have additional protection, meet the requirements for automatic disconnection and the installation is fitted with effective protective equipotential bonding, then supplementary equipotential bonding may be omitted (701.415.2).

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Details of installed equipment	Zone			
	Outside zones	2	1	0
230 V wall mounted plate switch		✗	✗	✗
Luminaire			Note 3	✗
SELV or PELV safety source		✗	✗	✗
Shaver supply unit		Note 2	✗	✗
Ventilation equipment			Note 3	✗
Pull cord switch mechanism		✗	✗	✗
Insulated pull cord				✗
SELV switches/socket-outlets			Note 6	✗
Switches or controls in fixed current-using equipment suitable for use in the zone				✗
Whirlpool unit, electric shower, shower pump, towel rail or water heating appliance			Note 3	✗
Equipment, such as a fan or light, protected by SELV or PELV at a nominal voltage not exceeding 25 V AC rms or 60 V ripple-free DC			Note 3	✗
Equipment, such as a light, protected by SELV at a nominal voltage not exceeding 12 V AC rms or 30 V ripple-free DC				Note 4
230 V socket outlet	Note 1	✗	✗	✗

Note 1 Prohibited within a distance of 3 m horizontally from the boundary of zone 1 (701.512.3).

Note 2 A shaver supply unit must be to *BS EN 61558-2-5* (701.512.3). The requirement for a degree of protection of a minimum of IPX4 in zone 2 does not apply to shaver units situated where direct spray from showers is unlikely (701.512.2).

Note 3 Equipment must be fixed, permanently connected, and suitable for zone 1 according to the manufacturer's instructions (701.55).

Note 4 Equipment must be fixed, permanently connected, and suitable for zone 0 according to the manufacturer's instructions (701.55).

Note 5 The general requirements in Parts 1 to 6 of the Regulations are applicable outside of the zones including Regulation 512.2.1, which requires equipment to be of a design appropriate to the situation in which it is to be used or its mode of installation must take account of the conditions likely to be encountered.

Note 6 Only SELV switches permitted, which must be supplied at a nominal voltage not exceeding 12 V AC rms or 30 V ripple-free DC.

- Equipment installed in zones 1 and 2 must have protection of at least IPX4 (IPX5 if water jets are likely).
- Equipment installed in zone 0 must have protection of at least IPX7

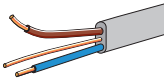
(701.512.2)

FIXED WIRING SINGLE-PHASE CABLE COLOUR CHANGES

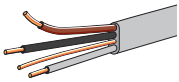
Old Was permitted until 31 March 2006	Harmonized Required from 1 April 2006
Red — Line	Brown — Line
Black — Neutral	Blue — Neutral
Red — Line	Brown — Line
Yellow — Line	Black — Line
Blue — Line	Grey — Line

Examples of core colour changes:

Twin-and-earth flat cable



Triple-and-earth flat cable*



The colour of the circuit protective conductor remains green-and-yellow.

*** Where triple-and-earth cable is used in a single-phase installation:**

- Any cores used as line conductors must be identified by the use of the colour brown (see Table 51 of *BS 7671*).
- Any cores used as neutral conductors must be identified by the use of the colour blue (514.4.1).
- The use of oversleeving or similar is permitted to apply identification of conductors (514.3.2).

Notes

(1) This Guide applies to single-phase cable harmonized colour changes. Reference should be made to Regulation Group 514 and Appendix 7 of *BS 7671: 2018*.

(2) Where cables are identified by colour use of the old colours of cables was required in installation work commencing on site before 31 March 2004, and was still permitted in installation work commencing on site up until 31 March 2006.

(3) Similarly use of the harmonized colours of cables was permitted for installation work commencing on site after 31 March 2004 and was required for installation work commencing on site after 31 March 2006.

(4) Except where there is no possibility of confusion, unambiguous marking needs to be provided at the interface between conductors (514.1.3).

(5) Except where identification is not required, cores of cables should be identified by colour (as shown) or lettering and/or numbering (514.3.1).

(6) If wiring alterations are made to an installation using cables with the harmonized colours but there is also old coloured wiring to previous versions of the regulations, a warning label must be affixed at or near the appropriate distribution board with the wording as shown above. (514.14.1)

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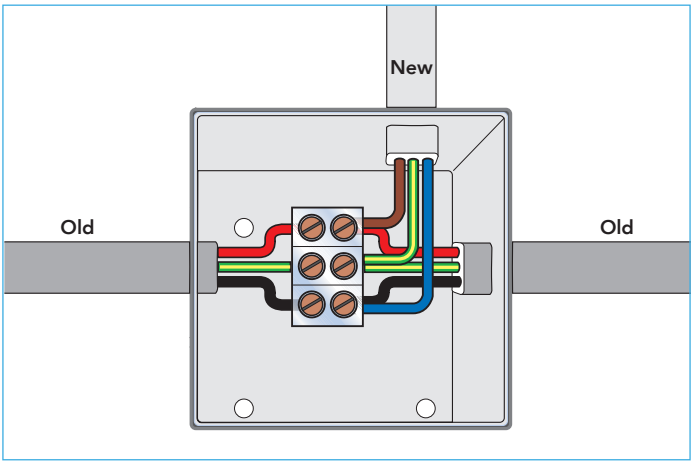
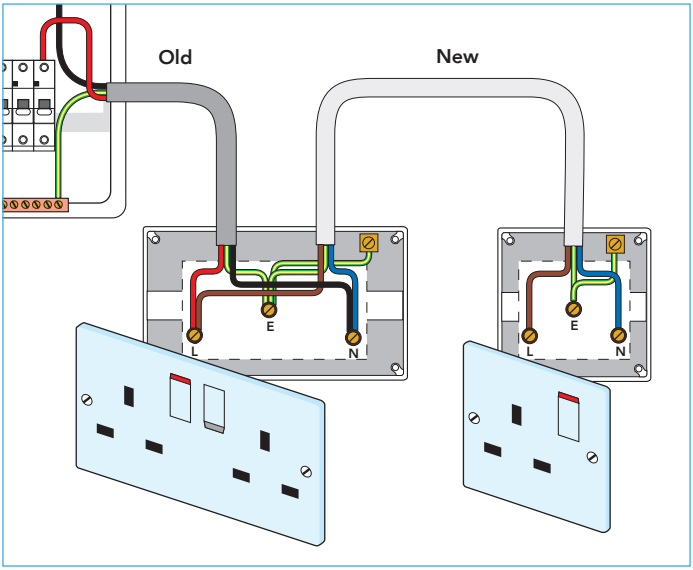
FIXED WIRING SINGLE-PHASE CABLE COLOUR CHANGES





A warning label is required

CAUTION

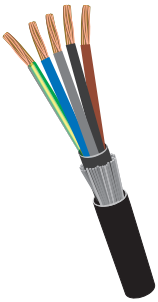
This installation has wiring colours to two versions of BS 7671.

Great care should be taken before undertaking extension, alteration or repair that all conductors are correctly identified.

FIXED WIRING THREE-PHASE CABLE COLOUR CHANGES

Old			Harmonized		
Was permitted until 31 March 2006			Required from 1 April 2006		
		Alphanumeric identification			
Red	Line 1	L1	Line 1	Brown	
Yellow	Line 2	L2	Line 2	Black	
Blue	Line 3	L3	Line 3	Grey	
Black	Neutral	N	Neutral	Blue	

An example of colour core changes in a five-core armoured cable:



The colour of the circuit protective conductor remains green-and-yellow.

Notes

(1) This Guide applies to three-phase cable harmonized colour changes. Reference should be made to Regulation Group 514 and Appendix 7 of *BS 7671: 2018*.

(2) Where cables were identified by colour, use of the old colours of cables was required in installation work commencing on site before 31 March 2004, and was still permitted in installation work commencing on site up until 31 March 2006.

(3) Similarly use of the harmonized colours of cables was permitted for installation work commencing on site after 31 March 2004 and was required for installation work commencing on site after 31 March 2006.

(4) Except where there is no possibility of confusion, unambiguous marking needs to be provided at the interface between conductors (514.1.3).

(5) Cores of cables should be identified by colour and/or lettering and/or numbering (as shown overleaf) (514.3.1).

(6) Another alternative arrangement of marking connections between existing and new cables is by using coloured sleeves.

(7) If wiring alterations are made to an installation using cables with the harmonized cable colours but there is also wiring to previous versions of the regulations, a warning label must be affixed at or near the appropriate distribution board with the wording as shown overleaf (514.14.1).

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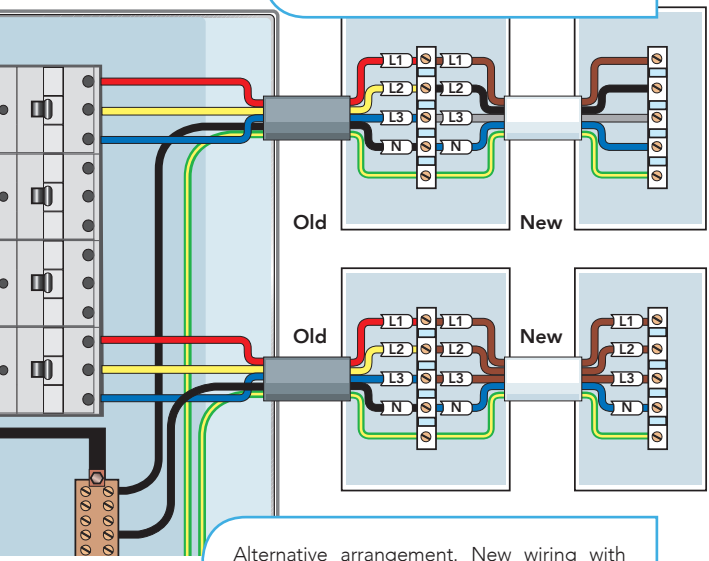
FIXED WIRING THREE-PHASE CABLE COLOUR CHANGES

Examples of an extension or alteration to an existing three-phase installation.

New wiring in harmonized colours (brown, black, grey line conductors, blue neutral and a green-and-yellow circuit protective conductor).



Alternative arrangement. New wiring with three brown line conductors, blue neutral and a green-and-yellow circuit protective conductor. Unambiguous identification is provided by lettering and numbering.

A warning label is required (514.14.1)

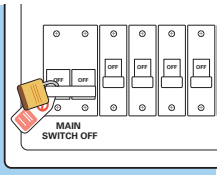
CAUTION

This installation has wiring colours to two versions of BS 7671.

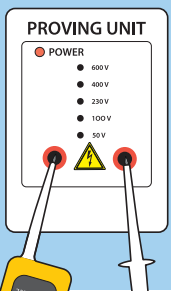
Great care should be taken before undertaking extension, alteration or repair that all conductors are correctly identified.

ISOLATION PROCEDURE

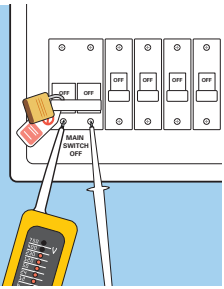
Step 1
Check it is safe and acceptable (with the occupier/ user) to isolate. If the isolator is an off-load device, remove the load. Open the means of isolation for the circuit(s) to be isolated and secure the isolating device in the open position with a lock or other suitable means.



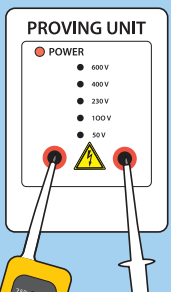
Step 2
Prove the correct operation of a suitable voltage detection instrument, see note (5), against a known voltage source, such as that illustrated.



Step 3
Using a voltage detection instrument, check that there is no dangerous voltage present on any circuit conductor to be worked on. It is important to confirm that conductors are not energised, for example, due to a wiring fault. Check terminal voltages between: (1) earth and line, (2) neutral and line (as shown) and (3) earth and neutral



Step 4
Prove the voltage detection instrument again against the known source to check that it was functioning correctly when the circuit(s) were tested for the presence of voltage.



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ISOLATION PROCEDURE - Notes

In practice the equipment being worked on is likely to be remote from the consumer unit, for example, a socket-outlet located remotely from the means of isolation. In this case it is necessary to check that all the socket-outlet contact terminals are dead.

When checking for a voltage between an earth terminal and live (including neutral) terminals, the test probe should make contact with the earth terminal first, to reduce the risk of the remaining probe becoming live.

(1) This Guide gives information on safe working procedures for the isolation of the supply of electrical energy to electrical equipment.

(2) The example illustrated shows the minimum steps required to isolate the final circuits supplied by a single-phase consumer unit. The consumer unit includes an isolator and circuit-breakers.

(3) When circuits are protected by fuses enclosed in a distribution board, remote isolation of the supply to the distribution board may be required.

(4) *HSG85 Electricity at work safe working practices* gives detailed guidance on devising safe working practices for people who carry out work on or near electrical equipment.

(5) Guidance on voltage detection instruments is given in *HSE Guidance Note GS 38 – Electrical test equipment for use on low-voltage electrical systems.*

(6) The *Electricity at Work Regulations 1989* require precautions to be taken against the risk of death or personal injury from electricity in work activities. Regulation 12 requires that, where necessary to prevent danger, a suitable means is available for cutting off the supply of electrical energy to any electrical equipment, and isolation of any electrical equipment.

(7) The Health and Safety Executive booklet *HSR25 Electricity at Work Regulations 1989 - Guidance on Regulations* is intended to help duty holders meet the requirements of the Regulations.

MOUNTING HEIGHTS OF ELECTRICAL EQUIPMENT IN DWELLINGS

Notes

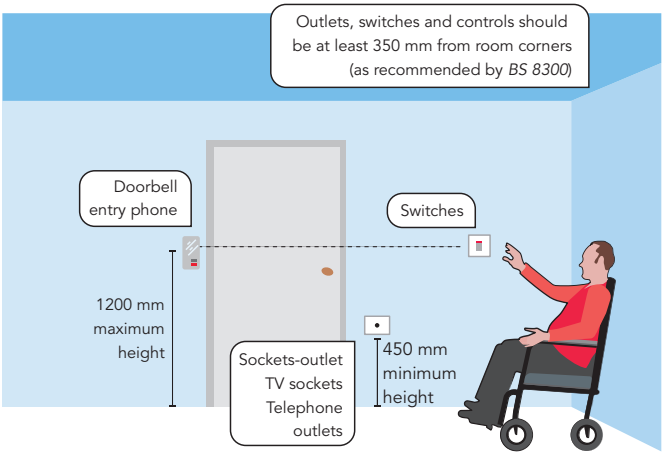
(1) This Guide explains the requirements of *BS 7671* and Part M of the Building Regulations for England and Wales* relating to the mounting heights of equipment in dwellings.

(2) Part M of the Building Regulations for both England and Wales require reasonable provision to be made for people to gain access to, use a building and its facilities. Guidance on meeting the requirements of Part M is given in Approved Document M*.

(3) Section 8 of Approved Document M, which applies to new dwellings, includes the objective of assisting people whose reach is limited to use the dwelling more easily by locating wall-mounted switches and socket-outlets at suitable heights.

(4) A way of satisfying the above objective, as suggested in Approved Document M, is to provide switches and socket-outlets for lighting and other equipment in habitable rooms at appropriate heights between 450 mm and 1200 mm from finished floor level (see diagram).

(5) Additionally, the mounting height of wall-mounted socket-outlets and other accessories is required to be sufficient to avoid them suffering wetting or impact, such as may result from floor cleaning (Regulation Groups 522.3 and 522.6 of *BS 7671*). **Continued overleaf >>**



Currently (2018) the requirements of the Building Regulations for electrical equipment mounting height for England and Wales correspond. However, due to devolvement of the government in Wales and the giving of powers to the Welsh Ministers the Building Regulations and therefore Approved Documents in Wales may be subject to future changes.

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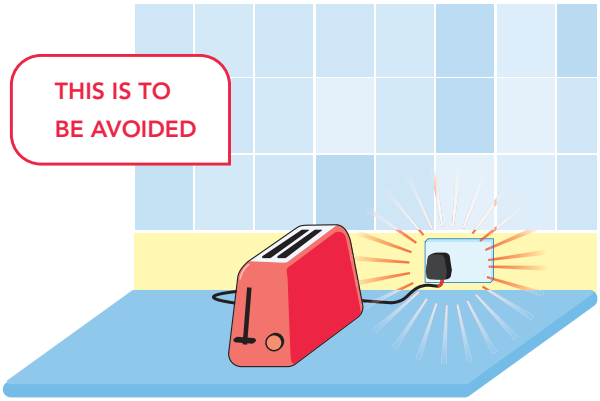
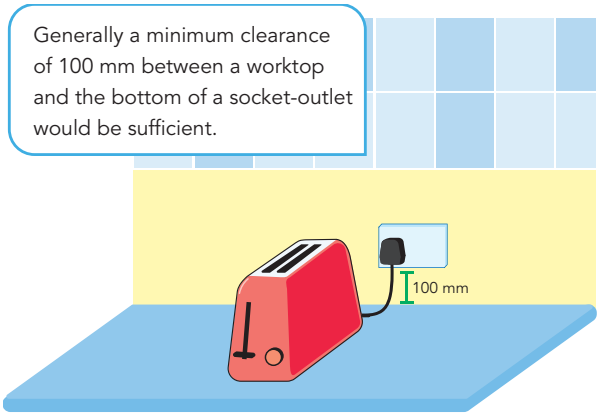
MOUNTING HEIGHTS OF ELECTRICAL EQUIPMENT IN DWELLINGS





>> Continued

(6) Regulation 553.1.6 requires that a wall-mounted socket-outlet is at a sufficient height above the floor or any working surface to minimise the risk of mechanical damage to the socket-outlet or to an associated plug and flexible cord during insertion, use or withdrawal of the plug.

See illustrations above regarding socket outlets above working surfaces. The minimum height above the floor to the bottom of a socket-outlet is 450 mm (see note 4 and diagram overleaf).

(7) If a dwelling is rewired there is no requirement to provide the measures described in note 4; however, it would be desirable to provide them.

PART P - NOTIFIABLE OR NOT, WALES

This Guide provides a quick reference to whether certain common items of electrical installation work in a dwelling or associated garden, conservatory or outbuilding in Wales need to be notified to a Building Control Body (BCB) in accordance with Part P of the Building Regulations 2010 for England and Wales (BR).

This Guide does not apply to excepted energy buildings[1] in Wales. For guidance on whether electrical installation work in England is notifiable, see NICEIC and ELECSA *Pocket Guide 31*.

A company registered with a Part P self-certification scheme, such as those operated by NICEIC and ELECSA, is not required to notify a BCB prior to carrying out 'notifiable work'. However, the company would need to notify the self-certification scheme operator on completion of the work.

The requirements of the BR and the issuing of appropriate electrical installation certification apply irrespective of whether an item of electrical work is notifiable or not.

EXAMPLES OF NOTIFIABLE WORK

Anywhere in a dwelling or its surroundings:

- a complete new installation or rewire
- changing a consumer unit
- installing
  - a new final circuit (e.g. for lighting, heating, socket-outlets, a shower or a cooker)
  - extra-low voltage[2] lighting (other than pre-assembled CE marked sets)
  - a solar photovoltaic power supply
  - electric ceiling or floor heating
  - a small scale electricity generator
  - power or control wiring for a new central heating system.

Within a kitchen[3] or special location[4]:

- modifying a final circuit (e.g. adding a lighting point, fused connection unit or socket-outlet).

Within a special location[4]:

- installing telephone or extra-low voltage[2] wiring and equipment for the purposes of communications, information technology, signalling, control or similar purposes
- installing a prefabricated equipment set (e.g. for lighting) and associated flexible leads with integral plug and socket connections[5].

Outdoors:

- installing garden lighting or power (for example a supply to a garden shed, detached garage, other outbuilding, electric gate or pond pump)
- installing a socket-outlet
- installing a lighting point or other fixed current-using equipment (for example an air conditioning unit or a radon fan)

PART P NOTIFIABLE OR NOT - WALES

EXAMPLES OF NON-NOTIFIABLE WORK

- installing prefabricated 'modular' wiring systems[5]
- replacing a damaged cable for a single circuit, on a like-for-like basis[7]
- replacing an accessory, such as a socket-outlet, control switch, ceiling rose or a fused connection unit
- providing mechanical protection to an existing fixed installation[8]
- installing or upgrading protective equipotential bonding
- Installing a new or replacement item of current-using equipment (such as a cooker) to an existing suitable circuit.
- modifying a final circuit, except in a kitchen[3] or special location[4].

