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Future developments in the IEE Wiring Regulations (BS 7671:2008)

A brief overview

by Geoff Cronshaw

CENELEC, the European Committee for Electrotechnical Standardization, publishes two kinds of standards, the European Standard (EN) and the Harmonised Document (HD). The HD and EN differ slightly. The EN must be literally transposed as it is, word for word, in all CENELEC member countries, where as, for the HD it is only the technical content that must be transposed into national standards. BS 7671, *Requirements for Electrical Installations,* takes account of the technical intent of CENELEC Harmonization Documents.

Currently there are three main areas of development which it is expected will be included within a future amendment to BS 7671:2008; these are:

- Section 710 - Medical locations
- Section 444 - Measures against Electromagnetic Influences, and
- Section 534 - Devices for Protection against Overvoltage (Surge Protection Devices)

Section 710 applies to electrical installations in medical locations so as to ensure safety of patients and medical staff. These requirements, in the main, refer to hospitals, private clinics, medical and dental practices, healthcare centres and dedicated medical rooms in the work place. This Section also applies to electrical installations in locations designed for medical research. The requirements of this Section do not apply to medical electrical equipment.

Section 444 deals with measures against electromagnetic disturbances. Electromagnetic Interference (EMI) may disturb or damage information technology equipment/systems as well as equipment with electronic components or circuits. Currents due to lightning, switching operations, short-circuits and other electromagnetic phenomena may cause overvoltages and electromagnetic interference. Section 444 provides basic requirements and recommendations to enable the avoidance and reduction of electromagnetic disturbances.

Section 534 deals with the installation of surge protective devices (SPD). The requirements of Section 534 are for the selection and erection of SPDs for electrical installations of buildings in order to limit transient overvoltages of atmospheric

origin transmitted via the supply distribution system and against switching overvoltages. The requirements are also intended to protect against transient overvoltages caused by direct lightning strikes or lightning strikes in the vicinity of buildings, protected by a lightning protection system.

The requirements do not take into account surge protective components, which may be incorporated in the appliances connected to the installation.

SECTION 710 - MEDICAL LOCATIONS

The risks

There are particular risks associated with medical locations. Therefore stringent measures are necessary to ensure the safety of patients likely to be subjected to the application of medical electrical equipment.

Shock hazards, due to bodily contact with the 50 Hz mains supply, are well known and documented. Currents of the order of 10 mA passing through the human body can result in muscular paralysis followed by respiratory paralysis depending on skin resistances, type of contact, environmental conditions and duration. Eventual ventricular fibrillation can occur at currents just exceeding 20 mA. These findings are listed in IEC/TR2 60479-1 'Effects of current on human beings and livestock – general aspects'.

The natural protection of the human body is considerably reduced when certain clinical procedures are being performed on it. Patients under treatment may have their skin resistance broken or their defensive capacity either reduced by medication or nullified while anaesthetised. These conditions increase the possible consequences of a shock under fault conditions.

In patient environments where intracardiac procedures (see note1) are undertaken, the electrical safety requirements are even stricter, in order to protect the patient against 'microshock'. Patient leakage currents from applied parts introduced directly to the heart can interfere with cardiac function at current levels which would be considered safe under other circumstances.

Patient leakage current which can flow into an earthed patient is normally greatest when the equipment earth is disconnected. A limit is set to the amount of leakage current which can flow in the patient circuit when the protective earth conductor is disconnected. Patient leakage currents (see note 2) of the order of 10 µA have a probability of 0.2 % for causing ventricular fibrillation or pump failure when applied through a small area of the heart. At 50 µA (microshock), the probability of ventricular fibrillation increases to the order of 1 % (refer to BS EN 60601-1).

Note (1)
"intracardiac procedure": This is a procedure whereby an electrical conductor is placed within the heart of a patient or is likely to come into contact with the heart, such conductor being accessible outside the patient's body. In this context, an electrical conductor includes insulated wires, such as cardiac pacing electrodes or intracardiac ECG electrodes, or insulated tubes filled with conducting fluids (catheter).

Note (2)
"Patient's leakage current": Current flowing from a medical electrical equipment applied part via the patient to earth.