Footnotes for both NOTIFIABLE WORK (see overleaf) and NON-NOTIFIABLE WORK (see above)

1. Broadly speaking, an excepted energy building is an energy infrastructure building (such as a generating station) not wholly used for residential purposes or as a shop, office, showroom or canteen. The legal definition is given in *The Welsh Ministers (Transfer of Functions) (No. 2) Order 2009*. *Pocket Guide 31* (for England) may be used for excepted energy buildings in Wales.

2. Extra-low voltage is defined in *BS 7671* as 'normally not exceeding 50 V AC or 120 V ripple-free DC, whether between conductors or to earth'.

3. A kitchen is defined in *The Building (Amendment) (No.3) Regulations 2004* as 'a room or part of a room which contains a sink and food preparation facilities'. (A utility room, though it may contain a sink, does not fall within the definition of a kitchen if it does not contain food preparation facilities.)

4. 'Special locations' include locations containing a bath, shower, swimming pool, paddling pool or a hot air sauna.

5. The installation of prefabricated 'modular' systems (for example kitchen lighting systems and armoured garden cabling) linked by plug and socket connectors is not notifiable, provided that the products are CE-marked and that any final connection in a kitchen or special location is made to a suitable existing connection unit or point.

6. Notification is not required if wiring to such outdoor equipment; (1) is not a new circuit, and (2) passes directly through an outside wall into the equipment, and (3) is not an extension to a special location or kitchen circuit.

7. A like-for-like basis includes the condition that the replacement cable has the same current-carrying capacity and follows the same route.

8. If the circuit protective measures and current-carrying capacity of conductors are unaffected by increased thermal insulation.

SUPPORTS FOR CABLES

Cross-section through a flat type cable, indicating the major axis

Note: Wiring used in the electrical installation of a caravan must be of a type listed in Regulation 721.521.2.

Fig 1. Non-armoured cable maximum support spacing

Cable overall diameter[a] (mm)	Maximum support spacing			
	Horizontal[b] (mm)		Vertical[c] (mm)	
	In general	Caravans	In general	Caravans
Up to 9	250	250 (all sizes)	400	400 (all sizes)
Exceeding 9 but not exceeding 15	300		400	
Exceeding 15 but not exceeding 20	350		450	
Exceeding 20 but not exceeding 40	400		550	

Fig 2. Armoured cable maximum support spacing

Cable overall diameter (mm)	Maximum support spacing	
	Horizontal[b] (mm)	Vertical[c] (mm)
Exceeding 9 but not exceeding 15	350	450
Exceeding 15 but not exceeding 20	400	550
Exceeding 20 but not exceeding 40	450	600

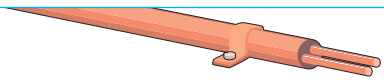


Fig 3. Mineral insulated copper sheathed (MICS) fixing

Cable overall diameter (mm)	Maximum support spacing	
	Horizontal[b] (mm)	Vertical[c] (mm)
Up to 9	60	800
Exceeding 9 but not exceeding 15	900	1200
Exceeding 15 but not exceeding 20	1500	2000
Exceeding 20 but not exceeding 40	2000	3000

SUPPORTS FOR CABLES

Footnotes for tables

a For flat type cables, the cable overall diameter (shown in Table 1) refers to the major axis (see illustration).

b Horizontal spacings are applicable to runs at an angle of more than 30° from the vertical.

c Vertical spacings are applicable to runs at an angle of 30° or less from the vertical.

Notes

(1) This Guide provides a quick reference to spacings of cable support clips in accessible positions.

(2) The basic requirements for the support of cables are given in Regulations 522.8.4 and 522.8.5 of *BS 7671*.

(3) *BS 7671* requires the intervals between cable supports (as well as the means of support) to be such that cables do not suffer mechanical damage or strain. Tables 1, 2 and 3 of this Guide give suggested maximum spacings between supports for both horizontal and vertical runs of accessible cable.

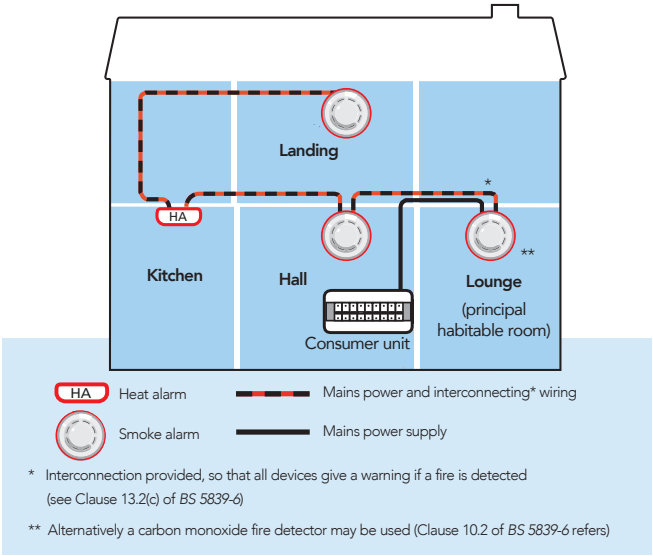
(4) The means of fixing a cable must not cause damage to the cable.

(5) As *BS 7671* is principally concerned with the safety aspects of support systems, supports additional to those indicated in the tables are often needed to make the finished installation visually acceptable. Additional supports may also be needed in an installation subjected to vibration of medium or high severity, or where there is an increased risk of mechanical damage, such as by accidental snagging of the cable.

(6) All cable supports are required to be of such construction that they will not prematurely collapse at times of fire. Non-metallic supports therefore should not be the sole means of cable support (521.10.202).

GRADES AND CATEGORIES FOR FIRE ALARM SYSTEMS in domestic premises and HMOs

This Guide addresses some of the recommendations for Grades and Categories of fire alarm system given in *BS 5839-6: 2019 – Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises.* The standard is applicable to new or materially altered premises and houses in multiple occupation (HMOs).



There are eight Grades of system, (B and E are not currently defined), which identify the equipment incorporated. Grades A and C incorporate fire detectors, sounders and central control equipment. Grades D1 and D2 incorporate smoke alarms and possibly heat alarms too, these all being mains-powered with an integral battery standby supply. D1 incorporates a tamper-proof battery and D2 a user-replaceable battery. Grades F1 and F2 describe a system of detectors powered by tamper-proof or user-replaceable batteries respectively.

There are two Categories of system: LD, for protection of life, and PD, for protection of property. The Categories are further subdivided numerically to identify the level or protection afforded. For example, Category LD1 is a life protection system installed throughout the premises, whereas LD2 is installed in all circulation spaces and specified rooms.

It should be noted that for domestic premises, fire detection and fire alarm systems are usually installed to protect life and rarely installed solely for property protection. The minimum standard for life protection against fire given in Table 1 of *BS 5839-6* for single-family dwellings and is a Grade D1/2, Category LD2 system. This system is for, example:

- dwellings of three-storeys or less with no floor greater than 200 m² in area, or
- single-storey where floor area may exceed 200 m², such as a bungalow.

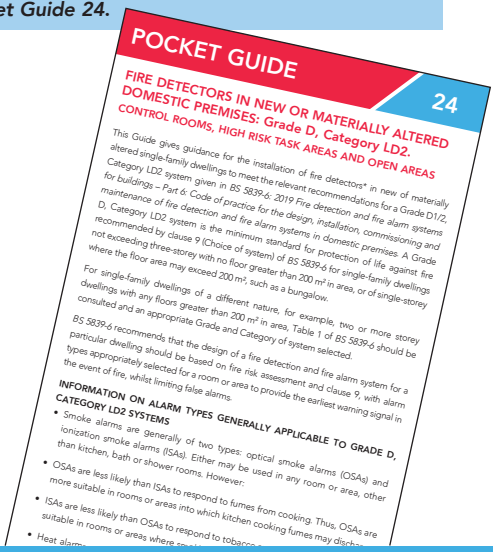
GRADES AND CATEGORIES FOR FIRE ALARM SYSTEMS in domestic premises and HMOs

An example of a Grade D1/2, Category LD2 system for a two-storey dwelling with no floor greater than 200 m² is depicted overleaf. A system of Grade and Category higher than Grade D, Category LD2 may be recommended where the dwelling or HMO has an increased fire risk due to, for example, the nature and use of the building and/or the characteristics of the building occupants.

Where this is the case, Clause 9 (choice of system) and Table 1 of *BS 5839-6* should be consulted and an appropriate Grade and Category selected. Although not comprehensive the following list provides examples of where a system of higher than Grade D, Category LD2 is recommended by Clause 9 and Table 1.

System Grade and Category	Recomended for:
Grade A LD2	A four (or more) storey house with no floor exceeding 200 m² in area.
Grade A LD2	Communal areas of HMOs.
Grade A LD2	A two-storey house where one or both floors exceed 200 m² in area.
Grade A LD1	Housing providing NHS supported living in the community.

Further information regarding Grade D Category LD2 systems in single-family dwellings is given in NICEIC and ELECSA *Pocket Guide 24.*


POCKET GUIDE

24

FIRE DETECTORS IN NEW OR MATERIALLY ALTERED DOMESTIC PREMISES: Grade D, Category LD2. CONTROL ROOMS, HIGH RISK TASK AREAS AND OPEN AREAS

This Guide gives guidance for the installation of fire detectors* in new of materially altered single-family dwellings to meet the relevant recommendations for a Grade D1/2, Category LD2 system given in *BS 5839-6: 2019 Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises.* A Grade D, Category LD2 system is the minimum standard for protection of life against fire recommended by clause 9 (Choice of system) of *BS 5839-6* for single-family dwellings not exceeding three-storey with no floor greater than 200 m² in area, or of single-storey where the floor area may exceed 200 m², such as a bungalow.

For single-family dwellings of a different nature, for example, two or more storey dwellings with any floors greater than 200 m² in area, Table 1 of *BS 5839-6* should be consulted and an appropriate Grade and Category of system selected.

BS 5839-6 recommends that the design of a fire detection and fire alarm system for a particular dwelling should be based on fire risk assessment and clause 9, with alarm types appropriately selected for a room or area to provide the earliest warning signal in the event of fire, whilst limiting false alarms.

INFORMATION ON ALARM TYPES GENERALLY APPLICABLE TO GRADE D, CATEGORY LD2 SYSTEMS

- Smoke alarms are generally of two types: optical smoke alarms (OSAs) and ionization smoke alarms (ISAs). Either may be used in any room or area, other than kitchen, bath or shower rooms. However:
- OSAs are less likely than ISAs to respond to fumes from cooking. Thus, OSAs are more suitable in rooms or areas into which kitchen cooking fumes may dischar
- ISAs are less likely than OSAs to respond to tobacco suitable in rooms or areas where
- Heat alarm

INITIAL VERIFICATION, ORDER OF TESTS

Notes

(1) This Guide gives information on the order of tests for the initial verification of an installation as required by Regulation 643.1 of *BS 7671*, which also requires that

a. the test results are compared with relevant criteria, and

b. any test that indicates a failure to comply with the criteria is repeated after the fault is rectified, together with any preceding test which may have been influenced by the fault.

(2) Tests must NOT be carried out until inspection has been completed (642.1).

(3) Precautions shall be taken to avoid danger to persons and to avoid damage to property and installed equipment during testing (641.4).

(4) Reference should be made to the NICEIC and ELECSA Pocket Guides: 5 *Isolation Procedure* and 12 *Test instrument leads* before carrying out any tests.

(5) Further information on testing is given in the NICEIC and ELECSA books *Inspection, Testing and Certification* and *Site Guide for Electrical Installations*.

(6) Table 1 lists the order of tests (where relevant)to be carried out before the supply is connected or with the supply isolated (Main switch OFF) as appropriate.

(7) Table 2 lists a recomended order of tests (where relevant) to be carried out AFTER the tests in Table 1 have been completed satisfactorily and the supply has been connected (Main Switch ON). **See tables overleaf >>**

INITIAL VERIFICATION, ORDER OF TESTS

Table 1. Order of tests to be carried out with the supply ISOLATED (AFTER the completion of inspection)

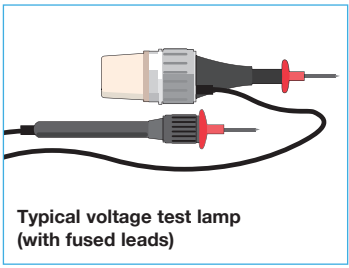
Order	Test	Regulation
1	Continuity of protective conductors including main protective bonding conductors or continuity of ring final circuit conductors	643.2.1
2	Insulation resistance	643.3
3	Protection by SELV, PELV or by electrical separation	643.4
4	Insulation resistance/impedance of floors and walls	643.5
5	Polarity (for example, at lighting switches)	643.6
6	Earth electrode resistance* (where the electrode is part of the installation)	643.7.2

* Alternatively for a TT system the installation earth electrode resistance may be measured with the incoming supply energised and the main switch OFF, using an earth fault loop impedance test instrument.

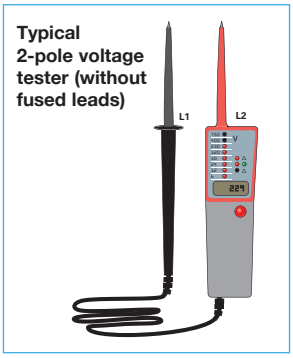
Table 2. Recommended order of tests to be carried out, where appropriate, with the supply CONNECTED and Main switch ON (AFTER satisfactory completion of the tests in Table 1)

7	Polarity (for example, at socket-outlets)	643.6
8	Protection by automatic disconnection of supply	643.7.1
9	Earth fault loop impedance	643.7.3
10	Prospective fault current	643.7.3.201
11	Additional protection provided by: • RCD, or • Supplementary protective equipotential bonding	643.8
12	Phase sequence maintained for polyphase circuits	643.9
13	Functional testing , including: • function of any integral test facility of installed RCDs and/or AFDDs • switchgear and controlgear assemblies, drives, controls and interlocks	643.10
14	Verification of voltage drop (Note: this is not normally required during initial verification)	643.11

TEST INSTRUMENT LEADS



Typical voltage test lamp (with fused leads)



Typical 2-pole voltage tester (without fused leads)

(1) This Guide includes recommendations on various British Standards Institution (BSI) guidance and Health and Safety Executive (HSE) guidance relating to test instrument leads. Such guidance should be followed to reduce the risk of electric shock or explosion and consequent serious injury or death when using electrical test equipment, and to meet the requirements of the *Electricity at Work Regulations 1989*.

(2) As well as injury or death caused directly by electric shock or explosion, injury can occur when a person reacts to an electric shock, for example by falling from height or touching another hazard.

(3) It is important that fused test instrument leads are used where there is a potential risk of a fault current passing through the test instrument leads that could cause damage to the instrument or the installation, and/or cause injury to the user of the instrument. Such a potential risk might be caused by a multimeter that has a voltage and current selector switch which is accidentally set to measure 'current', when in fact a 'voltage' from a high energy source (such as a 230 V circuit) is being measured (this type of instrument is not recommended for proving that a circuit is dead).

(4) Appendix 1 of the HSE publication *The Electricity at Work Regulations 1989. Guidance on Regulations* lists HSE Guidance Note GS38 – *Electrical test equipment for use on low voltage electrical systems* as a publication being particularly relevant to regulations 10 (Connections), 14 (Work on or near live conductors) and 16 (Persons to be competent to prevent danger and injury).

(5) HSE Guidance Note GS 38 is also referenced in HSE Guidance Note HSG 85 – *Electricity at work, safe working practices*. Paragraph 32 of HSG 85 advises using test equipment with insulated probes and, where appropriate, fused leads as suitable precautions to prevent injury. Furthermore, paragraph 54 of HSG 85 advises not to use multimeters, which can be set to the wrong function or non-contact devices, such as 'volt sticks' for proving dead.

(6) HSE Guidance Note GS38 covers, amongst other things:

- accident causes, such as inadequate insulation of test leads and probes
- design safety requirements for test probes, test leads, and test equipment sockets/terminals
- voltage detection instruments.

TEST INSTRUMENT LEADS

(7) Where there is no risk of test leads being accidentally short-circuited together AND the fault current in them is limited not to exceed their current-carrying capacity, for example by: (i) a voltage detector that conforms to *BS EN 61243-3: Live working – Voltage detectors – Two pole low-voltage type* or (ii) a test instrument that conforms to *BS EN 61010: Safety requirements for electrical equipment for measurement, control and laboratory use. Safety requirements for hand-held probe assemblies for electrical measurement and test* or *BS EN 61557: Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c.* fused leads may NOT be necessary. However, the design of the test probes and leads should meet the recommendations of GS 38 in other respects, such as having exposed metal tips not exceeding 4 mm in length (whilst *BS EN 61243-3* and *BS EN 61010-031* allow exposed tip lengths up to 19 mm).

(8) When using any test leads and instruments, the instructions of the manufacturer(s) should be followed and the test equipment should be inspected regularly to confirm its continued suitability for safe use.

(9) Contractors and their employees are reminded of their legal obligations relating to the safe use of test instruments, including those under the *Electricity at Work Regulations 1989* and the *Provision and Use of Work Equipment Regulations 1998*. In this context, contractors should carry out risk assessments to protect their employees, customers and bystanders from injury. Contractors should have appropriate test leads designed for use with each of their test instruments.

HSE GS38 examples of design safety requirements

Test leads should

- be adequately insulated
- except for voltage detectors, be coloured so that one lead can be easily distinguished from the other
- be flexible and of sufficient capacity and duty
- be sheathed to protect against mechanical damage
- be of adequate length for use
- not have accessible exposed conductors, other than the probe tips, or have live conductors accessible to a person's finger if a lead becomes detached from a probe, indicator or instrument when in use.

Test probes should

- have finger barriers or be shaped to guard against inadvertent hand contact with live conductors
- be insulated to leave an exposed metal tip not exceeding 4 mm measured across any surface of the tip. Where practicable it is strongly recommended that this is reduced to 2 mm or less, or that spring retractable screen probes are used
- When used with a multimeter, have suitable high breaking capacity (hbc) fuses with a low current rating (usually not exceeding 500 mA) and/or a current-limiting resistor
- have appropriate types of tip for allowing access to the contact where detection is being made.

SIZING MAIN PROTECTIVE BONDING CONDUCTORS

This Guide gives information on the sizing of main protective bonding conductors, based on the requirements given in Regulation Group 544.1 of *BS 7671*.

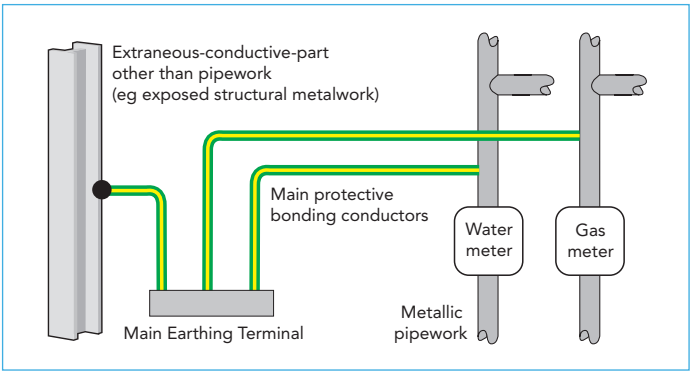
Protective equipotential bonding is a provision under the requirements for fault protection for protection against electric shock where the protective measure is Automatic Disconnection of Supply (ADS).

ARRANGEMENT OF PROTECTIVE EQUIPOTENTIAL BONDING

Where the protective measure is ADS, in each installation main protective bonding conductors complying with Chapter 54 of *BS7671* are required to connect to the main earthing terminal the extraneous-conductive-parts of that installation including:

- water installation pipes
- gas installation pipes
- other installation pipework and ducting
- central heating and air conditioning systems
- exposed metallic structural parts of the building.