Additional to the consideration of risk from electric shock, some electromedical equipment (life-support equipment, surgical equipment) perform such vital functions that loss of supply would pose an unacceptable risk to patients. Medical locations where such equipment is used require secure supplies. This has implications not only for the provision of safety (emergency) power supplies but also render some conventional protection measures unsuitable. Hence, for example, when protecting circuits supplying critical medical equipment, restrictions are stipulated on the use of RCDs.

Additional measures

Since the type and description of these hazards can vary according to the treatment being administered, the manner in which a medical room is used necessitates some division into different areas for differing medical procedures. Section 710 segregates medical locations into different "Groups". These are:

Group 0 medical location where no applied parts are intended to be used and where discontinuity (failure) of the supply cannot cause danger to life.

Group 1 medical location where discontinuity of the electrical supply does not

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represent a threat to the safety of the patient and applied parts are intended to be used as follows:

- externally
- invasively to any part of the body, except where 710.3.7 applies

Group 2 medical location where applied parts are intended to be used in applications such as intracardiac procedures, vital treatments and surgical operations where discontinuity (failure) of the supply can cause danger to life.

To protect patients from possible electrical hazards, Section 710 requires additional protective measures to be applied in medical locations. These include:

- particular requirements for protection against electric shock
- medical IT systems
- requirements concerning supplementary equipotential bonding
- additional requirements for the selection and erection of electrical equipment including switchgear and controlgear
- safety services including the sources and detailed requirements for safety lighting

SECTION 444 - MEASURES AGAINST ELECTROMAGNETIC DISTURBANCES

Section 444 provides basic requirements and recommendations to enable the avoidance and reduction of electromagnetic disturbances. These include the use of surge protection devices and/or filters, the routing of conductors (live and protective conductors) of a power circuit to avoid inductive loops, by-pass equipotential bonding conductor for screen reinforcement and the separation of power and signal cables.

Section 444 requires that consideration must be given to the location of the sources of electromagnetic disturbances relative to the positioning of other equipment. Potential sources of electromagnetic disturbances within an installation typically include:

(i) Switching devices for inductive loads
(ii) Electric motors
(iii) Fluorescent lighting
(iv) Welding machines
(v) Rectifiers
(vi) Choppers
(vii) Frequency converters/ regulators including Variable Speed Drives (VSD)
(viii) Lifts
(ix) Transformers
(x) Switchgear
(xi) Power distribution busbars

Note: For further information refer to the BS EN 50174 Series of Standards

Section 444 includes the following measures to reduce the effects of electromagnetic interference:

(i) Metal sheaths, screens or armouring of cables shall be bonded to the CBN unless such bonding is required to be omitted for safety reasons.

(ii) Where screened signal or data cables are earthed, care shall be taken to limit the fault current from power systems flowing through the screens and cores of signal cables, or data cables.

(iii) The use of additional conductors shall be considered, e.g. a by-pass equipotential bonding conductor for screen reinforcement.

(iv) The impedance of equipotential bonding connections intended to carry functional earth currents having high frequency components shall be as low as practicable and this should be achieved by:

(a) being as short as possible, and either
(b) having a shape that results in a low inductive reactance and impedance per metre of route, e.g. a bonding strap/strip (with a width:thickness ratio of at least 5:1 and a length: width ratio of no greater than 5:1) or a braid or
(c) the use of separated multiple bonds

(v) The use of surge protection devices and/or filters to improve electromagnetic compatibility with regard to conducted electromagnetic phenomena for electrical equipment sensitive to electromagnetic disturbances.

(vi) The selection of a common route for all the conductors, (live and protective conductors) of a power circuit to avoid inductive loops.

(vii) The separation of power and signal cables.

Where a lightning protection system is installed, reference shall be made to BS 6651 (BS EN 62305).

Section 444 also includes requirements on earthing, equipotential bonding, segregation of circuits and cable management systems.

The appendices to this section include examples of protective conductors in star network, multiple meshed bonding star network, common meshed bonding star network, equipotential bonding networks in a structure without a lightning protection system and examples of Cable Separation and Segregation.

SECTION 534 - DEVICES FOR PROTECTION AGAINST OVERVOLTAGES

Section 534 deals with the installation of surge protective devices (SPD) where required by Section 443 of BS 7671:2008 or where otherwise specified by the designer.

This Section sets out the requirements for the selection and erection of

– SPDs for electrical installations of buildings to obtain a limitation of transient overvoltages of atmospheric origin transmitted via the supply distribution system and against switching overvoltages
– SPDs for the protection against transient overvoltages caused by direct lightning strokes or lightning strikes in the vicinity of buildings, protected by a lightning protection system.

Surge protective components incorporated into appliances are not taken into account.

Generally, any switching

operation, fault initiation, interruption, etc., in an electrical installation is followed by a transient phenomenon in which overvoltages can occur. The sudden change in the system can initiate damped oscillations with high frequencies (determined by the resonant frequencies of the network), until the system is stabilised to its new steady state. The magnitude of the switching overvoltages depends on several parameters, such as the type of circuit, the kind of switching operation (closing, opening, restriking), the loads and the protection device. In most cases, the maximum overvoltage is up to twice the amplitude of the system voltage but higher values can occur, especially when switching inductive loads (motors, transformers) or capacitive loads or even resistive loads connected very near to the terminals of a supply transformer. Also, interruption of short-circuit currents can cause high overvoltages. If current chopping occurs, relatively high energy can be stored in inductive loads and oscillations can occur on the load side of the opening switch or protective device.

As detailed within BS EN 62305 *"Protection against lightning"*, surges present a risk of dangerous sparking or flashover leading to possible fire and electric shock hazards. Surges also present risk of disruption, degradation and damage to electrical and electronic equipment leading to costly system downtime.

A surge protective device (SPD) is a device that is intended to limit transient overvoltages and divert surge currents. SPDs shall have the necessary capability to deal with the current levels and durations involved in the surges to be expected at their point of installation. In most cases, switching overvoltages are less damaging than lightning overvoltages and SPDs which are effective for protection against lightning overvoltages are also effective against switching surges. SPDs shall comply with BS EN 61643-11 and BS EN 61643-11/A11.

Section 534 contains detailed requirements for the selection, erection and co-ordination of SPDs in building installations. These include the use of SPDs and the connection of SPDs. Also, protection against overcurrent and consequences of an SPD failure are dealt with together with fault protection, SPD installation in conjunction with RCDs, Measurement of the insulation resistance, and the connecting conductors.

FURTHER INFORMATION

Important: this article is only intended as a brief summary of possible forthcoming requirements in BS 7671. Persons involved in these areas should seek specialist advice. For information on the installation of surge protective devices see HD 60364-5-534. For information on medical locations seek advice from the UK Health Departments.

CONCLUSION

Under these new sections designers and persons involved in electrical installations will have detailed requirements to follow for:

(i) the avoidance and reduction of electromagnetic disturbances
(ii) the installation of surge protective devices (SPDs)
(iii) medical locations.

A future amendment to the IEE Wiring Regulation (BS 7671:2008) incorporating these changes is expected during 2011. ■

Additions and Alterations by Mark Coles

BS 7671:2008, the 17th Edition of the IEE Wiring Regulations, contains specific requirements relating to additions and alterations to existing electrical installations. Whether adding an extra socket-outlet in a dwelling or undertaking a major reconfiguration of a large commercial building; in all cases the reconfigured aspect of the installation should comply with BS 7671:2008.

Scenario

Before we start, it is necessary to consider the following scenario which will be frequently cited throughout this article:

An existing ring-final circuit, supplying a number of socket-outlets on the first floor of a dwelling, is planned to be extended by the addition of one socket-outlet. The socket-outlet is to be located beside an existing socket-outlet, from which, the new addition will be incorporated into the ring-circuit. The existing circuit was installed to BS 7671:2001(2004) and complies completely with that edition of the standard. No part of the circuit is protected by an RCD.

Some installers are of the opinion that when adding to an existing circuit, provided that the existing circuit meets the requirements of BS 671:2001(2004), i.e. the 16th Edition, then the 17th Edition simply applies to the new addition. This article shows that in all cases, the 17th Edition is to be applied to the entire circuit worked on.

Introduction to BS 7671:2008

Let's look at the early pages of BS 7671:2008 as these opening paragraphs set the scene.

The first paragraph of the introduction to the 17th Edition is very straightforward as it states the effective date of commencement; the second paragraph, however, is a little more cryptic:

Existing installations that have been installed in accordance with earlier editions of the Regulations may not comply with this edition in every respect. This does not necessarily mean that they are unsafe for continued use or require upgrading.