Any bonding to a lightning protection system must be carried out in accordance with *BS EN 62305* (411.3.1.2).



WHERE PROTECTIVE MULTIPLE EARTHING (PME) CONDITIONS DO NOT APPLY

Where PME conditions do not apply, Regulation 544.1.1 requires a main protective bonding conductor to have a cross-sectional area (csa) of **not less than half the csa required for the earthing conductor** of the installation, and **not less than 6 mm^2.** The csa need not exceed 25 mm^2 if the bonding conductor is of copper, or a csa affording equivalent conductance in other metals.

SIZING MAIN PROTECTIVE BONDING CONDUCTORS

WHERE PME CONDITIONS APPLY

Where PME conditions apply, Regulation 544.1.1 requires the main protective bonding conductors to be selected in accordance with the size of the combined protective and neutral (PEN) conductor of the supply and Table 54.8 (data reproduced below for reference).

TABLE 54.8 OF *BS 7671*
Minimum csa of the main protective bonding conductor in relation to the PEN conductor of the supply

Copper equivalent csa of the PEN conductor	Minimum copper equivalent* csa of the main protective bonding conductor
35 mm^2 or less	10 mm^2
over 35 mm^2 up to 50 mm^2	16 mm^2
over 50 mm^2 up to 95 mm^2	25 mm^2
over 95 mm^2 up to 150 mm^2	35 mm^2
over 150 mm^2	50 mm^2

*The minimum copper equivalent csa is given by a copper bonding conductor of the tabulated csa or a bonding conductor of another metal affording equivalent conductance.

Notes

(1) Table 54.8 should be used as a guide only, and the specific minimum requirements of the electricity distributor should always be obtained with regard to the selection of main protective bonding conductors.

(2) The PEN referred to in Table 54.8 is the neutral conductor of the electricity distributor's low voltage network. It is not the neutral conductor on the consumer's side of the supply terminals, which may have a different csa.

The advice of the electricity distributor should always be obtained where it is proposed to use a main protective bonding conductor of a metal other than copper.

SIZING OF PROTECTIVE CONDUCTORS BY SELECTION

Regulation Group 543.1 of *BS 7671* requires that a protective conductor other than protective bonding conductor is sized either by calculation or selection.This guide covers the sizing of protective conductors by selection, using Table 54.7.

It should be noted that where the choice of the cross-sectional-area (csa) of the line conductors has been determined by considerations of short-circuit current, and if the earth fault current is expected to be less than the short-circuit current, the csa of the protective conductor must be calculated (543.1.1).

MINIMUM PROTECTIVE CONDUCTOR SIZES

Certain lower limits apply to the csa of a protective conductor. The size of the protective conductor used must be not less than the appropriate limiting value (see below) and not less than that determined by selection (see later).

Where a protective conductor is not an integral part of a cable (such as a 'twin & earth' cable or an armoured cable); or formed by conduit, ducting or trunking; or contained in an enclosure formed by a wiring system, the csa of the protective conductor must not be less than 2.5 mm^2 copper equivalent if protection against mechanical damage is provided (such as by a sheath), and not less than 4 mm^2 copper equivalent if protection against mechanical damage is not provided (543.1.1).

Where PME conditions apply, a protective conductor used as an earthing conductor must have a csa not less than that required by Regulation 544.1.1 (refer to NICEIC Pocket Guide 13).

A protective conductor buried in the ground must have a csa not less than that required by Table 54.1 of *BS 7671*.

SELECTING THE SIZE OF THE PROTECTIVE CONDUCTOR

The process of selection uses the csa (S) of the associated line conductor and Table 54.7 of *BS 7671* (Data reproduced below in part). Where the protective conductor is common to several circuits, its csa should be based on the csa of the largest line conductor of the circuits (543.1.2). Where selection produces a non-standard size, a conductor having at least the nearest larger standard csa should be used.

DATA FROM TABLE 54.7 OF *BS 7671*

CSA of line conductor *S* (mm^2)		$S \leq 16$	$16 < S \leq 35$	$S > 35$
Minimum csa of the corresponding protective conductor (mm^2)	A	S	16	$\frac{S}{2}$
	B	S	$\frac{k_1}{k_2} X\ 16$	$\frac{k_1}{k_2} X \frac{S}{2}$

The csa of the protective conductor must be not less than required by Row A or Row B of the above table, as applicable.

Row A should be used where the protective conductor is of the same material as the associated line conductor.

Row B should be used where the protective conductor is not of the same material as the associated line conductor.

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SIZING MAIN PROTECTIVE BONDING CONDUCTORS BY SELECTION

Where row B is used (overleaf), values of k_1 for the line conductor and k_2 for the protective conductor are required. The values of k_1 can normally be determined from Table 43.1 of *BS 7671*, and of k_2 from Tables 54.2 to 54.6, as applicable (data reproduced in part below).

DATA FROM TABLE 43.1 Values of *k* for common conductors

Conductor	Insulation material	*K*
Copper	70 °C thermoplastic	115/103*
	90 °C thermoplastic	100/86
	60 °C thermosetting	141
	90 °C thermosetting	143
Copper - Forming part of a mineral insulated cable	**Sheath material**	
	- thermoplastic sheath	115
	- bare (unsheathed)	135/115**

DATA FROM TABLES 54.2 TO 54.6

Material of conductor	Insulation of protective conductor or cable covering		
	70 °C thermoplastic	90 °C thermoplastic	90 °C thermosetting
54.2 Values of *k* for insulated protective conductor not incorporated in a cable and not bunched with cables, or for separate bare protective conductor in contact with cable covering but not bunched with cables.			
Copper	143/133*	143/133*	176
Aluminium	95/88*	95/88*	116
Steel	52	52	64
54.3 Values of *k* for protective conductor incorporated in a cable or bunched with cables, where the assumed initial temperature is 70 °C or greater.			
Copper	115/103*	100/86*	143
54.4 Values of *k* for protective conductor as a sheath or armour of a cable.			
Aluminium	93	85	85
Steel	51	46	46
Lead	26	23	23
54.5 Values of *k* for steel conduit, ducting and trunking as the protective conductor			
Steel conduit, ducting and trunking	47	44	58

* Indicates a conductor of greater than 300 mm^2
** value for bare exposed to touch

Note: The data from Table 54.6 is outside the scope of this Pocket Guide.

SIZING OF PROTECTIVE CONDUCTORS BY CALCULATION

Regulation Group 543.1 of *BS 7671* requires that a protective conductor other than an protective bonding conductor is sized either by calculation or selection. This Guide covers the sizing of protective conductors by calculation, which uses the adiabatic equation, as explained later. Information on sizing of protective conductors by selection is given in Pocket Guide 14.

A protective conductor must always be sized by calculation where the line conductor has been sized by considerations of short-circuit current and if the earth fault current is expected to be less than the short-circuit current (543.1.1).

MINIMUM PROTECTIVE CONDUCTOR SIZES

Certain lower limits apply to the cross-sectional-area (csa) of the protective conductor. The size of the protective conductor used must not be less than the limiting values given in Regulations 543.1.1 and, where applicable, 544.1.1 as discussed in Pocket Guide 14.

CALCULATING THE SIZE OF THE PROTECTIVE CONDUCTOR

The csa of the protective conductor, where calculated, is to be no less than the value (S) determined using the adiabatic equation (543.1.3).

Where:

$$S = \frac{\sqrt{I^2t}}{k}$$

S is the nominal csa of the protective conductor in mm^2.

I is the value in amperes (rms for AC) of the fault current for a fault of negligible impedance, which can flow through the associated protective device, due account being taken of the current limiting effect of the circuit impedances and the limiting capability (I^2t) of that protective device.

t is the operating time of the disconnecting device in seconds corresponding to the fault current (I) in amperes.

k is a factor taking account of the resistivity, temperature coefficient and heat capacity of the conductor material, and the appropriate initial and final temperatures of the conductors.

Where a non-standard size is calculated, a conductor having at least the nearest larger standard csa should be used.

Where the protective conductor is common to several circuits, the calculation process should be based on the most onerous values of fault current (I) and operating time (t) (or energy let-through (I^2t)) encountered in each of the circuits (543.1.2).

SIZING OF PROTECTIVE CONDUCTORS BY CALCULATION

DETERMINING THE VALUES OF FAULT CURRENT (*I*) AND TIME (*t*)

The value of fault current (*I*) used in the adiabatic equation is normally determined by calculation, from the following formula:

Where:

$$I = \frac{U_0}{Z_s}$$

I the fault current (*I*) at the furthest point in the circuit.

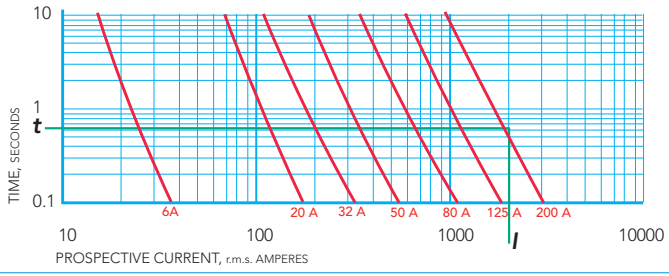
U_0 the nominal voltage.

Z_s the measured value of earth fault loop impedance corrected to allow for the circuit conductors being at their normal operating temperature.

The value of operating time (*t*) for the disconnecting device, for use in the adiabatic equation, can often be found from the time/current characteristic for the device. An example of determining *t* is given below.

FUSES TO *BS 88-2* FUSE SYSTEM E AND G

Example only, do not use for design



It can be seen from the time/current characteristic of the 200 A *BS 88* fuse (above) that, with a fault current (*I*) of 2000 A, the protective device has an operating time (*t*) of 0.55 seconds. However, where the value of *I* is so high that the corresponding value of *t* is not shown in the time/current characteristic for the disconnecting device, the value of energy let-through (I^2t) should be obtained from the device manufacturer and substituted into the adiabatic equation. The use of a value of I^2t obtained from the manufacturer may also be necessary in the following circumstances:

- for operating times (less than 0.1 s) where asymmetry of current is significant, such as for a protective device close to the output terminals of a generator or transformer
- where the protective device is a current limiting circuit-breaker or fuse that will 'cut off' or limit the current during prospective earth fault conditions.

VALUE OF *k* FOR USE IN THE ADIABATIC EQUATION

Values of *k* for protective conductors for use in the adiabatic equation, may be obtained from Tables 54.2, 54.3, 54.4, 54.5 and 54.6 of *BS 7671* extracts from which are reproduced in Pocket Guide 14, for the most common situations.

IP CODES

This Guide gives basic information about the IP (International Protection) code, based on information given in *BS EN 60529: 1992 + A2: 2013 – Degrees of protection provided by enclosures* (IP code), where you can find further details if necessary.

BS EN 60529 describes a system for classifying the degree of protection given by enclosures of electrical equipment. This is to protect:

a) persons against 'access to hazardous parts inside an enclosure', and

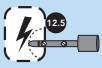
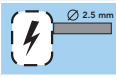
b) equipment inside an enclosure against the 'ingress of solid foreign objects or dust' and 'the harmful effects from ingress of water or moisture'.

Electrical equipment enclosures are specified in the form IPXX. As appropriate, the 'first' and/or 'second' X is replaced by a number as shown in Tables 1 and 2, respectively, of this guide.

As an example, for IP2X, the 2 (from Table 1) defines an enclosure giving protection against ingress of solid foreign objects with a diameter of 12.5 mm, and from a finger being inserted and accessing hazardous parts; the X means there is no protection against ingress of water specified.

A letter A, B, C or D, as shown in Table 3, is sometimes added after 1st and 2nd numbers. the designation IPXX followed by a letter, means that the first and second numbers are not specified, and the letter denotes the degree of protection provided against access to live parts.

FIRST NUMBER OF IP CODES (TABLE 1)

1st number	Protection of equipment inside the enclosure against ingress of solid objects or dust		Protection of persons against access to hazardous (live or moving) parts inside the enclosure
0	No protection		No protection
1	50 mm diameter solid foreign object		Back of hand
2	12.5 mm diameter solid foreign object		Finger Standard joint test (12 mm diameter, 80 mm length)
3	2.5 mm diameter solid foreign object		Tool
4	1.0 mm diameter solid foreign object		Wire
5	Dust protected		Wire
6	Dust-tight		Wire

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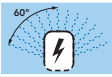
IP CODES

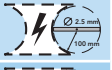
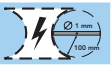
SECOND NUMBER OF IP CODE (TABLE 2)

2nd number	Protection of equipment inside the enclosure against ingress of water with harmful effects	
0	No protection	
1	Vertically falling water drops, such as from condensation from surfaces above the enclosure	
2	Vertically falling water drops when the enclosure is tilted at any angle up to 15° from the vertical	
3	Water sprayed at any angle up to 60° on either side of the vertical	
4	Water splashed against the enclosure from any direction	
5	Water jets projected against the enclosure from any direction, such as from hosepipes	
6	Powerful water jets projected against the enclosure from any direction, such as from power jet sprays, or sea waves	
7	'Temporary' immersion of enclosure in water under specified conditions	
8	'Continuous' immersion of enclosure under specified conditions	
9	Water at high pressure and temperature against the enclosure from any direction, such as from steam cleaning	

Equipment enclosures of an installation need to be correctly selected, installed and maintained to meet the requirements of *BS 7671*, and the manufacturer. For example, an enclosure needs to have an appropriate IP code, and impact resistance against any likely mechanical damage. Cable glands fitted to an enclosure also need to have an IP code at least equal to that of the enclosure.

Covers of an enclosure need to be securely fixed, and access doors left tightly shut.

ADDITIONAL LETTER OF IP CODE (TABLE 3)

Letter	Protection of persons against access to hazardous (live or moving) parts inside the enclosure	
A	Back of hand (50 mm diameter)	
B	Standard jointed test finger (12 mm diameter, 80 mm length)	
C	Tool 2.5 mm diameter,100 mm length	
D	Wire 1.0 mm diameter, 100 mm length	

CONDITION REPORT CLASSIFICATION CODES

This Guide provides information on the application of Classification codes on a Condition Report.

This Guide is limited to the range of observations associated with domestic and similar electrical installations, and takes into account the requirements of *BS 7671: 2018*.

Each observed and verified instance of damage, deterioration, defect or non-compliance with requirements of *BS 7671* must be given an appropriate Classification code *C1*, *C2*, or *C3*. This is for the benefit of the person ordering the report, and of persons subsequently involved in additional or remedial work, or further inspections. Each Classification code has a particular meaning as shown in Table 1.

Usually, it should be possible to attribute a Classification Code to an observation without the need for further investigation.

However, a Classification code *FI* should be recorded in respect of any observation that could reasonably be expected to reveal danger or potential danger but this could not be confirmed fully due to, for example, operational limitations or time constraints.

Observations that are not non-compliances with the requirements of *BS 7671*, such as where *BS 3871* circuit-breakers are in-service, should not be recorded on the Condition Report.

Although other observations, such as those associated with fire detection and alarm systems to *BS 5839* may be recorded on the report, they should not be assigned a Classification code.

TABLE 1. DESCRIPTION AND MEANING OF STANDARD CLASSIFICATION CODES

Code	Description	Meaning
C1	Danger present	The safety of those using the installation is at risk and immediate remedial action is required.
C2	Potentially dangerous	Those using the installation may not be at immediate risk, however urgent remedial action is required to remove potential danger.
C3	Improvement recommended	The investigation has revealed a non-compliance with the current safety standard which, whilst not presenting immediate or potential danger, would result in significant safety improvement if remedied.

Where a real and immediate danger is observed that puts the safety of those using the installation at risk, a Classification code *C1* must be recorded, and that danger should be removed without delay.

CONDITION REPORT CLASSIFICATION CODES

Where a verified observation could be given more than one Classification code, only the most serious risk should be recorded (code ***C1*** being the most serious risk).

Where a Condition Report contains an observation with a recorded Classification code *C1*, code *C2* or code *FI*, it would not be reasonable for the installation to be assessed as 'satisfactory' for continued use.

Examples of applying verified standard codes are shown in Table 2. However, it is the responsibility of the skilled person(s) (electrically)* carrying out the inspection and testing to ensure that a Classification code appropriate for the particular observation is recorded on the Condition Report, and the person(s) signing the report is fully responsible for ensuring its content and accuracy before it is issued to the client.

TABLE 2. EXAMPLES OF STANDARD CLASSIFICATION CODES APPLIED TO OBSERVATIONS

Code	Observation
C1	a) Exposed live parts that are accessible to touch, such as where accessible live conductors have no (or damaged) insulation. b) Incorrect polarity. c) Conductive parts that have become live as the result of a fault.
C2	a) A 30/32 A ring final circuit is discontinuous or cross-connected with another circuit. b) Separate protective devices in line and neutral conductors (for example, double-pole fusing). c) A metallic pipe for gases or flammable liquids, or the metallic pipe of a water utility supply, being used as the means of earthing.
C3	a) Absence of 'Safety Electrical Connection – Do Not Remove' notice. b) Absence of a notice indicating that the installation has wiring colours to two versions of *BS 7671*. c) Absence of RCD periodic test notice.

It should be noted that the examples listed in Table 2 are not exhaustive. Further examples of Classification codes are given in Appendix G of the NICEIC and ELECSA publication *Inspection, Testing and Certification*. Further guidance on Classification codes can be found in Electrical Safety First's *Best Practice Guide 4 – Electrical installation condition reporting: Classification codes for domestic and similar electrical installations*, which is available as a free download from

www.electricalsafetyfirst.org.uk

* *BS 7671* defines a skilled person (electrically) as 'Person who possesses, as appropriate to the nature of the electrical work to be undertaken, adequate education, training and practical skills, and who is able to perceive risks and avoid hazards which electricity can create'.

MAXIMUM MEASURED VALUES OF EARTH FAULT LOOP IMPEDANCE (Z_s)

The values of maximum earth fault loop impedance (Z_s) given in Tables 41.2, 41.3 and 41.4 in Chapter 41 of *BS 7671*, for commonly-used overcurrent protective devices should not be exceeded when the conductors are at their normal operating temperature (such as up to 70 °C for thermoplastic insulated conductors).

However, values of Z_s are generally obtained under no-load conditions, when the conductors are at ambient temperature (usually not to exceed 20 °C) and their resistance is therefore lower than when at normal operating temperature.

Where this is the case, then as indicated in Appendix 3 of *BS 7671*, the fault protection requirements of Regulations 411.4.4 (TN system) or 411.5.4 (TT system) are considered to be met when the measured value of Z_s does not exceed 80% of the applicable maximum value (such as that given in Tables 41.2, 41.3 and 41.4 of *BS 7671).*

Tables 1 and 2 of this Pocket Guide give maximum measured values of Z_s for fuses and circuit-breakers or the overcurrent characteristic of RCBOs, equal to 80% (rounded down) of the applicable maximum values given in Tables 41.2, 41.3 and 41.4 of *BS 7671*.

TABLE 1. MAXIMUM MEASURED VALUES OF Z_s FOR FUSES

Rated Current (A)	Fuses									
	BS 88 (gG) Parts 2 and 6		*BS 1361* or *BS 1362*		*BS 3036*		*BS 88-2* Fuse systems E and G*		*BS 88-3* Fuse system C	
	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s
2	N/A	N/A	N/A	N/A	N/A	N/A	26.48	34.96	N/A	N/A
3	N/A	N/A	12.46	17.63	N/A	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A	N/A	N/A	12.48	16.64	N/A	N/A
5	N/A	N/A	7.94	12.48	7.28	13.44	N/A	N/A	7.94	11.64
6	6.47	10.28	N/A	N/A	N/A	N/A	6.24	9.70	N/A	N/A
10	3.88	5.63	N/A	N/A	N/A	N/A	3.71	5.45	3.71	5.45
13	N/A	N/A	1.83	2.90	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	2.49	3.80	1.93	4.06	N/A	N/A	N/A	N/A
16	2.05	3.17	N/A	N/A	N/A	N/A	1.93	3.17	1.84	3.12
20	1.34	2.20	1.28	2.12	1.34	2.91	1.34	2.24	1.54	2.56
25	1.08	1.74	N/A	N/A	N/A	N/A	1.02	1.74	N/A	N/A
30	N/A	N/A	0.87	0.39	0.83	2.00	N/A	N/A	N/A	N/A
32	0.79	1.36	N/A	N/A	N/A	N/A	0.79	0.36	0.72	1.24
40	0.62	1.02	N/A	N/A	N/A	N/A	0.6	1.02	N/A	N/A
45	N/A	N/A	0.43	0.72	0.44	1.20	N/A	N/A	0.45	0.79
50	0.45	0.79	N/A	N/A	N/A	N/A	0.45	0.79	N/A	N/A
60	N/A	N/A	0.28	0.52	0.32	0.84	N/A	N/A	N/A	N/A
63	0.34	0.62	N/A	N/A	N/A	N/A	0.35	0.62	0.28	0.54
80	0.23	0.43	0.21	0.37	N/A	N/A	N/A	0.43	N/A	0.40
100	0.17	0.31	0.14	0.27	0.14	0.40	N/A	0.33	N/A	0.29
125	0.12	0.24	N/A	N/A	N/A	N/A	N/A	0.25	N/A	N/A
160	0.09	0.19	N/A	N/A	N/A	N/A	N/A	0.20	N/A	N/A
200	0.07	0.14	N/A	N/A	N/A	N/A	N/A	0.14	N/A	N/A

Note: Values of Z_s for disconnection times other than 0.4 s or 5 s shown may be required by *BS 7671*. For example, 0.2 s may be required for a 230 V final circuit not exceeding 63 A supplying one or more socket-outlets in a TT system (Table 41.1 refers).

MAXIMUM MEASURED VALUES OF EARTH FAULT LOOP IMPEDANCE (Z_s)

TABLE 2. MAXIMUM MEASURED VALUES OF Z_s FOR CIRCUIT-BREAKERS OR THE OVERCURRENT CHARACTERISTIC OF RCBOs

Rated Current (A)	Circuit-breakers to *BS 3871* or *BS EN 60898* or RCBOs to *BS EN 61009*					
	Type 1	Type 2	Type B	Type 3 and C	Type D	
	0.4 s to 5 s				0.4 s	5 s
2	N/A	N/A	N/A	N/A	N/A	N/A
3	N/A	N/A	11.64	N/A	N/A	N/A
5	8.73	4.99	N/A	3.49	1.74	3.49
6	7.28	4.16	5.82	2.91	1.45	2.91
10	4.36	2.49	3.49	1.74	0.87	1.74
15	2.91	1.66	N/A	1.16	0.57	1.16
16	2.72	1.56	2.18	1.08	0.54	1.08
20	2.18	1.24	1.74	0.87	0.43	0.87
25	1.74	0.99	1.39	0.69	0.34	0.69
30	1.45	0.83	N/A	0.57	0.28	0.57
32	0.36	0.77	1.08	0.54	0.27	0.54
40	1.08	0.62	0.87	0.43	0.21	0.43
45	0.96	0.55	0.77	0.38	0.19	0.38
50	0.87	0.49	0.69	0.34	0.16	0.34
63	0.68	0.39	0.55	0.27	0.13	0.27
80	0.54	0.31	0.43	0.21	0.10	0.21
100	0.43	0.24	0.34	0.16	0.08	0.16
125	N/A	N/A	0.27	0.13	0.06	0.13

N/A (Not Applicable) – indicates that the device is not available or not appropriate.

The values of Z_s in Tables 1 and 2 are based on the 'worst case limits' of *BS 7671* Some manufacturers' protective devices operate at higher values of Z_s than the values shown.

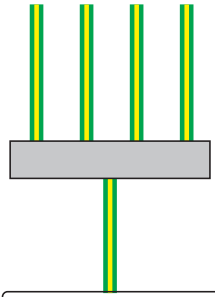
Where a measured value of Z_s exceeds the value given in Table 1 or 2, as applicable, a more precise assessment of compliance with Regulation 411.4.5 or 411.5.4 may be made by evaluating the value of Z_s by calculation.

Guidance on measuring and reporting measured values of Z_s is given in NICEIC and ELECSA books, *Domestic Periodic Inspection, Testing and Reporting* and *Inspection, Testing and Certification*.

SIZING EARTHING CONDUCTORS

This Guide gives information on determining the cross-sectional area (csa) for an earthing conductor as required by *BS 7671*.

THE EARTHING CONDUCTOR OF AN INSTALLATION IN RELATION TO THE MET AND THE MEANS OF EARTHING



Circuit protective conductors and main protective bonding conductors

Main Earthing Terminal

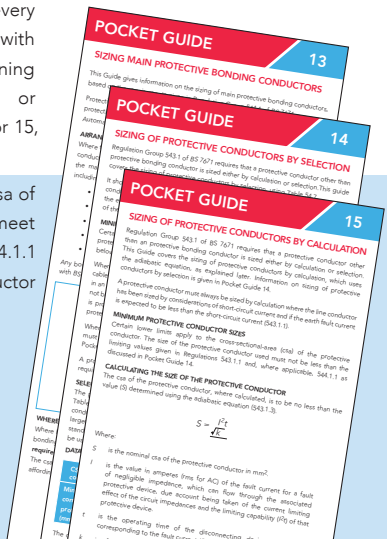
Earthing conductor

Distributor's earthing facility (TN system) or installation earth electrode (TT or IT system)

Means of earthing

Regulation 542.3.1 requires that every earthing conductor must comply with Section 543, which includes determining the csa required by selection or calculation (see Pocket Guides 14 or 15, respectively).

Where PME conditions apply, the csa of an earthing conductor must also meet the requirements of Regulation 544.1.1 of a main protective bonding conductor (see Pocket Guide 13).



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SIZING EARTHING CONDUCTORS

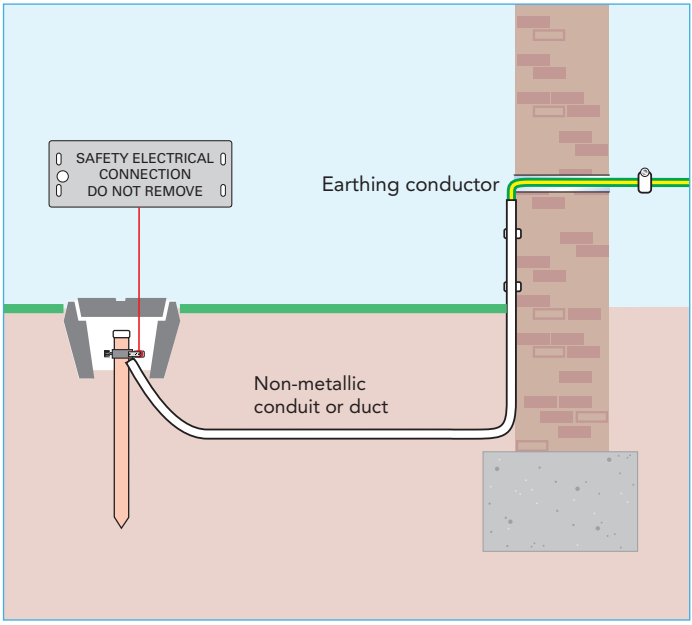
Additionally, an earthing conductor buried in the ground must have a csa not less than that given in Table 54.1 of *BS 7671* (reproduced below for ease of reference).

MINIMUM CROSS-SECTIONAL AREA OF A BURIED EARTHING CONDUCTOR

	Protected against mechanical damage	Not protected against mechanical damage
Protection against corrosion by sheath	2.5 mm^2 copper 10 mm^2 steel	16 mm^2 copper 16 mm^2 coated steel
Not protected against corrosion	25 mm^2 copper 50 mm^2 steel	

The thickness of a tape or strip conductor must be suitable to withstand mechanical damage and corrosion. *BS 7430 – Code of practice for protective earthing of electrical installations* recommends that unprotected strip conductors are not less than 3 mm thick (clause 9.7 refers).

EARTHING CONDUCTOR PROTECTED AGAINST CORROSION



HOLES AND NOTCHES IN JOISTS

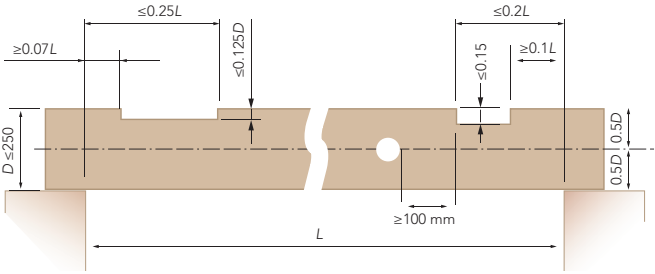
Electrical installers erecting electrical systems within premises of traditional construction often need to cut notches or drill holes in joists for the passage of cables and/or their enclosures.

No wiring system should penetrate an element of building construction which is intended to be load bearing unless the integrity of the load-bearing element can be assured – by a structural engineer – after such penetration (522.8.14).

Clear practical guidance on drilling or notching joists in a manner that does not detrimentally affect their load bearing capability is given in *BS 6891:2015 Specification for the installation and maintenance of low pressure gas installation pipework of up to 35 mm (R1¼) on premises*. The advice given in this standard and used as the basis of this Guide is equally applicable when installing cables and/or wiring systems as it is to gas pipework.

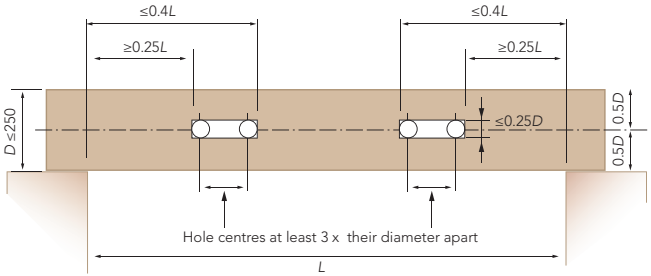
Where cables or other wiring systems are installed within roof spaces, building elements such as roof rafters, purlins, trussed rafters, bracing, etc., may only be notched, drilled or cut away with the approval of a structural engineer.

FIG 1. ACCEPTABLE ALTERNATIVE ARRANGEMENTS FOR NOTCHING



Note 1: Notch dimensions applicable to top or bottom of joist.
Note 2: Notching can be carried out at both ends, on either the top or the bottom (but not both at the same end) without a design check.

FIG 2. LIMITS FOR DRILLING JOISTS WHERE DRILLING AND NOTCHING OCCUR



Note: Holes must be located at least 100 mm horizontally from notches.

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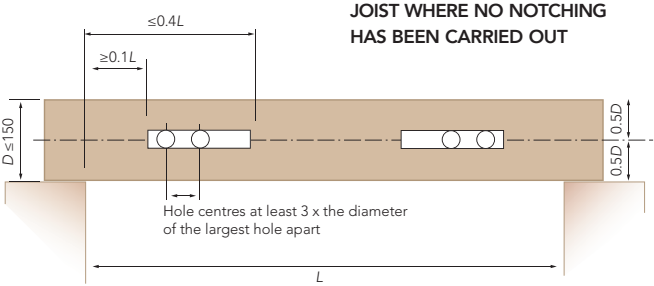
NOTCHES AND HOLES IN JOISTS

FIG 3. LIMITS FOR DRILLING OF JOIST WHERE NO NOTCHING HAS BEEN CARRIED OUT



Note: A maximum of 8 × 30 mm holes is permitted within each drilling zone. No notching is permitted.

FIG 4. INSTALLATION OF WIRING SYSTEMS IN METAL WEB JOISTS

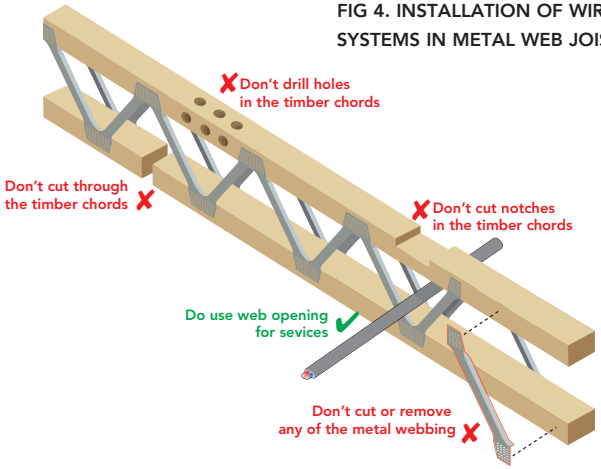
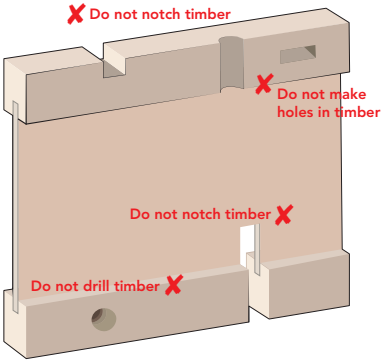


FIG 5. DRILLING/NOTCHING OF TIMBER-ENGINEERED JOISTS



CABLES PASSING THROUGH OR OVER JOISTS

Cables that pass through or over timber joists can be particularly vulnerable to damage from impact, which can lead to a risk of electric shock or fire unless suitable measures are taken to provide protection.

In order to protect against impact, Regulation 522.6.201 of *BS 7671* requires a cable installed under a floor or above a ceiling to be installed in such a position where it is not liable to be damaged by contact with the floor or ceiling or their fixings (nails, screws or the like).

This Regulation also requires that where a cable passes through a joist of a floor or ceiling construction or through a ceiling support (e.g. under floorboards) the cable should be:

- Installed at least 50 mm measured vertically from the top, or bottom as appropriate, of the joist or batten, or
- meet one (or more) of the requirements given in Regulation 522.6.204; described below.

Regulation 522.6.204 requires a cable to:

i incorporate an earthed metallic covering which meets with the requirements of *BS 7671* for a protective conductor of the circuit concerned, or

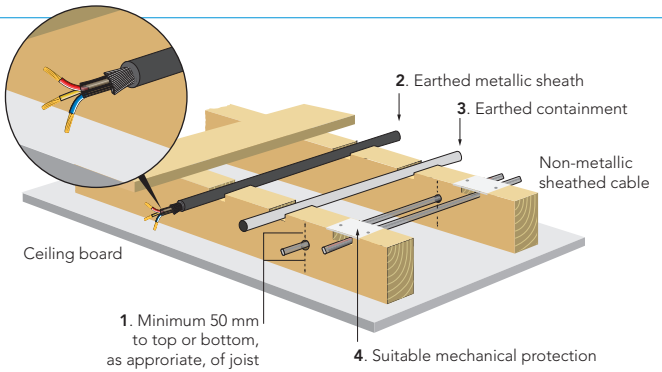
ii be enclosed in earthed metallic conduit meeting the requirements of *BS 7671* for a protective conductor, or

iii be enclosed in earthed metallic trunking or ducting meeting the requirements of *BS 7671* for a protective conductor, or

iv be provided with mechanical protection having sufficient strength to prevent penetration of the cable by fixings, or

v form part of a SELV or PELV circuit complying with Regulation 414.4.

An example of the methods to minimise impact to cables of Regulations 522.6.201 and 522.6.204 (except indent v, which is self-explanatory) is illustrated below:



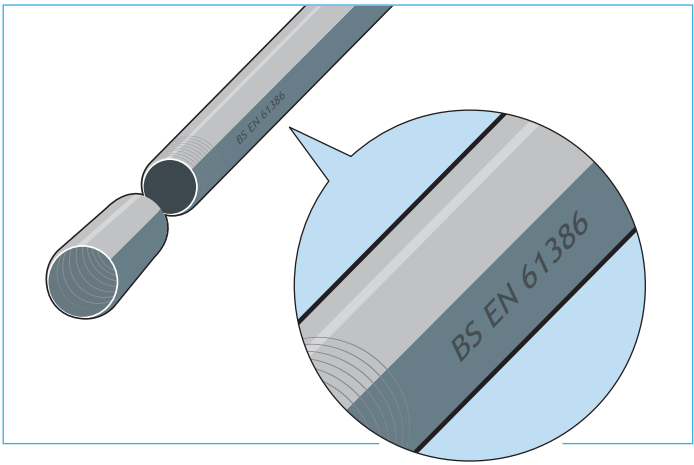
Notes for methods 1-4 overleaf

CABLE PASSING THROUGH OR OVER JOISTS

EXPLANATORY NOTES FOR CABLES INSTALLED UNDER A FLOOR OR ABOVE A CEILING

1. Regulation 522.6.201 specifies a minimum depth of 50 mm from the top or bottom, as appropriate, of a joist or batten to minimise the risk of a cable being penetrated by a fixing (nail, screw or the like) that is used to fix the floorboards or ceiling boards to the joist. Where the contractor suspects that a depth of 50 mm will not be sufficient, which might be the case due to the length of the particular fixings, the cable must be installed at an increased depth. Where a joist, due to its dimensions, does not permit an increased depth (or the 50 mm previously mentioned), one (or more) of the following methods should be used.
2. Regulation 522.6.204* specifies the use of cables complying with *BS 5467, BS 6724, BS 7846, BS 8436* and *BS EN 60702-1*, such as mineral insulated copper sheathed or steel wire armoured (swa) cables. The intention of installing such cables is to ensure that should a fixing penetrate a cable it cannot make contact with a live conductor without first coming into contact with the earthed metallic covering, thereby providing a direct path for earth fault current to flow so that automatic disconnection of the circuit occurs. Also, Regulation 543.2.5 requires that where the metallic covering of a cable is used as a protective conductor, the metallic covering should satisfy the requirements of items (i) and (ii) of Regulation 543.2.2, relating to electrical continuity and cross-sectional area, respectively.
3. Regulation 522.6.204 specifies conduit complying with *BS EN 61386-21* and trunking or ducting complying with *BS EN 50085-2-1*. The intention of installing these earthed containment systems to enclose cables in floors and ceilings is to provide similar protection as given in 2 (above).
4. The electrical industry recognises that steel having a minimum thickness of 3 mm may be suitable to prevent penetration of a cable by fixings. However, where shot fired fixings are used a 3 mm plate is unlikely to prevent penetration and a thicker plate will need to be used. Metal and plastic capping is not of sufficient strength and should not be used.

* The titles of the British Standards given in Regulation 522.6.204 can be found in Appendix 1 of *BS 7671*.



EMERGENCY LIGHTING PART 1. GENERAL LIGHTING FOR ESCAPE ROUTES

This Guide covers the recommendations for emergency lighting in escape routes, contained in *BS 5266-1 2016: Code of practice for the emergency lighting of premises.*

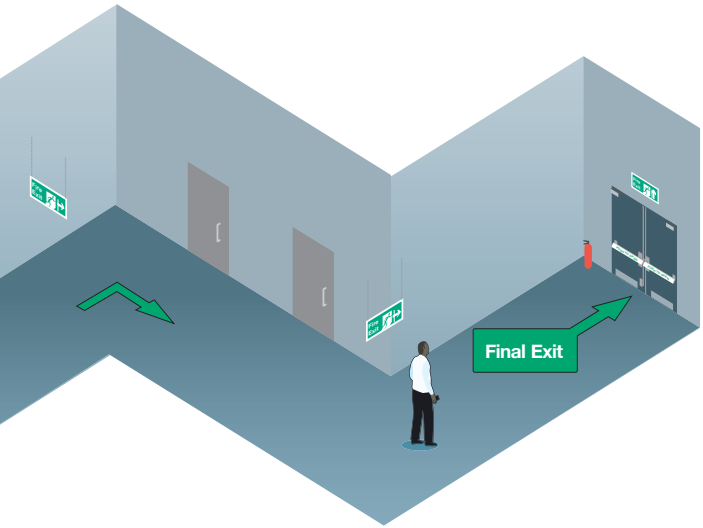
Part 2 of this Guide (Pocket Guide 23) covers emergency lighting for control rooms, high risk task areas and open areas. As this Guide provides only a reminder of the main recommendations, contractors involved in emergency lighting work should, where necessary, consult the *BS 5266* series to ensure its recommendations and requirements are complied with in the design, construction, verification and certification of emergency lighting installations.