The intention of this paragraph is to acknowledge that electrical installations may have been installed to earlier versions of the Regulations, e.g. BS 7671:2001(2004) but there is no requirement to bring the installation up to the standard of the 17th Edition unless a periodic inspection report, for example, has highlighted safety issues or an alteration or addition is planned. If a periodic inspection report has identified some issues of safety, which have been given a PIR code 1, for example, the owner/operator of the installation would need to make a decision on the best course of action. Note that a Code 1 recorded on a periodic inspection report requires urgent attention.

Note by the Health and Safety Executive

A note from The Health and Safety Executive (HSE) is included as BS 7671 and the IEE Wiring Regulations have been extensively referred to in HSE guidance over the years. It is pertinent to state that BS 7671 is not a statutory document and it is, therefore, not a legal requirement to follow the practices referred to within. The legal requirements are contained within the Electricity at Work Regulations 1989 (EWR) which includes a requirement that all systems are to be safe - from this requirement, BS 7671 provides the framework to which electrical installations should follow in order to meet the requirements of the law.

There is reference in the note by the HSE, rather like the one seen previously in the introduction, which refers to older installations:

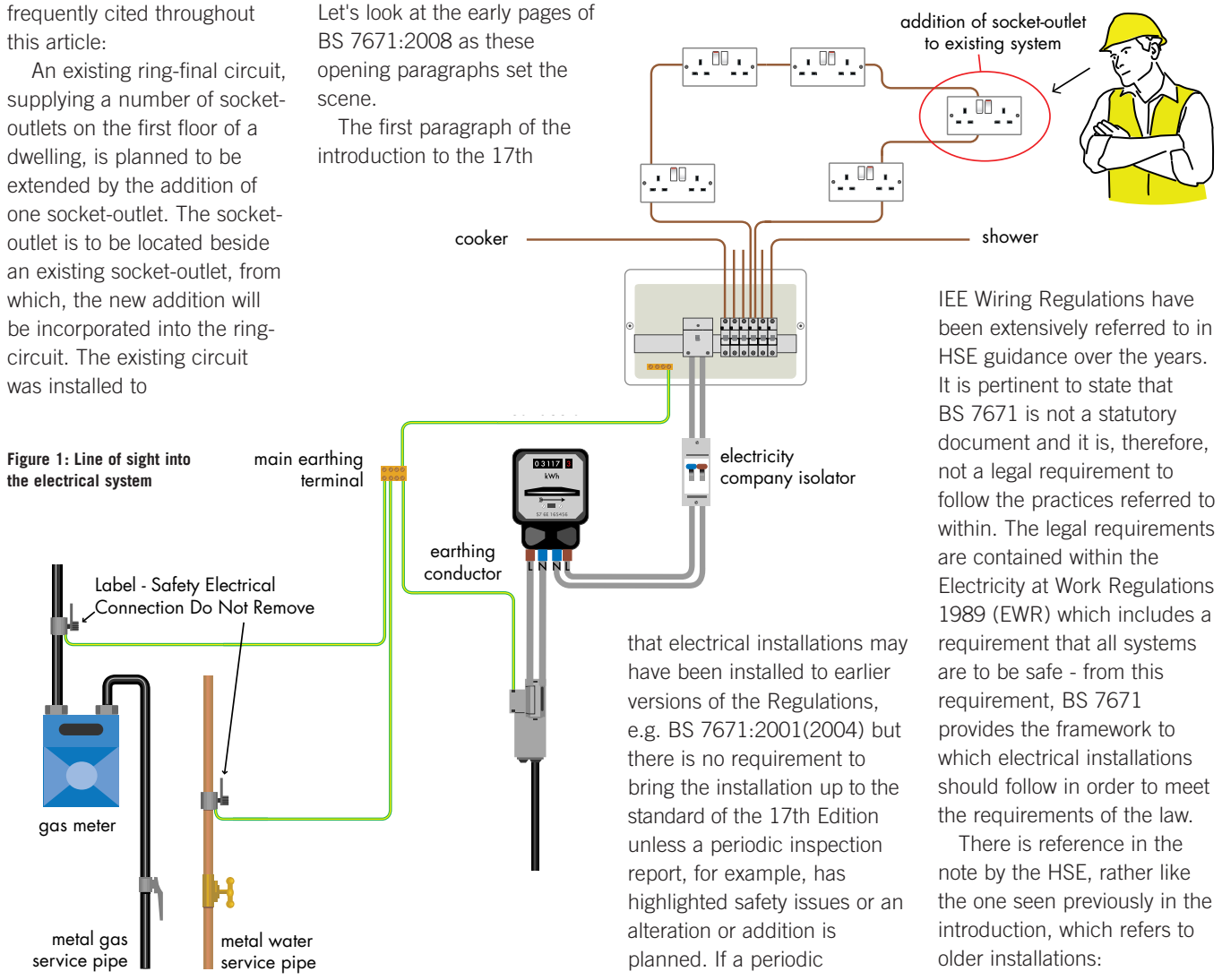


Figure 1: Line of sight into the electrical system

Existing installations may have been designed and installed to conform to the standards set by earlier editions of BS 7671 or the IEE Wiring Regulations. This does not mean that they will fail to achieve conformity with the relevant parts of the Electricity at Work Regulations 1989.

Again, the intent is to make it known that an installation which was not installed to the 17th Edition may not be unsafe and may be suitable for continued use and, hence, does not mean that they will fail to achieve conformity with the relevant parts of the Electricity at Work Regulations 1989

The Regulations

The requirements for additions and alterations in BS 7671:2008 are given in a number of Regulations, each will be examined in this article.

The very first Regulation, 110.1, from the Scope of BS 7671 states that the Regulations have requirements for:

(xx) additions and alterations to installations and also parts of the existing installation affected by an addition or alteration

Note the words "... *parts of the existing installation affected by an addition or alteration*" in part (xx) of the Regulation. When a circuit is extended, the new addition alters the characteristics of the existing circuit/installation to some extent, i.e. the increased load or the resulting earth fault loop impedance.

The next entry is a key Regulation, 131.8 - Additions and alterations to an installation:

131.8 *No addition or alteration, temporary or permanent, shall be made to an existing installation, unless it has been ascertained that the rating and the condition of any existing equipment, including that of the distributor, will be adequate for the altered circumstances. Furthermore, the earthing and bonding arrangements, if necessary for the protective measure applied for the safety of the addition or alteration, shall be adequate.*

The Regulation requires that if you plan to make any changes, the existing installation must be in such a condition which will be suitable for the intended alteration. As is stated, this includes:

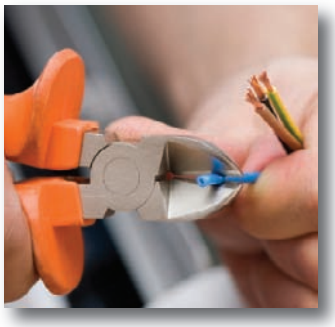
- the equipment belonging to the distributor - e.g. the condition and size of the supply cable, the District Network Operator's (DNO) cutout (sometimes referred to as the "head"), metering equipment, supply and meter-tails
- distribution equipment - switchboard, consumer unit, etc., and
- the earthing and bonding arrangements.

If any part of the installation intended to be altered is not suitable it must be brought up to standard - the standard being BS 7671:2008. Where equipment belonging to the distributor or metering company is not suitable for the altered circumstance, i.e. the tails are undersized or the equipment is damaged with exposed live parts, the installer must ensure that the equipment is in a safe condition before undertaking the installation work. In most cases, it will be necessary to arrange for the distributor and/or metering company to attend site and make the changes; this type of work will usually incur a charge.

Consider the scenario given at the beginning of this article. Upon completion of the work, the installer would take responsibility for his "line of sight" into the installation (see figure 1), i.e. the circuit worked on, the condition of the consumer unit, the earthing and bonding arrangements, the sizing of the

meter-tails and the incoming supply. The installer would not take responsibility for any other circuit within the installation that they have not worked on, however, the electrical installation certificate has a facility for comments on the existing installation. The installer should record any unsafe conditions or practices and, hence, bring them to the client's attention; this requirement can be found in Regulation 633.2:

633.2 *The contractor or other person responsible for the new work, or a person authorized to act on their behalf, shall record on the Electrical Installation Certificate or the Minor Electrical Installation Works Certificate, any defects found, so far as is reasonably practicable, in the existing installation.*



Other requirements of BS 7671 when carrying out additions or alterations

Identification

514.1.2 *As far as is reasonably practicable, wiring shall be so arranged or marked that it can be identified for inspection, testing, repair or alteration of the installation.*

This is a very clear requirement. Usually, conductors are identifiable by colour or alpha-numeric markings; Regulation 514.3.1 refers. Often, in installations of dwellings, the blue conductor, which is usually neutral, is used as a switch-wire on a lighting circuit, it is, therefore, very important to identify this conductor as a line conductor and not leave it blue where it would be expected to be neutral.