ESCAPE ROUTE LIGHTING

The purpose of escape lighting is to enable buildings to be safely evacuated should the normal lighting fail (clause 5.2.1). The lighting should provide the appropriate visual conditions and direction-finding on escape routes and ensure that fire-fighting and safety equipment can be readily located and used (clause 5.2.8.1).

To minimise the risk of parts of the escape route being in total darkness should a emergency light fail, illuminance should be provided by at least two luminaires (clause 6.3).

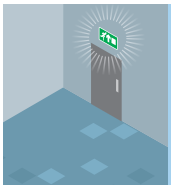
Where the building is not intended to be evacuated immediately, emergency safety lighting should be provided (clause 5.3).



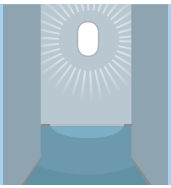
For reliability, a larger number of lower output luminaires placed close together is preferred to a few high output luminaires spaced further apart (clause 6.5).

EMERGENCY LIGHTING PART 1.
GENERAL LIGHTING FOR ESCAPE ROUTES

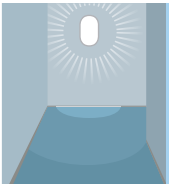
EMERGENCY LIGHTING SHOULD BE PROVIDED AT THE FOLLOWING LOCATIONS:



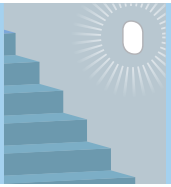
EXIT DOORS
Install within 2 m of an exit door intended to be used in an emergency.



JUNCTIONS
Install within 2 m of escape route junctions.

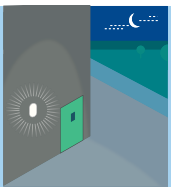


CORRIDORS
Install within 2 m horizontal distance of a change of direction in an escape route.



STAIRWAYS
Install within 2 m horizontal distance of change in floor level or stairs (each tread to receive direct light).

ALARM AREAS
Fire alarms, first aid points and firefighting equipment, install within 2 m horizontal distance.



OUTSIDE THE BUILDING
Install externally to illuminate the route to a place of safety.

The Industry Committee for Emergency Lighting (ICEL)* provide verification of photometric data for emergency lighting luminaires.

In accordance with this photometric data, emergency lighting manufacturers produce spacing tables for their luminaires. These tables show the maximum distances between luminaires for a given mounting height. Installing luminaires in accordance with the relevant spacing table will ensure the minimum lighting level will be achieved.

ESCAPE ROUTE CORRIDORS:
1 lux minimum on the centre line of the escape route (clause 5.2.5).

OPEN AREAS:
0.5 lux minimum in the central core to within 0.5 m of the walls (clause 5.2.6).

ESCAPE ROUTE SIGNS:
Signs designated as E001 and E002 in *BS EN 7010: 2012+A5* should be used (subclause 5.2.9.1.1 of *BS 5266-1* refers). Signs should be either back illuminated or have an emergency luminaire within 2 m of horizontal height. Signs should be of the same format throughout the building.

* ICEL formulates and promotes standards for emergency lighting and provides guidance on that subject to specifiers, users and contractors.

For further information on installation design requirements, visit the ICEL website at **www.icel.co.uk**

EMERGENCY LIGHTING PART 2.
CONTROL ROOMS, HIGH RISK TASK AREAS AND OPEN AREAS

This Guide covers the recommendations for emergency lighting in control rooms, high risk task areas and the open areas of buildings that are contained in *BS 5266-1: Code of practice for the emergency lighting of premises.*

Part 1 (Pocket Guide 22) deals with general escape route lighting.

As this Guide provides only a reminder of the main recommendations of *BS 5266-1*, contractors involved in emergency lighting work should, where necessary, consult the *BS 5266* series to ensure its recommendations and requirements are complied with in the design, construction, verification and certification of the emergency lighting installation.

CONTROL ROOMS

Emergency lighting is needed in control, plant and switch rooms to support personnel who may need to undertake tasks or corrective actions to restore the lighting, such as to replace an electrical fuse, reset a circuit-breaker or confirm the operation of a standby generator. In circumstances where a generator supplies the emergency lighting, battery-powered emergency luminaires should be provided in the vincinity of the generator (clause 5.2.8.6 refers).

HIGH RISK TASK AREA LIGHTING

Emergency lighting is needed to safeguard people who are involved in a potentially dangerous process or situation. Its purpose is to enable shut-down procedures to be properly carried out in a way that the operator and other occupants of the building are not put into harm's way, such as by walking into dangerous machinery, (clause 5.2.7 of *BS 5266-1* refers).

OPEN AREA (OR ANTI-PANIC) LIGHTING

Emergency lighting is needed in large rooms and/or open areas to help reduce the likelihood of panic and to enable safe movement of occupants towards escape routes by providing appropriate visual conditions and direction finding (clause 3.14 of *BS 5266-1* refers).

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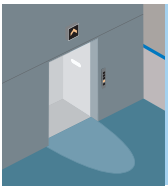
EMERGENCY LIGHTING PART 2.
CONTROL ROOMS, HIGH RISK TASK AREAS AND OPEN AREAS

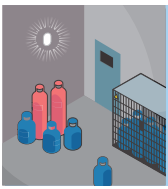
ESCALATORS
Should not be used as an escape route, but require the same illumination to protect users when the supply fails.

TOILETS
Install in all toilets exceeding 8 m^2 area or where natural light is not present.

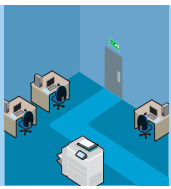


LIFTS
To provide emergency illumination in all lifts.

CONTROL ROOMS
Motor generator, control and plant rooms for essential and safety services.



HIGH RISK AREAS
Should be illuminated to at least 10 % of the normal lighting or 15 lux, whichever is greater (*BS EN 1838* and clause 5.2.7 *of BS 5266-1 refer*).



OPEN AREAS
Either with a particular hazard, an escape route passing through or larger than 60 m^2.

When luminaires have been sited to cover locations shown in this Guide, additional luminaires may be required to ensure minimum lighting levels are achieved — ICEL manufacturers provide spacing tables for this purpose. These tables show the maximum distances between luminaires for a given mounting height. Installing luminaires in accordance with the relevant spacing table will ensure the minimum lighting level will be achieved.

ESCAPE ROUTE CORRIDORS:

1 lux minimum on the centre line of the escape route.

OPEN AREAS:

Emergency lighting should be provided for rooms with a floor area greater than 60 m^2 or those, such as windowless areas, that have been risk assessed as needing emergency lighting. These open areas should be provided with a minimum horizontal illuminance of 0.5 lux at floor level, excluding a border of 0.5 m around the perimeter.

ESCAPE ROUTE SIGNS:

Should be located and operated in accordance with *BS 5499-4:2013* (clause 5.2.9.1.1 of *BS 5266-1* refers).

FURTHER INFORMATION:

The Industry Committee for Emergency Lighting formulates and promotes standards for emergency lighting and provides guidance on that subject to specifiers, users and contractors. For further information on installation design requirements, visit the ICEL website at **www.icel.co.uk**

FIRE DETECTORS IN NEW OR MATERIALLY ALTERED DOMESTIC PREMISES: Grade D, Category LD2.

CONTROL ROOMS, HIGH RISK TASK AREAS AND OPEN AREAS

This Guide gives guidance for the installation of fire detectors* in new of materially altered single-family dwellings to meet the relevant recommendations for a Grade D1/2, Category LD2 system given in *BS 5839-6: 2019 Fire detection and fire alarm systems for buildings – Part 6: Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises.* A Grade D, Category LD2 system is the minimum standard for protection of life against fire recommended by clause 9 (Choice of system) of *BS 5839-6* for single-family dwellings not exceeding three-storey with no floor greater than 200 m² in area, or of single-storey where the floor area may exceed 200 m², such as a bungalow.

For single-family dwellings of a different nature, for example, two or more storey dwellings with any floors greater than 200 m² in area, Table 1 of *BS 5839-6* should be consulted and an appropriate Grade and Category of system selected.

BS 5839-6 recommends that the design of a fire detection and fire alarm system for a particular dwelling should be based on fire risk assessment and clause 9, with alarm types appropriately selected for a room or area to provide the earliest warning signal in the event of fire, whilst limiting false alarms.

INFORMATION ON ALARM TYPES GENERALLY APPLICABLE TO GRADE D, CATEGORY LD2 SYSTEMS

- Smoke alarms are generally of two types: optical smoke alarms (OSAs) and ionization smoke alarms (ISAs). Either may be used in any room or area, other than kitchen, bath or shower rooms. However:
- OSAs are less likely than ISAs to respond to fumes from cooking. Thus, OSAs are more suitable in rooms or areas into which kitchen cooking fumes may discharge.
- ISAs are less likely than OSAs to respond to tobacco smoke. Thus, ISAs are more suitable in rooms or areas where smoking is likely.
- Heat alarms are slower to respond to fire than smoke alarms and are therefore generally recommended for use in kitchens to provide fire detection, whilst limiting false alarms. They also may be used in other rooms, for example, where the speed of fire detection is not imperative. They should not be used in circulation areas, such as hallways, corridors or staircase landings, (clause 10 (Types of fire detector and their selection) of *BS 5839-6* refers).
- Carbon monoxide fire detectors may be installed as an alternative to smoke detectors in the principal habitable room**, provided the applicable parts of *BS 5839-6*, such as clause 10.2 are met. They may also be used as alternatives in other rooms and areas (except kitchens).

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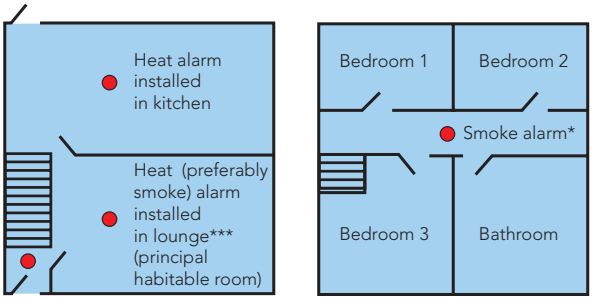
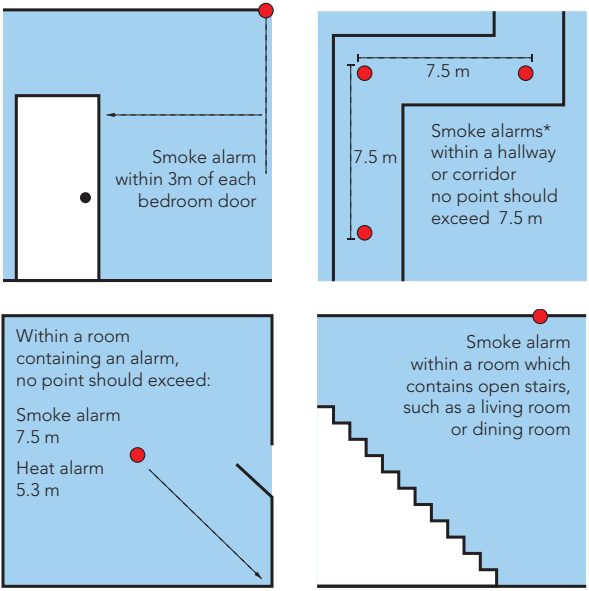
GRADE D, CATEGORY LD2

The following recommendations, given in clause 11 (Location and siting of fire detectors) of *BS 5839-6*, are the minimum for a Grade D1/2, Category LD2 system in new or materially altered single-family dwellings:



Smoke alarm*

However, additional alarms may be required to satisfy fire risk assessment and/or the relevant recommendations for a Grade D, Category LD2 system given in *BS 5839-6* as follows:



Further information regarding the recommendations of *BS 5839-6* are given in Pocket Guide 10.

* Where detectors for smoke, heat and carbon monoxide are referred to in this Guide, it is taken that they are devices which incorporate within one housing the components to, detect their relevant characteristics for fire, and give an audible alarm.

** Principal habitable room – normally the most frequently used room for general daytime living (excluding a kitchen, utility room, bathroom, dressing room or toilet).

*** Alternatively a carbon monoxide fire detector may be used.

RCDS - OPERATING TIMES

FAULT PROTECTION

Where an RCD is installed to provide fault protection in an installation forming part of a TN or TT system, Regulation 643.7.1 requires verification of its effectiveness to provide automatic disconnection of supply taking into account the operating characteristic of the RCD employed.

Initially, the RCD should be visually inspected to confirm that it is of an appropriate type, rated current or current setting, and sensitivity in terms of its rated residual operating current for its intended purpose.

Testing should then be carried out using suitable test equipment to confirm that the device will operate within the relevant disconnection time given in Chapter 41 of *BS 7671* when tested at any current greater than or equal to the rated residual operating current ($I_{\Delta n}$) of the RCD and preferably the highest test current that can be delivered safely by the instrument or at a test current specified by the RCD manufacturer.

Circuit type	Earthing system	Disconnection time (seconds)	*BS 7671* Reference
Final circuits. Rated currents not exceeding: • 63 A supplying socket-outlets, and • 32 A supplying only fixed current-using equipment	TN	0.4	411.3.2.2 Table 41.1
	TT	0.2	
Distribution circuit or circuit not covered by Regulation 411.3.2.2/Table 41.1	TN	*5*	411.3.2.3
	TT	*1*	411.3.2.4
Part of a reduced low voltage system	TN or TT	*5*	411.8.3
Provision of additional protection	TN or TT	0.04	643.8

TABLE 1. SUMMARY OF DISCONNECTION TIMES GIVEN IN CHAPTER 41 OF *BS 7671*

Testing should be performed in both half-cycles and the longer of the two disconnection times obtained should be recorded on the *schedule of test results* accompanying the Electrical Installation Certificate or in Part 4 of the Minor Electrical Installation Works Certificate.

RCDS - OPERATING TIMES

ADDITIONAL PROTECTION

Where an RCD is installed to provide additional protection in an installation forming part of a TN or TT system, Regulation 643.8 requires its effectiveness to be verified by visual inspection and testing.

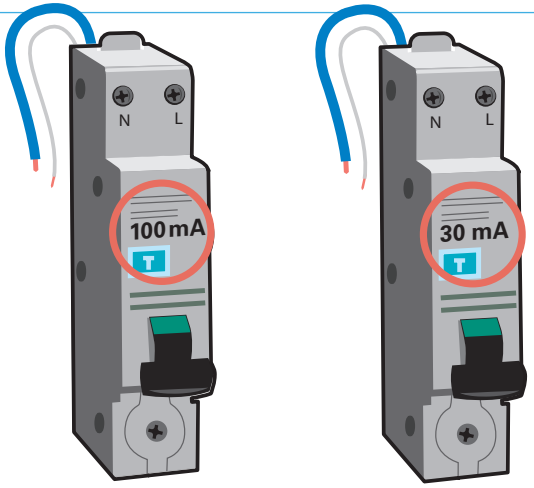
The purpose of the visual inspection is to confirm that the RCD has a rated residual operating current ($I_{\Delta n}$) not exceeding 30 mA as required by Regulation 415.1.1.

The RCD should then be tested at any current greater than or equal to five times the rated residual operating current ($I_{\Delta n}$) of the RCD and preferably the highest test current that can be delivered by the instrument.

Testing should be performed in both half-cycles and the longer of the two disconnection times obtained should be recorded on the *schedule of test results* accompanying the Electrical Installation Certificate or in Part 4 of the Minor Electrical Installation Works Certificate.

The RCD meets the requirements of Regulation 643.8 if it operates within 40 ms when tested.

Note: There is no requirement to carry out a test at half the rated residual operating current during initial verification and so such testing is not discussed in this Guide. However, such a test might be useful when fault finding during maintenance or fault finding procedures.



TYPICAL RCBOs RATED FOR FAULT PROTECTION AND ADDITIONAL PROTECTION

INSULATION RESISTANCE TESTING - LOW VOLTAGE AND FELV CIRCUITS

This Guide covers insulation resistance (IR) testing of low voltage (LV) circuits – typically 230/400 V rated, and FELV circuits. It does not cover IR testing of SELV and PELV circuits; see NICEIC and ELECSA Pocket Guide 27.

IR testing is one of the vital safety checks that must be carried out (with satisfactory results) before circuits are first energised (643.1 and 643.3), and which should also be repeated periodically during the life of an installation.

IR testing can reveal dangerous conditions such as contact between a live conductor and (say) a metal support bracket or a metal frame of a partition, due to a screw penetrating a concealed cable, for example. To increase the chance of revealing such hazards, the protective conductors MUST be connected to the earthing arrangement of the installation; that is, the distributor's earthing facility (TN system) or installation earth electrode (TT system), when IR testing between live conductors and protective conductors is carried out (643.3.1).

Comparing the results of IR tests with relevant criteria gives an indication of the condition of conductor insulation. A minimum IR value of 1.0 MΩ is considered satisfactory for LV and FELV circuits where the main switchboard and each distribution circuit are tested separately, with final circuits connected but current-using equipment disconnected (643.3.2). However, much higher readings should usually be expected, especially for individual circuits, for which readings could be 200 MΩ or more.

For tests on an existing installation, the measured IR values should be compared with any available records of measured IR values from previous testing, to identify any deterioration.

PROCEDURE

1 Persons carrying out IR testing must be suitably competent and must follow a safe working procedure.

2 Securely isolate the installation and/or circuits to be tested and confirm with a suitable test instrument that no dangerous voltage is present. Pocket Guide 5 gives information on safe isolation procedure.

3 Disconnect and/or unplug equipment likely to influence, or be damaged by, IR testing, such as surge protective devices, electronic time switches and certain current-using equipment. Alternatively, where it is not reasonably practicable to disconnect such equipment, test only between the line and neutral conductors connected together and the protective conductor (connected to the earthing arrangement) (643.3.1) or, exceptionally, reduce the applied test voltage to 250 V DC However, the minimum satisfactory measured value remains 1.0 MΩ. (643.3.2)

4 RCDs can be damaged by IR testing and may affect IR test results. It may therefore be necessary to disconnect RCDs temporarily while these tests are performed and/or to test the wiring on the load side of RCDs separately, to ensure the wiring is included in the test.

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INSULATION RESISTANCE TESTING - LOW VOLTAGE AND FELV CIRCUITS

5 When testing a distribution board or distribution circuit, ensure all relevant devices controlling outgoing circuits, such as circuit-breakers, are closed, so all relevant parts of the installation are tested (but see also **4** above). Two-way (and intermediate) switching should be operated during the test procedure and the test repeated so that all live conductors are subjected to IR testing.

6 Carry out IR testing using a test instrument to *BS EN 61557-2* set to 500 V DC or, exceptionally, 250 V DC, and to the highest resistance range on the instrument such as 200 MΩ, as follows:

- For single-phase circuits, between:
  - a) Line and neutral
  - b) Line and neutral conductors temporarily connected together and the protective conductor (connected to the earthing arrangement).
- For a three-phase installation, between:
  - c) Line 1 and Line 2
  - d) Line 2 and Line 3
  - e) Line 3 and Line 1
  - f) Line conductors temporarily connected together and neutral
  - g) Line and neutral conductors temporarily connected together and the protective conductor (connected to the earthing arrangement).

Compare the results obtained with the minimum satisfactory value of 1.0 MΩ and, for an existing installation, with records of previous tests.

POINTS TO REMEMBER

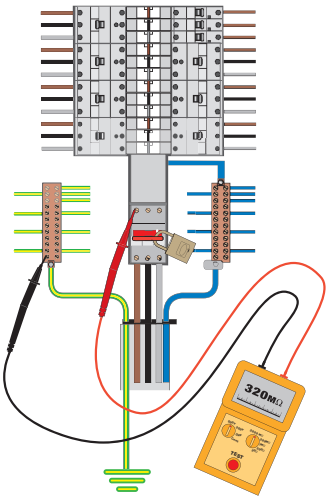
- A good insulator should have high resistance, typically many megohms (MΩ). Any lower than expected IR test results must be investigated.

They could indicate:

- a dangerous condition in the installation, and/or
- current-using equipment is connected, and/or
- for an existing installation, noticeable deterioration.

- Reconnect any equipment disconnected during stages 3 and/or 4 above, after IR testing has been performed.
- Do not energise a circuit unless all 'dead' test results are satisfactory.

INSTALLATION MUST BE CONNECTED TO EARTH



INSULATION RESISTANCE TESTING - SELV AND PELV CIRCUITS

This Guide covers insulation resistance (IR) testing of separated extra-low voltage (SELV) and protective extra-low voltage (PELV) circuits. These are circuits having a nominal voltage not exceeding 50 V AC. or 120 V ripple-free DC, complying with Section 414 of *BS 7671*. IR testing of functional extra-low (FELV) circuits is not covered by this Guide; see NICEIC and ELECSA Pocket Guide 26, Insulation resistance testing – low voltage and FELV circuits. This Guide should be read in conjunction with Pocket Guide 26, as many of the general principles referred to in that Guide also apply to IR testing of SELV and PELV circuits.

SELV and PELV circuits generally form only part of an installation. There is not usually a SELV or PELV switchboard or distribution board. An example of a SELV or PELV circuit is an extra-low voltage circuit fed by a safety isolating transformer and supplying luminaires.

Like low voltage (LV) and FELV circuits, the IR testing of SELV and PELV circuits is carried out with a test instrument to *BS EN 61557-2*, set to the highest resistance range, such as 200 MΩ. However, the requirements of test voltage and insulation resistance differ from those for LV and FELV circuits, as explained in this Guide.

The IR tests referred to in **A** and, where applicable, **B** of this Guide must be carried out (with satisfactory results) before the SELV or PELV circuits are first energised, and should be repeated periodically during the life of the installation.

A. IR TESTS BETWEEN SELV/PELV CIRCUIT CONDUCTORS, AND TO EARTH

Separation of the live parts of each SELV and PELV circuit from those of other circuits and, for SELV circuits, from Earth must be confirmed by measuring the insulation resistance (643.4.1 and 643.4.2).

Table 64 of *BS 7671* indicates that the measurements are carried out with a test voltage of 250 V DC, applied:

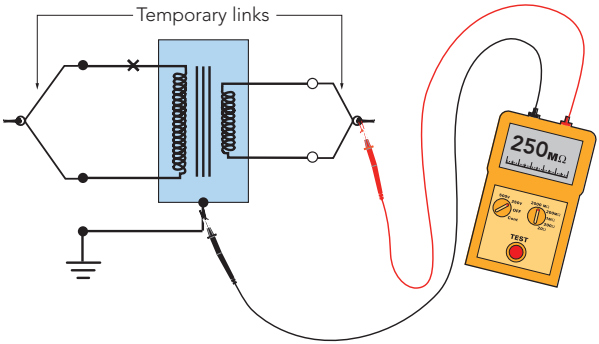
- between the live conductors of each SELV or PELV circuit and the live parts of other SELV and PELV circuits, and
- between the live conductors of each SELV circuit and Earth (Fig 1 shows an example).

A minimum measured IR value of 0.5 MΩ applies to testing carried out at 250 V (Table 64). However, much higher readings should usually be expected, especially for individual circuits, for which readings could be 200 MΩ or more.

Continued overleaf

INSULATION RESISTANCE TESTING - SELV AND PELV CIRCUITS

FIG 1. EXAMPLE OF IR TESTING BETWEEN THE LIVE CONDUCTORS OF A SELV CIRCUIT AND EARTH



Note: The protective conductor MUST be connected to the earthing arrangement of the installation (643.3.1)

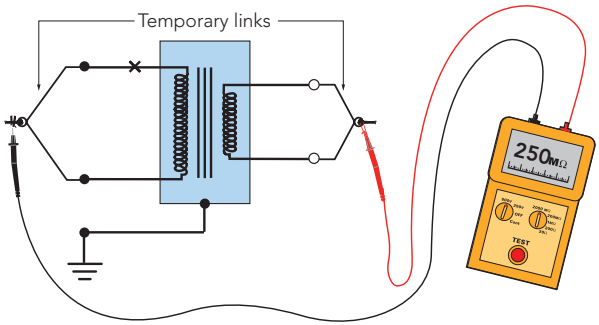
B. IR TESTS BETWEEN SELV/PELV CIRCUITS AND NON-SELV/PELV CIRCUITS

Separation of the live parts of each SELV and PELV circuit from those of circuits other than SELV or PELV must be confirmed by measuring the insulation resistance (643.4.1 and 643.4.2). Fig 2 shows an example of this test.

Table 64 of *BS 7671* indicates that where the nominal voltage of the non- SELV/PELV circuits is up to 500 V, a test voltage of 500 V DC should be applied, and where the nominal voltage of the non-SELV/PELV circuit is above 500 V, a test of 1,000 V DC should be applied.

The minimum satisfactory measured IR value increases to 1.0 MΩ (Table 64). However, much higher readings should usually be expected, especially for individual circuits, for which readings could be 200 MΩ or more.

FIG 2. EXAMPLE OF IR TESTING BETWEEN THE LIVE CONDUCTORS OF A SELV OR PELV CIRCUIT AND THOSE OF A NON-SELV/PELV CIRCUIT



APPLICATION OF RESIDUAL CURRENT DEVICES (RCDs)

This Guide gives information on typical applications of RCDs, according to their rated residual operating current ($I_{\Delta n}$). See Pocket Guide 29 for information on the classification of RCDs according to whether or not they incorporate a time delay and their ability to give protection where current includes a DC component. See Pocket Guide 25 for information on the operating times of RCDs.

The 'preferred' values of $I_{\Delta n}$ given in product standards for RCDs used in electrical installations are 10 mA, 30 mA, 100 mA, 300 mA and 500 mA. Table 1 summarises some typical applications for RCDs, and the main requirements of *BS 7671*.

TABLE 1. APPLICATION AND USE OF RCDs

	Typical application (Note 1)	*BS 7671* Reg
	$I_{\Delta n}$ not exceeding 30 mA (Note 2)	
Additional protection	Socket-outlets rated at up to 32 A (Note 4) and mobile equipment up to 32 A for use outdoors	411.3.3
	Cables concealed in walls and partitions in certain circumstances (Note 5)	522.6.202 522.6.203
	Lighting in telephone kiosks, bus shelters, advertising panels, town plans etc.	714.411.3.3
	All low voltage circuits (e.g. 230 V) of a location containing a bath or shower either serving the location or passing through zones 1 and/or 2 but not serving the location	701.411.3.3
	All low voltage circuits of a sauna location, except sauna heater unless recommended by manufacturer	703.411.3.3
	Final circuits supplying socket-outlets rated at up to 32 A in agricultural and horticultural premises	705.411.1
	Caravan pitch socket-outlets. Each socket-outlet to be individually protected by an RCD (Note 6)	708.415.1
	Circuits supplying floor and ceiling heating systems	753.415.1

APPLICATION OF RESIDUAL CURRENT DEVICES (RCDs)

	Typical application (Note 1)	*BS 7671* Reg
Fault protection	Certain circuits of a location containing a swimming or paddling pool	702.410.3.4.1 702.410.3.4.2
	Socket-outlets for boats, and circuits to supply houseboats, at marinas and similar. Each to be individually protected by an RCD (Note 6)	709.531.2
	The installation of a caravan or motor caravan (Note 6)	721.415.1
	Charging points for electric vehicles (Note 6)	722.531.2.101
	Circuits supplying floor and ceiling heating systems	753.411.3.2
	Installations generally (Note 3)	
	Where a sufficiently low earth fault loop impedance (Z_s) for overcurrent device cannot be achieved	411.4.4 (TN system) 411.5.3 (TT system)
	$I_{\Delta n}$ not exceeding 100 mA	
	Final circuits supplying socket-outlets rated at more than 32 A in agricultural and horticultural premises	705.411.1
	$I_{\Delta n}$ not exceeding 300 mA (Note 6)	
Protection against fire	Wiring systems except mineral insulated cable, busbar trunking and Powertrack, in locations with risk of fire due to processed or stored materials.	422.3.9
	Agricultural and horticultural premises (Note 6)	705.422.7
Fault protection	Circuits in agricultural and horticultural premises, except socket-outlet circuits (covered earlier)	705.411.1
	$I_{\Delta n}$ not exceeding 500 mA	
	Final circuits supplying socket-outlets rated at more than 32 A on construction and demolition sites, where the protective measure is automatic disconnection of supply	704.411.3.2.1

Notes.

1. The applications in Table 1 are not exhaustive. For example, RCDs required by Part 7 of *BS 7671* in Sections 710 (Medical locations), 711 (Exhibitions, shows and stands), 717 (Mobile or transportable units) and 740 (Temporary installations for fairgrounds etc) are not included.
2. RCD must be of general (non-delay) type.
3. Except for a special installation or location for which Part 7 of *BS 7671* gives a different requirement.
4. Where, other than for an installation in a dwelling, a documented risk assessment determines that the RCD protection is not necessary.
5. Cables without earthed metallic covering or earthed metallic enclosure or not forming part of a SELV or PELV circuit, at a depth of less than 50 mm from surface of a wall or partition, or irrespective of depth if the wall or partition has internal metal parts (except screws or nails etc).
6. RCD must disconnect all live (line and neutral) conductors.
7. $I_{\Delta n}$ must be not more than 30 mA where a resistive fault may cause a fire (see Regulation 422.3.9 for details).

CLASSIFICATION OF RESIDUAL CURRENT DEVICES (RCDs)

This Guide gives information on the classification of RCDs according to whether or not they incorporate a time-delay and their ability to give protection where residual current includes a DC component. See Pocket Guide 25 for information on the operating times of RCDs, and Pocket Guide 28 for information on typical applications of RCDs.

TIME-DELAY (IN THE PRESENCE OF RESIDUAL CURRENT)

RCDs are manufactured as follows:

- without time-delay for general use
- Type S or time-delayed.

Where necessary to provide selectivity with an RCD downstream, an RCD will need to be of Type S or incorporate a time delay. Additionally, the ratio of the rated residual operating current of the upstream RCD to that of the downstream RCD must be at least 3:1(536.4.1.4).

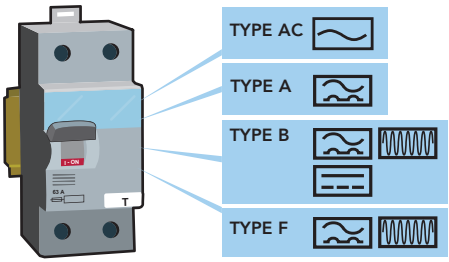
Where a protective conductor current is expected in normal operation (such as may be the case where the installation supplies electronic equipment or heating elements), consideration should be given to the following to avoid unnecessary tripping:

- sub-division into circuits protected by individual RCDs
- circuit design to ensure protective conductor current downstream of an RCD does not exceed 30 % of its rated residual operating current
- use of short-term time-delay whilst ensuring the relevant disconnection time of Chapter 41 can still be achieved
- effective coordination between general type, selective type and time-delay type RCDs
- coordination between RCDs and surge protective devices (531.3.2).

PROTECTION WHERE RESIDUAL CURRENT INCLUDES A DC COMPONENT

RCDs are classified into a number of types, according to their ability to give protection with different residual current waveforms. The figure adjacent shows the symbols used to denote the main types, and the table overleaf lists the current waveforms for which the operation of each of these types is assured.

Note: Only the symbol(s) applicable to the particular type are marked on an RCD.



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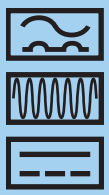
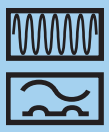
CLASSIFICATION OF RESIDUAL CURRENT DEVICES (RCDs)

MAIN TYPES OF RCD

Type	Operation is assured for
AC 	residual sinusoidal alternating currents, whether suddenly applied or slowly rising.
A 	as for Type AC and, in addition, residual pulsating direct currents and residual pulsating direct currents superimposed on a smooth direct current of up to 6 mA.
B 	as for Type F, and in addition: residual sinusoidal alternating currents up to 1000 Hz, residual alternating currents superimposed on a smooth direct current of 0.4 times the rated residual operating current, residual pulsating rectified direct currents resulting from two or more phases, and residual smooth direct currents, independent of polarity, whether suddenly applied or slowly increased.
F 	as for Type A, intended for circuit supplied between line and neutral or line and earthed middle conductor, and for residual pulsating direct currents superimposed on a smooth direct current up to 10 mA.

From the table, it can be appreciated that a Type AC RCD can only be expected to give protection where no DC component is present in any residual current detected by the RCD.

For a circuit used to supply equipment liable to produce residual current having a DC component (such as some types of electronic equipment), any RCD used should be of a suitable type, other than Type AC, depending on the characteristics of the DC component (see table).

Where a solar PV power supply system does not provide at least simple separation between the AC and DC sides (such as where the inverter is transformerless), any RCD used to provide fault protection should be of Type B to *BS EN 62423*. (712.411.3.2.1.2). The only exception is where it has been established, such as from a written declaration from the inverter manufacturer, that the inverter is so designed that it is not able to feed DC fault currents into the electrical installation.

NOTICES AT OR NEAR THE ORIGIN OF AN INSTALLATION IN A BUILDING

This Guide lists the notices that Section 514 and Part 7 of *BS 7671* require to be fixed at or near the origin of an electrical installation (the position at which electrical energy is delivered to the installation) in a building. The Guide is intended as a convenient reminder for use during the planning, construction, initial verification and periodic inspection of an electrical installation.

For a new installation, the electrical certification must not be issued until any defect or omission revealed during the inspection and testing has been corrected (644.1.1).

For an addition and/or alteration to an existing installation, any defect or omission revealed during inspection and testing that will affect the safety of the addition or alteration must be corrected before the certification is issued (644.1.2).

For a periodic inspection, any observed deficiencies which may give rise to danger, including the absence of any certain notices, should be recorded in the Electrical Installation Condition Report and an appropriate Classification code attributed (653.2).

The following table summarises the applicable requirements of Section 514 and Part 7 for notices at or near the origin.

Some notices may also be required at other appropriate locations within an installation (as well as at or near the origin), such as where bonding conductors connect to extraneous-conductive-parts, or on or near a distribution board downstream from the origin serving wiring identified by colours to two versions of *BS 7671*.

Notices should be legible, constructed from appropriately durable material and securely fixed in a prominent position. See also *BS 7671* for full requirements relating to wording of each notice.

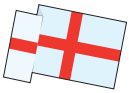
Subject/summary	Example/Regulation No.
Voltage. Warning, before gaining access to them, that live parts with nominal voltage to earth exceeding 230 V are present within an item of equipment or enclosure where this would not normally be expected.	**514.10.1** Residual sinusoidal alternating currents, whether suddenly applied or slowly rising.
Isolation. Warning that an item of electrical equipment contains live parts not capable of being isolated by a single device.	**514.11.1** On or near an enclosure that contains parts connected to a mains supply and parts connected to a generator.
Periodic inspection and testing*. Notification of the recommended date of the next inspection.	**514.12.1** On or near the main distribution board.

NOTICES AT OR NEAR THE ORIGIN OF AN INSTALLATION IN A BUILDING

RCD. Notification to remind the relevant person to test the RCD every six months.	**514.12.2** On or near each RCD within the installation.
Earthing and bonding connections. Warning not to remove earthing and bonding connections.	**514.13.1** Adjacent to a main earthing terminal that is separate from the main switchgear.
Where protective measure of earth-free local equipotential bonding (Regulation Group 418.2) or electrical separation for supply to more than one item (Regulation Group 418.3) is used. Warning that relevant bonding conductors must not be earthed, and not to bring equipment having earthed exposed-conductive-parts into the location.	**514.13.2** Adjacent to every point of access to the location (one of which could be near the origin).
Non-standard colours Warning that installation contains wiring colours to two versions of *BS 7671*.	**514.14.1** On or near a distribution board serving an installation where additions/alterations using brown and blue insulated conductors have been made but original wiring uses red and black insulated conductors.
Alternative supplies Warning that an installation includes one or more supplies other than the incoming mains supply.	**514.15.1** On or near a distribution board of an installation having a mains supply and a solar PV supply.
High protective conductor currents Notification that an installation includes circuit(s) with a high protective conductor current.	**514.16** On or near a distribution board containing circuit(s) complying with Regulation Group 543.7 (543.7.1.205).
Non-isolatable live parts enclosed (PV system) Warning that parts may be live after isolation from the PV convertor.	**712.537.2.2.5.1** On a PV system junction box containing parts supplied from PV modules.
Floor and ceiling heating systems. Notification and information where an installation contains a floor or heating system.	**753.514** On or near a distribution board serving a floor or ceiling heating system.

*required at or near the origin in every installation and the others are required only in certain circumstances, such as where an installation has an alternative supply (to the mains supply).

PART P - NOTIFIABLE OR NOT ENGLAND



This Guide provides a quick reference to whether electrical installation work that began on or after 6 April 2013 in a dwelling or associated buildings or land in England needs to be notified to a Building Control Body (BCB) in accordance with the *Building Regulations 2010 for England* (the BR).

For guidance on whether electrical installation work in Wales is notifiable, see NICEIC and ELECSA Pocket Guide 8.

A company registered with a Part P self-certification scheme, such as those operated by NICEIC and ELECSA, is not required to notify a BCB prior to carrying out 'notifiable work'. However, the Part P registered company must notify their relevant registration body following completion of the notifiable work so that a copy of the Building Regulations compliance certificate will be issued to the occupier, and so that the certificate (or a copy of the information on it) will be issued to the BCB. For items of work not covered here, see *Approved document P 2013 edition – for use in England* to find out if they are notifiable.

The requirements of the BR and the issuing of electrical installation certification apply irrespective of whether an item of electrical installation work is notifiable or not.

APPLICATION OF PART P

In England, Part P of the BR applies to electrical installations intended to operate at low voltage (typically 230 V) or extra-low voltage:

- in or attached to a dwelling (house or flat), and associated land (garden) and buildings, such as a garage, shed, conservatory or greenhouse,
- in the common access areas (staircases and corridors excluding the power supply to a lift) of buildings containing flats,
- in shared amenities, such as a room used as a laundry or kitchen within a building containing flats, and
- where business premises (excluding agricultural buildings) and a dwelling share the same land and meter, such as a shop and a dwelling.

UPDATED TO: Part P APPROVED DOCUMENT 2013 edition FOR USE IN ENGLAND

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PART P - NOTIFIABLE OR NOT ENGLAND

NOTIFIABLE WORK

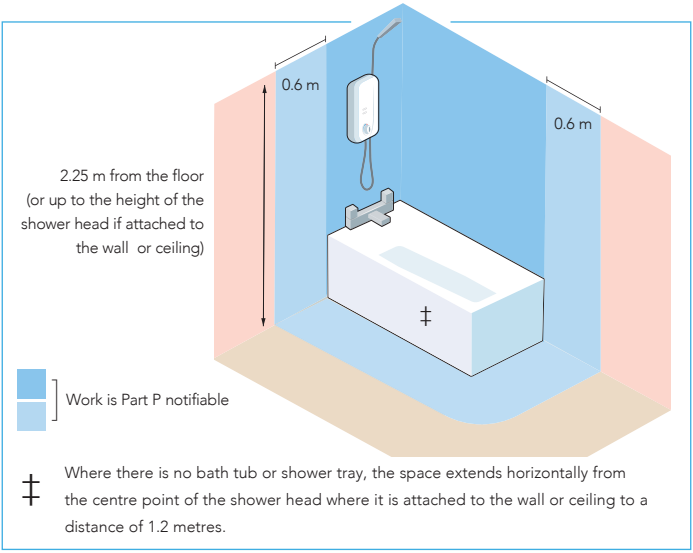
Anywhere in a dwelling or its surroundings:

- Installation of a new final circuit or distribution circuit, whether at low voltage (typically 230 V) or extra-low voltage
- Replacement of a consumer unit.

Within a special location*:

- Any alteration or addition to an existing circuit, whether at low voltage (typically 230 V) or extra-low voltage.

* A special location is a room containing a bath or shower, swimming pool or a sauna heater. For a room containing a bath or shower, an alteration or addition to an existing circuit is notifiable only where carried out in the space surrounding a bath or shower (as illustrated below), rather than the whole room volume, which is the case for rooms containing a swimming pool or sauna heater. For a fuller explanation of special locations, see Section 2 of Approved document P 2013 edition - for use in England.



NON-NOTIFIABLE WORK

All electrical work that is not listed above under 'Notifiable work' need not be notified, namely:

- additions or alterations to existing installations outside of special locations (but not including the provision of a new circuit),
- replacements, repairs and maintenance anywhere,
- installing fixed current-using equipment (provided the circuit protective device and current-carrying capacity of conductors are suitable).

USE OF THE FORMS RECOGNISED BY *BS 7671* FOR CERTIFICATION AND REPORTING

This Guide explains the application of the three forms specified by Part 6 of *BS 7671* for the certification of, and reporting on, electrical installations. The relevant form, duly compiled, should be issued to the person ordering the work to provide information on the installation.

FORMS REFERRED TO IN PART 6 OF *BS 7671* AND THEIR APPROPRIATE USE

Electrical Installation Certificate (EIC):

Except where Regulation 644.4.201 applies, Regulation 644.1 requires an EIC (including a record of the inspection and the results of testing) to be issued upon completion of the verification of a new installation or additions and alterations to an existing installation.

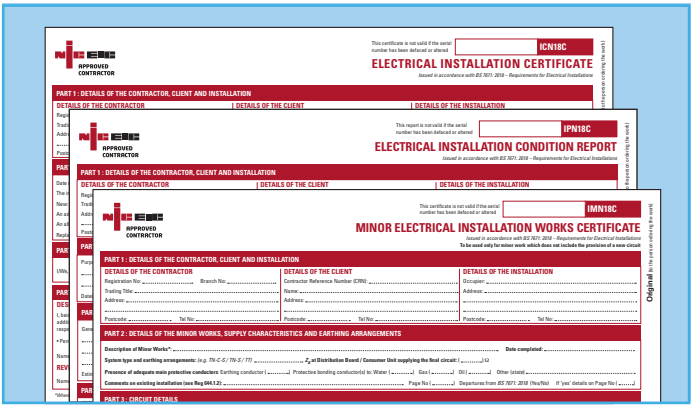
Minor Electrical Installation Works Certificate (MEIWC):

Regulation 644.4.201 permits a MEIWC to be issued instead of an EIC upon completion of the verification of minor electrical installation work that does not include the provision of a new circuit.

Electrical Installation Condition Report (EICR):

Regulation 653.1 requires an EICR (including a record of the inspection and the results of testing) to be issued following the periodic inspection and testing of an existing installation in accordance with Chapter 65 of *BS 7671*.

Forms may be produced in any durable medium, including written and electronic media. The forms should be based on the models given in Appendix 6 of *BS 7671* and contain, as a minimum, the detailed information given in those models. Forms similar in design to the models and/or containing additional information are therefore not precluded. Table 1 overleaf gives examples of the appropriate use of each of the forms, and Table 2 gives examples of inappropriate uses that have been found by NICEIC and ELECSA.



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USE OF THE FORMS RECOGNISED BY *BS 7671* FOR CERTIFICATION AND REPORTING

TABLE 1 EXAMPLES OF APPROPRIATE USE OF THE FORMS

Type of form	Examples of appropriate use
Electrical Installation Certificate	Certification of: • a new installation, • a new circuit, • one or more additions and/or alterations to an existing installation (a MEIWC may be used in some cases – see below), or • the replacement of a consumer unit/distribution board.
Minor Electrical Installation Works Certificate	Certification of: • the modification of an existing circuit (such as by the addition of one or more lighting points, switches or socket-outlets)[1], • the upgrading of existing main protective bonding, or • the replacement of a section of damaged cable in an existing circuit[2].
Electrical Installation Condition Report	Reporting on the condition of an existing installation or part of an existing installation.

[1] Provided this does not involve changing the type or rating of the circuit protective device.

[2] Provided the replacement cable is of the same construction and cross-sectional area.

TABLE 2 EXAMPLES OF INAPPROPRIATE USE OF FORMS FOUND BY NICEIC AND ELECSA

Type of form	Examples of inappropriate use
Electrical Installation Certificate	Reporting on the condition of an existing installation. Certifying installation work carried out by others[3].
Minor Electrical Installation Works Certificate	Certification of: • a new circuit • the replacement of a consumer unit/distribution board.
Electrical Installation Condition Report [4]	Certification of: • a new installation or circuit, • an addition or alteration to an existing installation, or • the installation or replacement of a consumer unit.

[3] This also applies to MEIWC and EICR (except in certain circumstances as described in note 4 below).

[4] In certain circumstances, such as where a contractor carries out installation work then develops a long-term illness or ceases trading due to bankruptcy before issuing an EIC or where a Building Control Body authorises installation work to be certified to meet Part P of the Building Regulations, an appropriate means of determining whether the installed work is fit to be put into service is for another contractor to carry out inspection and testing and issue an EICR. However, the decision to issue an EICR in lieu of an EIC must not be taken lightly, and a detailed examination of the work beyond the scope of a periodic inspection might be required, such as exposing cables in walls and floors to confirm they are correctly installed.

RISK ASSESSMENT IN THE WORKPLACE

This Guide summarises some of the requirements for carrying out a risk assessment (RA) in accordance with *The Management of Health and Safety at Work Regulations 1999* (referred to as the *Management Regulations*), to give electrical contractors an understanding of establishing a safe workplace. This Guide may also assist contractors where they consider the risk assessment option given in the additional protection requirements of Regulation 411.3.3 of *BS 7671*.

PURPOSE OF RISK ASSESSMENT

Risk is a part of everyday life, and it is probably impractical to eliminate all risks in the workplace, but reasonably practicable measures should be taken to combat significant risks to protect against harm to employees, visitors and, where applicable, members of the public.

Clause 3 (*Risk assessment*) of the *Management Regulations* places a duty on every employer (including the self-employed) to carry out a suitable and sufficient assessment of the nature of work activities carried out in all locations under their control, to identify hazards resulting from the activities and implement preventive and protective measures for those hazards, to protect the health and safety of persons in their employment, and of persons, such as the public, in and about the locations.

Paragraph 6 of clause 3 requires the significant findings arising from a RA to be recorded where an employer employs more than five employees. However, it is strongly recommended that the significant findings are always recorded, to provide evidence that due care and attention has been taken to manage risks in the workplace, whilst protecting against future liability.

Having records of past assessments will also aid future assessments, for example, when an existing workplace activity requires reviewing (see Step 5).

Risk assessment should be carried out before work commences by a suitably competent person having sufficient training and experience or knowledge to identify the significant workplace hazards and select appropriate protective measures to combat the hazards.

NATURE OF HAZARDS

The nature of hazards arising from workplace activities is varied and will depend upon the environment and the type of work activities carried out. Examples of significant hazards to persons working on a typical electrical installation may include electric shock, burns, falling from height and most commonly, slips, trips and falls. Not all hazards are obvious, for example, long-term exposure to noise, vibration, chemicals or substances, may lead to ill health.

RISK ASSESSMENT IN THE WORKPLACE

BASIC STEPS TO RISK ASSESSMENT

The leaflet INDG163 (*Risk assessment*) published by the Health and Safety Executive identifies five steps for carrying out a RA. The Table below gives a short explanation for each step and provides examples of RA for people who carry out electrical works.

Step 1	**Identify the hazards** • walk around the workplace to observe the activities and identify what could cause harm, • ask fellow workers for known hazards, and • consult manufacturers' instructions for correct use of equipment, tools, chemicals, substances and materials.
Step 2	**Identify who could be harmed and how** • for each hazard identified in Step 1, identify the group of people liable to harm and the type of injury or ill health that might occur, for example, people who carry out electrical works may receive a shock and/or burns.
Step 3	**Evaluate the risk and select appropriate protective measures** • decide what reasonably practicable measures will protect people identified in Step 2 from harm. For example, ensure employees have adequate electrical education, training and practical skills relating to the type of work carried out.
Step 4	**Record the significant findings and implement them** 1. **electrical testing hazards -** electric shock and/or burns, falling from height 2. **who might be harmed** - electrical workers and others in close proximity 3. **measures** - ensure persons are briefed on site safety, competent to carry out testing and have appropriate test meter(s) (including leads), tools, and appropriate personal protective equipment **Note:** the details of the person(s) responsible for ensuring the selected measures are implemented should also be recorded on a RA document
Step 5	**Review the risk assessment and update if necessary (including accidents or, near misses)** • review the workplace and existing measures regularly to consider • whether there have been any significant changes, • assess any new equipment, tools and materials used by the business and record any significant findings. **Note:** always keep a risk assessment document up to date

EXTERNAL INFLUENCES RECOGNISED IN SECTION 522

This Guide lists, with a brief overview, the fifteen different external influences[1] recognised by Section 522[2] of *BS 7671*. Electrical installation designers must consider these influences to ensure every wiring system[3] will have adequate protection for the expected in-service conditions. The intention of this Guide is to provide persons carrying out construction, initial verification and periodic inspection with a quick reference check list, to ensure the wiring system is appropriate to withstand any detrimental effect at the particular location.

Regulation Group and title [4]		The installed wiring system at the particular location must:
522.1	Ambient temperature	Be suitable for the range of ambient temperatures experienced during both erection and use.
522.2	External heat sources	In relation to local heat sources, such as hot water systems and luminaires be mounted at an appropriate distance or protected, for example, by shielding.
522.3	Prescence of water or high humitity	Be suitable for and have an appropriate degree of protection against any water exposure (including condensation). Where required, provisions should be made to allow moisture to escape.
522.4	Prescence of solid foreign bodies	Have an appropriate degree of protection against the ingress of solid foreign bodies, such as dust and, where required, measures to prevent accumulation of such particulates.
522.5	Prescence of corrosive or polluting substances	Be protected to minimise degradation from any polluting substances, including water having a salt content, such as in coastal locations. Where required, be positioned to avoid contact with materials liable to give rise to other conditions, such as electrolytic action.

1 External influences are also referenced within other regulations given in *BS 7671*, for example, impact and mechanical stress are mentioned in Regulation 521.9.1.

2 Section 522 (Selection and erection of wiring systems in relation to external influences).

3 A wiring system is an assembly made up of a cable or busbars and parts which secure and, if necessary, enclose the cable or busbars (Part 2 of *BS 7671* refers).

4 A number of regulation group titles in Section 522 contain external influence codes (see Appendix 5). These codes, for clarity, are omitted from the titles in this Guide.

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EXTERNAL INFLUENCES RECOGNISED IN 522

522.6	Impact[5]	Be selected and installed to minimise the likelihood of damage during installation or use caused by impact, abrasion, penetration, tension or compression.
522.7	Vibration	Have appropriate supports and appropriate fixings for the expected conditions. Cables with flexible cores may be required.
522.8	Other mechanical stresses	Be protected from damage by having sufficient numbers of appropriate supports, bends of appropriate radius, enclosures without sharp edges and means to permit expansion (where required). Where buried in the structure, adequate access points and suitable protection must be included.
522.9	Prescence of flora and/or mould growth	Include measures such as suitable positioning or planned maintenance.
522.10	Presence of fauna	Be positioned, have mechanical characteristics or additional mechanical protection sufficient to resist damage to the system by the animals expected, for example, livestock in agricultural locations.
522.11	Solar and ultraviolet radiation	Be suitable for the effects of such radiation, for example, by colour or be adequately shielded or positioned to resist detrimental effects.
522.12	Seismic effects	Be suitably fixed for any likely seismic hazards. Connections between the fixed wiring and essential equipment, such as safety services should have adequate flexibility.
522.13	Movement of air	Have appropriate supports for the expected conditions. Consideration should also be given to the effects of vibration and other mechanical stresses.
522.14	Nature of processed or stored materials	Have appropriate measures for any particular fire risks to minimise fire spread in accordance with Section 422 and Section 527, respectively.
522.15	Building design	Have appropriate supports to avoid excessive stress in the event of structural movement. A flexible wiring system may be required where such movement is expected.

[5] Included in this group are the use of SELV or PELV and additional protection by an RCD. These are omitted because they are not a measure against impact.

TYPICAL VALUES OF EXTERNAL EARTH FAULT LOOP IMPEDANCE

This Guide gives information on the recommended earth fault loop impedance (Z_e) values given in the Energy Networks Association (ENA) publication Engineering Recommendation P23/2. *Guidance on Earth Fault Loop Impedance at Customers' Intake Supply Terminals.*

DISTRIBUTED SYSTEM EARTHING ARRANGEMENTS

Table 1 below, based on the guidance given in P23/2 gives details of the typical earth fault loop impedance (Z_e) which can be expected at the point of supply to a consumer's installation.

Table 1: Typical maximum Earth Fault Loop Impedance values for existing connections (applicable to all distributed system earth arrangements)

Installation voltage and type	Maximum service capacity (A)	Typical values of EFLI under normal network conditions	
		EFLI (Ω)	Proportion of installations where EFLI will occur (%)
230 V single-phase (Residential premises)	100	< 0.34	90
		< 0.64	98
		> 0.64	2
400 V three-phase (Large residential, commercial and light industrial premises)	150	≤ 0.42	95
	200	≤ 0.31	
	300	≤ 0.21	
	400	≤ 0.16	
	600	≤ 0.10	

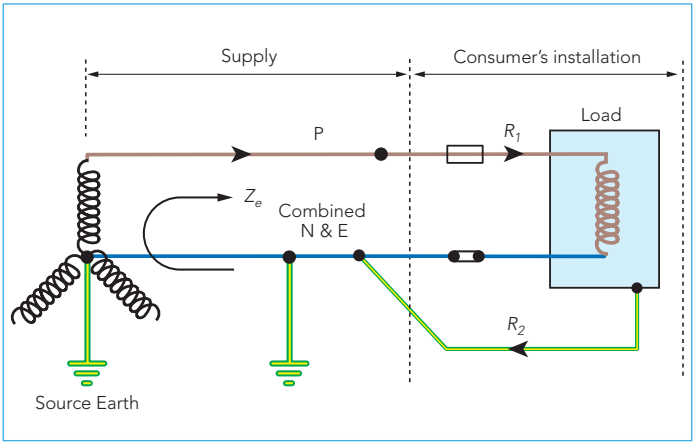
It should be noted that DNOs are not required to provide or maintain networks which provide a particular maximum value of EFLI.

THE VALUES GIVEN IN TABLE 1 ARE:

- Typical maximum values and the measured value of EFLI can change depending on the network configuration due to alterations, faults, maintenance and the effect of any embedded generation capacity.
- Applicable to all distributed system earthing arrangements. Prior to the publication of P23/2, the ENA stated values of typical maximum Ze which varied depending on the type of system earthing arrangement employed.

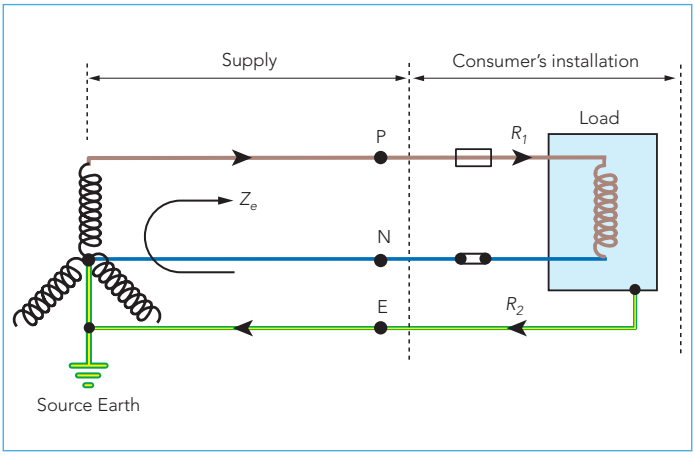
TYPICAL VALUES OF EXTERNAL EARTH FAULT LOOP IMPEDANCE

FIG 1. TN-C-S SYSTEM (PME/PNB)



Note: Protective Neutral Bonding (PNB) is similar to PME except the neutral conductor is only earthed at one point which is usually located closer to the customer than the transformer and often connected at the cut-out.

FIG 2. TN-S SYSTEM



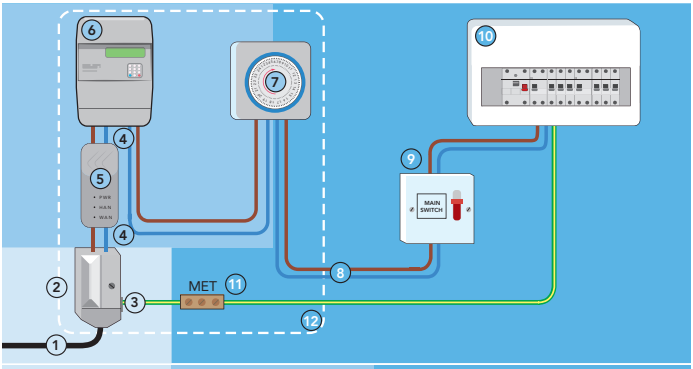
RESPONSIBILITY FOR SERVICE POSITION EQUIPMENT

This Guide gives information on the parties responsible for the electrical equipment found at the service position of an electrical installation, based on the information given in the *Guidance for Service Termination Issue Reporting* issued in January 2018 to accompany the Meter Operation Code of Practice Agreement (MOCOPA).

The intention of this Guide is to provide electrical installation contractors (contractors for short) with an understanding of which parts of the equipment at the service position are the responsibility of the Distribution Business (DB), which parts are the responsibility of the Supplier and which parts are the responsibility of the person ordering the work (typically the customer), and what action to take where a defect to the equipment is identified. Fig 1 illustrates, in accordance with the MOCOPA, the boundaries of responsibility for a typical service position where the supply is TN-C-S (similar responsibilities apply to TT systems).

There are a number of companies known as Meter Operators which also operate in the electricity supply chain; however, they are not a party having responsibilities for equipment. Meter Operators install and maintain metering equipment under agreement, generally with the Supplier.

FIG 1. RESPONSIBILITY FOR EQUIPMENT AT THE SERVICE POSITION (REPRODUCED FROM THE MOCOPA)



DB equipment

1. Service cable
2. Cut-out (or main or DB fuse)
3. DB earth terminal

Supplier equipment

4. Meter tails (cut-out to meter and meter to timeswitch)
5. Communications hub if fitted (may be within the meter)
6. Meter
7. Timeswitch (if fitted)

Customer equipment

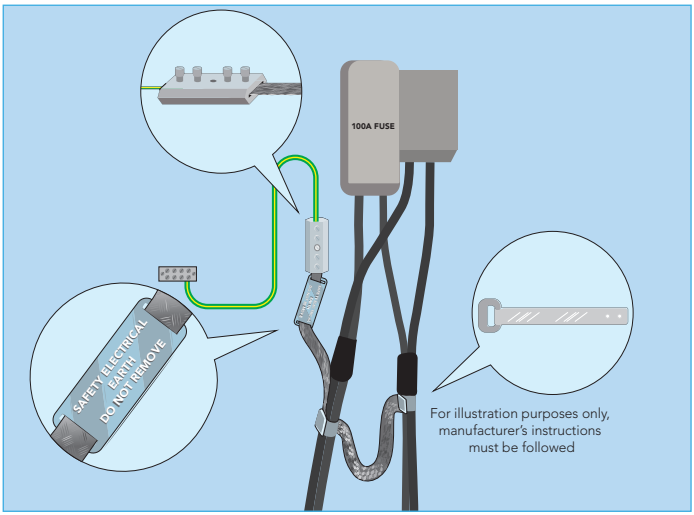
8. Meter tails (between the meter/timeswitch and the Customer equipment)
9. Customer isolating switch (if fitted/requested)
10. Customer consumer unit
11. Customer earthing conductor (and earth block if fitted)
12. Meter board (and external meter box if fitted)

MOCOPA was issued on 1st July 2013 with the primary purpose to provide meter operatives with guidance on what action to take where a defect is identified in the distributor's equipment at the service position and to provide an efficient process for meter operatives to report the defect (using a system of codes) to the particular distributor.

RESPONSIBILITY OF SERVICE POSITION EQUIPMENT

Fig 1 does not detail all the possible scenarios for equipment at the service position and it is not a wiring diagram for an installation. However, MOCOPA will be of use to contractors and others working in the electrical industry as it clarifies the boundaries of responsibility. From Fig 1, contractors should recognise that a potential for change in responsibility exists for part of the earthing system (conductor and earth block) where the supply is TN-S, such as where the Distribution Business originally connected the means of earthing, for the customer's use, to the lead sheath by soldering or using a clamp. In cases where this connection is found to present an immediate risk of danger, Asset Condition Code A10 of the MOCOPA places the responsibility on the Distribution Business (rather than the customer) to repair/maintain any defects. In such cases, it is likely that the Distribution Business will install a consumer earth bond clamp (often referred to as a Hepworth clamp). See Fig 2.

FIG 2. EXAMPLE OF AN INDUSTRY APPROVED CONSUMER EARTH BOND (HEPWORTH) CLAMP WITH THE CUSTOMER'S EARTHING CONDUCTOR CONNECTED.



Generally the customer, as they are the account holder, reports the defect to their Supplier quoting their reference number. Alternatively, the person ordering the work would be responsible for contacting the relevant party to report any recorded defects.

Because MOCOPA advises on a reporting process for meter operatives, where contractors as part of an initial inspection or a periodic inspection identify a defect in the Distribution Business or Suppliers' equipment at the service position, for example, the cut-out is damaged, that defect should be recorded on the relevant certificate or report, and the contractor should inform the customer (owner or user of the installation).

COMMONLY USED STANDARDS

This Guide lists[1] the standard number for some of the British Standards and adopted European Harmonised Standards commonly used in the electrical industry, and may assist electrical contractors when recording standard numbers on certificates and reports or identifying and/or verifying items of equipment.

The full titles relating to the standards given in this Guide are omitted and replaced with a simplified 'Related to' reference. Some standards have been withdrawn; however, they are included because their associated equipment may still be found in-service.

Standard	Related to
BS 67	Ceiling roses
BS 88 (series) *and BS EN 60269* (series)	Cartridge fuses (typically called HRC fuses)
BS 546	Socket-outlets having round pin (typically used for lighting)
BS 842	Voltage-operated earth-leakage circuit-breakers
BS 951	Clamps for earthing and bonding
BS 1361 (withdrawn)	Cartridge fuses (typically used in domestic and similar consumer units)
BS 1362	Cartridge fuses (primarily for use in plugs)
BS 1363 (series)	Socket-outlets, connection units, plugs and adaptors
BS 3036	Semi-enclosed fuses (rewireable)
BS 3535 (withdrawn)	Safety isolating transformers
BS 3871 (withdrawn)	Circuit-breakers (First generation of circuit-breaker introduced in 1965, and typically identified by 'type numbers' 1 - 4)
BS 4177	Cooker control units
BS 4293 (withdrawn)	Residual current operated circuit-breakers (First generation of RCD introduced in 1983 to replace current operated earth-leakage circuit-breakers)
BS 4573	Shaver sockets and associated plugs
BS 5266 (series)	Emergency lighting systems
BS 5467	Armoured cables having thermosetting insulation

[1]A comprehensive list is given in Appendix 1 of *BS 7671*

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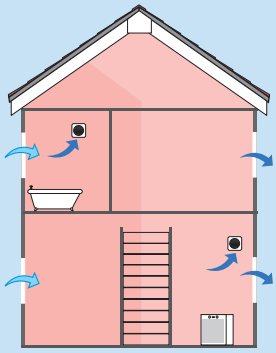
COMMONLY USED STANDARDS

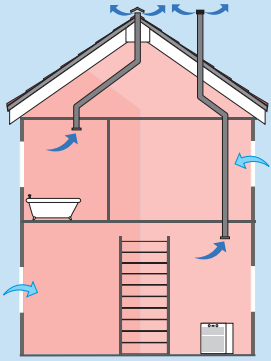
BS 5486 (withdrawn)	Low voltage switchgear and controlgear assemblies
BS 5839 (series)	Fire detection and fire alarm systems
BS 6004	Non-armoured cables having PVC insulation and PVC insulation and sheath
BS 6724	Armoured cables having thermosetting insulation with LSF emission
BS 7211	Non-armoured cables having thermosetting insulation with LSF emission
BS 7375	Electricity distribution systems on construction and building sites
BS 7430	Earthing of electrical installations
BS 7846	Armoured fire-resistant cables having thermosetting insulation
BS 8436	Screened cables having LSF emission for use in walls, partitions and voids
BS 9991	Fire safety in the design, management and use of residential buildings. Code of practice
BS 9999	Fire safety (design and management)
BS EN 50085 (series)	Cable trunking and cable ducting systems
BS EN 60309 (series)	Socket-outlets, plugs and couplers for industrial use
BS EN 60439 (series) (withdrawn)	Low voltage switchgear and controlgear assemblies
BS EN 60529	Degrees of protection provided by enclosures (IP codes)
BS EN 60598 (series)	Luminaires
BS EN 60702 (series)	Mineral insulated cables
BS EN 60898 (series)	Circuit-breakers (Second generation of circuit-breaker introduced in 1991, and typically identified by 'type letters' B – D)
BS EN 60947 (series)	Low voltage switchgear and controlgear, including disconnectors
BS EN 61008-1	Residual current operated circuit-breakers not having overcurrent protection (Second generation of RCD introduced in 1995)
BS EN 61009-1	Residual current operated circuit-breakers having overcurrent protection
BS EN 61386 (series)	Conduit systems (including flexible, rigid, pliable and underground)
BS EN 61439 (series)	Low voltage switchgear and controlgear assemblies (Part 3 of this series is related to distribution boards intended for operation by ordinary persons - also known as consumer units)
BS EN 61558 (series)	Transformers (including shaver supply units)

DOMESTIC VENTILATION SYSTEMS

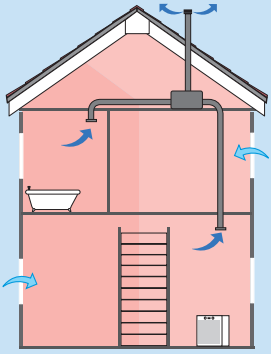
SYSTEM TYPES



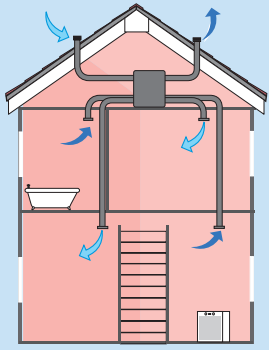
System 1
Background ventilators and intermittent extract fans



System 2
Passive stack ventilation



System 3
Continuous mechanical extract



System 4
Continuous mechanical supply and extract with heat recovery

For further information –

ENGLAND & WALES

- Approved Document F (Ventilation)
- Domestic Ventilation Compliance Guide

SCOTLAND

- Technical Handbook – Domestic
- Building Standards Supporting Guidance Domestic Ventilation 2nd Edition

NORTHERN IRELAND

- Technical Booklet K (Ventilation)

NICEIC ELECSA

updated to 18TH EDITION BS 7671:2018

DOMESTIC VENTILATION SYSTEMS
NEW DWELLINGS

TABLE 1 EXTRACT VENTILATION RATES

Room	Intermittent extract	Continuous extract	
	Minimum rate	Minimum high rate	Minimum low rate
Kitchen	30 l/s adjacent to hob; or 60 l/s elsewhere	13 l/s	Total extract rate should be at least the whole **dwelling ventilation rate** given in Table 2
Utilty room	30 l/s	8 l/s	
Bathroom	15 l/s	8 l/s	
Sanitary accomodation	6 l/s*	6 l/s	

***Note:** In Scotland, 3 air changes/hour

TABLE 2 WHOLE DWELLING VENTILATION RATES

Number of bedrooms in dwelling					
	1	2	3	4	5
Whole dwelling ventilation rate [a. b.] (l/s)	13	17	21	25	29

Notes:

a. In addition, the minimum ventilation rate should be not less than 0.3 l/s per m^2 of internal floor area. (This includes all floors, e.g. for a two-storey building add the ground and first floor areas.)

b. This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. This should be used as the default value. If a greater level of occupancy is expected add 4 l/s per occupant.

Notification of work

In most cases where it is proposed to carry out notifiable ventilation work on a building it will be necessary to notify the work to a Building Control Body (BCB) in advance. This notification would usually be by way of a full plans application or a building notice given to a local authority, or an initial notice given jointly with the approved inspector. Alternatively work can be notified through the NICEIC Ventilation Competent Persons Scheme. s

All fixed mechanical ventilation systems, where they can be tested and adjusted, shall be commissioned and a commissioning notice given to the BCB. For mechanical ventilation systems installed in new dwellings, air rates shall be measured on site and a notice given to the BCB. This shall apply to intermittently-used extract fans and cooker hoods, as well as continuously running systems.

The owner shall be given sufficient information about the ventilation system and its maintenance requirements so that the ventilation system can be operated to provide adequate air flow.

APPROVED DOCUMENT F TO THE BUILDING REGULATIONS (England & Wales 2010)

This Guide provides a quick reference to whether ventilation system work needs to be notified to a Building Control Body (BCB) in accordance with the Building Regulations 2010 for England and Wales. A company registered with a ventilation self-certification scheme, such as those operated by NICEIC, is not required to notify a BCB prior to carrying out 'notifiable work'. However, the registered business must notify their relevant registration body following completion of the notifiable work so that a copy of the Building Regulations compliance certificate will be issued to the occupier, and so that the certificate (or a copy of the information on it) will be issued to the BCB.

APPLICATION OF PART F

In England and Wales, Part F of the Building Regulations applies to fixed systems for mechanical ventilation and includes a number of different system types:

Work	Related to	Commisioning Notice*
Emergency repairs to ventilation system (no changes made to ventilation system)	No	Yes

Note: In such cases it will be necessary for the work to comply with the relevant requirements and to give a notice to the BCB at the earliest opportunity

Emergency repairs to ventilation system (changes made to ventilation system)	Yes	Yes

Note: In such cases it will be necessary for the work to comply with the relevant requirements and to give a notice to the BCB at the earliest opportunity, unless an installer registered under an appropriate competent person scheme carries out the work

Planned replacement of a ventilation system on a like-for-like basis	No	Yes

Note: Assuming existing cabling is used

Minor Works	No	Yes

Note: Such as replacement of parts or unit on a like-for-like basis (using existing cabling), or the addition of an output or control device where testing and adjusting is not possible or would not affect the system's energy efficiency

* A commissioning notice is always required where testing and adjustment must be carried out to ensure the system operates efficiently.

APPROVED DOCUMENT F TO THE BUILDING REGULATIONS (England & Wales 2010)

Work	Related to	Commisioning Notice*
System 1 installation (no open flued combustion appliance installed)	No	Yes

Note: Provision of a self-contained mechanical ventilation appliance provided that any electrical work is exempt from a requirement to give advance notice to a BCB, and testing and adjustment is not possible or would not affect its energy efficiency, and the appliance is not installed in a room containing an open flued combustion appliance. Examples might be a cooker hood, a bathroom extract fan or a room air-conditioning unit, which cannot be adjusted from their factory settings.

System 1 installation (open flued combustion appliance installed)	Yes	Yes

Note: Examples might be a cooker hood that extracts to outside, a bathroom extract fan etc.

System 2 installation	Yes	Yes

Note: Passive Stack Ventilation (PSV)

System 3 installation	Yes	Yes

Note: Continuous mechanical extract

System 4 installation	Yes	Yes

Note: Continuous mechanical supply and extract with heat recovery

* A commissioning notice is always required where testing and adjustment must be carried out to ensure the system operates efficiently.

PROTECTIVE EQUIPOTENTIAL BONDING OF METALLIC GAS INSTALLATION PIPEWORK IN DOMESTIC PREMISES

This Pocket Guide provides guidance on the acceptable location for the connection of a protective equipotential bonding (PEB) conductor to metallic gas pipework installed in domestic premises. A protective bonding conductor is not required where the gas pipe is not an extraneous-conductive-part; that is where the incoming gas pipe is non-metallic (411.3.1.2 refers).

The requirements of *BS 7671* are also stipulated to gas engineers via Gas Safe Register's Technical Bulletin (TB) 102 *'Location of protective equipotential bonding on gas installation pipework in domestic premises'*.

BS 7671, REGULATION 544.1.2

> *"The main protective bonding connection to any extraneous-conductive-part such as gas, water or other metallic pipework or services shall be made as near as practicable to the point of entry of that part into the premises. Where there is a meter, isolation point or union, the connection shall be made to the consumer's hard metal pipework and before any branch pipework. Where practicable the connection shall be made within 600 mm of the meter outlet union or at the point of entry to the building if the meter is external."*

The requirements of *BS 7671* are also expressed in British Standards used by gas engineers, for example *BS 6891* (for gas pipework not exceeding 35 mm (R11/4)

BS 6891, CLAUSE 8.4.3.1

> *"A gas installation within a property with an electrical supply shall have a main protective bonding conductor connecting the pipework to the electrical installation's main earth terminal, as specified in BS 7671."*

Given the above, PEB should be connected to metallic pipework and specifically, to gas pipework as follows:

Internal gas meter (for example, under the stairs)

- preferably within 600 mm of the outlet union of the meter; and
- before any branch (tee) in the pipework.

External gas meter or enclosure (within a meter box)

- preferably within 600 mm of the pipework entering the property, or
- within the meter box, provided that the box's integrity and that of any sleeve (for example, its ability to prohibit the passage of gas either into the property or the wall cavity) is maintained (see overleaf); and
- before any branch in the pipework.

BS 7671: 2018 Requirements for electrical installations. IET Wiring Regulations Eighteenth Edition.

BS 6891: 2015 Specification for the installation and maintenance of low pressure gas installation pipework of up to 35 mm (R11/4) on premises.

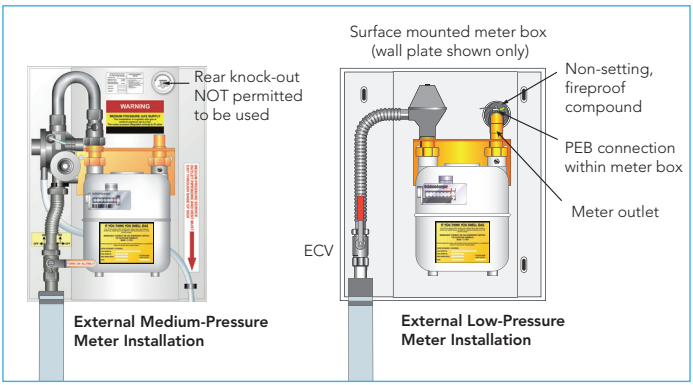
PROTECTIVE EQUIPOTENTIAL BONDING OF METALLIC GAS INSTALLATION PIPEWORK IN DOMESTIC PREMISES

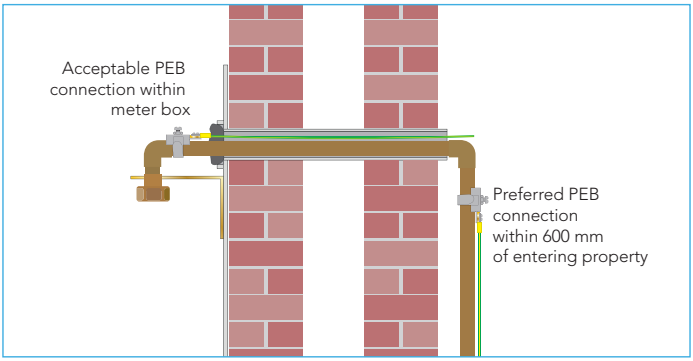
SLEEVES FOR GAS PIPEWORK

Low-pressure gas meter installations ONLY (≤ 75 mbar) can utilise a rear exit sleeve of a meter box for routing the gas pipework into the property (surface mounted and semi-concealed meter box - see illustrations below).

Where this arrangement is encountered, the exit sleeve can also be used for routing the PEB conductor. The sleeve must be sealed within the box (one end only) with non-setting fire resisting compound, ensuring the annulus around the pipe and the PEB is completely sealed.

Installation pipework and therefore, PEB from medium-pressure (MP) fed meter installations (> 75 mbar ≤ 2 bar) is prohibited from entering a property via a rear exit meter box sleeve. In this scenario, the installation pipework must exit the base of the box externally before entering the property via a sleeve (not shown). This sleeve may also be used for routing of the PEB.





IDENTIFICATION OF EXTRANEOUS-CONDUCTIVE-PARTS

This guide gives information on identification of extraneous-conductive-parts and whether or not they need to be bonded.

WHAT IS AN EXTRANEOUS-CONDUCTIVE-PART?

*BS 7671: 2018** defines an extraneous-conductive-part as -

> *A conductive part liable to introduce a potential, generally Earth potential, and not forming part of the electrical installation.*

WHAT ARE THE REQUIREMENTS OF *BS 7671?*

Where the protective measure automatic disconnection of supply (ADS) is applied, Regulation 411.3.1.2 requires that in each installation main protective bonding conductors complying with Chapter 54 shall connect to the main earthing terminal (MET) extraneous-conductive-parts including the following:

i. water installation pipes,

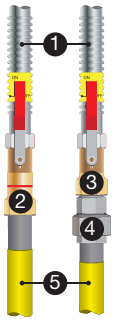
ii. gas installation pipes,

iii. other installation pipework and ducting,

iv. central heating and air conditioning systems,

v. exposed metallic structural parts of the building.

Installation and/or service pipework entering a building that is wholly non-metallic or metallic pipework with an insulating section/fitting at the point of entry (as illustrated below) should not be connected to the protective equipotential bonding (see also *Items not considered to be extraneous-conductive-parts* on the reverse of this Guide). Refer to 411.3.1.2 for the full requirement.



1. Pliable connector (generally referred to as an 'Anaconda' within the gas industry)
2. Proprietary emergency control valve (ECV) incorporating electrical insulation (the red band below the ECV)
3. Standard ECV
4. Steel fitting incorporating electrical insulation
5. Steel gas service with applied corrosion protection (other forms of corrosion protection to that shown and which are not visible may also be utilised)

**BS 7671: 2018 Requirements for electrical installations. IET Wiring Regulations Eighteenth Edition.*

updated to 18TH EDITION BS 7671:2018

IDENTIFICATION OF EXTRANEOUS-CONDUCTIVE-PARTS

CAUTION: Insulated fittings (couplings) used on metallic pipework, particularly older designs, may be difficult to identify (without appropriate tagging or marking). Where doubt exists, bond pipework to the MET of the installation.

ITEMS NOT CONSIDERED TO BE EXTRANEOUS-CONDUCTIVE-PARTS

Normally metallic items such as suspended ceilings and floors, are insulated from Earth and are therefore deemed to be isolated metalwork and not extraneous-conductive-parts. Similarly, an external component such as a metal staircase may be fixed to the building structure but, owing to the manner of fixing, it may be considered to be isolated metalwork, where not directly connected to the building lightning protection system.

Even an apparently extraneous-conductive-part that is not readily accessible to touch would not require bonding. For example, where 'earthy' metallic pipework is enclosed by insulating material (boxed in).

Internal structures such as filing cabinets, racking systems, and metallic tables and work surfaces – such as those found in commercial kitchens – and similar items do not normally require bonding.

DETERMINING AN EXTRANEOUS-CONDUCTIVE-PART BY MEASUREMENT

Where there is doubt as to whether Earth potential is liable to be introduced by a conductive part that is connected to the general mass of Earth, a continuity measurement should be made of the resistance between the conductive part (R_{cp}) and the MET of the installation, this will give an indication of whether or not something constitutes an extraneous-conductive-part; it may be necessary to remove any parallel earth paths to be able to measure the conductive part.

The measured resistance (excluding body resistance) is then inserted into the following formula to determine if the conductive part is an extraneous-conductive-part:

$$Rcp > \frac{U_o}{I_b}$$

Where

R_{cp} is the resistance between the conductive part concerned and the MET of the installation in ohms (Ω).

U_o is the nominal voltage to Earth of the installation in volts.

I_b is the value of current through the human body (or livestock) which should not be exceeded in amperes (when protected by an RCD have a rated residual operating current not exceeding 30 mA).

Example: For a 230 V (50 Hz) supply, an item would not be considered an extraneous-conductive-part where R_{cp} is not less than 7.67 kΩ as shown:

$$\frac{230}{0.030} = 7.67\ \text{k}\Omega$$