514.14.1 *If wiring additions or alterations are made to an installation such that some of the wiring complies with Regulation 514.4 but there is also wiring to previous versions of these Regulations, a warning notice shall be affixed at or near the appropriate distribution board with the wording above right.*

This requirement first appeared in amendment No.2 of BS 7671:2001 in 2004 following the adoption of the harmonized cable core colours from the CENELEC HD 308-S2:2001.

Sealing of wiring systems or penetrations

527.2.3 *During alteration work, sealing which has been disturbed shall be reinstated as soon as practicable.*

This Regulation requires that the resealing of penetrations through walls, etc., is re-established as soon as practicable to stop the spread of fire.

Verification

610.4 *For an addition or alteration to an existing installation, it shall be verified that the addition or alteration complies with the Regulations and does not impair the safety of the existing installation.*

Once an addition or alteration has been made to an installation, it should be verified for compliance with the Regulations prior to certification and subsequent handing over to the client for use.

Departures from the Regulations

BS 7671 permits *intended* departures from the Regulations but the requirements are very specific and two conditions would be acceptable.

The first condition:

120.3 *Any intended departure from these Parts (1 to 7 of the Regulations) requires special consideration by the designer of the installation and shall be noted on the Electrical Installation Certificate specified in Part 6. The resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.*

In Regulation 120.3, the key words are "*The resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations*".

Consider the scenario posed earlier where a socket-outlet is to be added to an existing ring circuit in a dwelling. The existing circuit does not currently have an RCD rated at 30 mA providing additional protection as required by Regulation 411.3.3.

If it is decided that additional protection by use of an RCD rated at 30 mA is not to be provided then some other method, equal in terms of safety to protection against electric shock by additional protection, should be adopted to ensure that the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.

Regulation 410.3.3 gives four methods of protection against electric shock which are generally permitted:

(i) Automatic disconnection of supply (Section 411)
(ii) Double or reinforced insulation (Section 412)
(iii) Electrical separation for the supply to one item of current-using equipment (Section 413)
(iv) Extra-low voltage (SELV and PELV) (Section 414).

Beyond the implementation of automatic disconnection of supply with additional protection by use of an RCD rated at 30 mA, given in (i) of Regulation 410.3.3 and Regulation 411.3.3, it is very unlikely that any of the other three generally permitted measures with an enhancement will be suitable in the posed scenario.

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

The second condition:

120.4 New materials and inventions *Where the use of a new material or invention leads to departures from the Regulations, the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations. Such use is to be noted on the Electrical Installation Certificate specified in Part 6.*

Regulation 120.4 permits the use of a new methodology or item of equipment that may not have been manufactured to a British or other standard, again, the requirement is that *"the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations"*.

Consider again the scenario posed earlier. If the installer decides to leave the existing installation as it is and provide additional protection by means of an RCD rated at 30 mA to the new circuitry/socket-outlet then this will not comply with the 17th Edition. This may be an intended departure from the Regulations but does not meet the criteria for departures so, therefore, will not comply with BS 7671:2008.

Certification

When making alterations to an existing circuit, the person responsible for the construction element of the works is required to issue a certificate for the work undertaken, usually a Minor Electrical Installation Works Certificate but it is also acceptable to issue an Electrical Installation Certificate. Note that a Periodic Inspection Report is a Form, not a certificate and is not suitable for electrical installation work as it does not certify anything.

The following Regulations have requirements for certification:

134.2.1 *During erection and on completion of an installation or an addition or alteration to an installation, and before it is put into service, appropriate inspection and testing shall be carried out by competent persons to verify that the requirements of this Standard have been met. Appropriate certification shall be issued in accordance with Section 631.*

633.1 *The requirements of Sections 631 and 632 for the issue of an Electrical Installation Certificate or a Minor Electrical Installation Works Certificate shall apply to all the work of the additions or alterations.*

The model forms of certification can be seen in Appendix 6 of BS 7671:2008 and can also be downloaded from the IET's website.

Note that the model forms of certification permit the declaration of conformity to one version of the Regulations, i.e. BS 7671:2008. The forms are not intended to cover two versions of BS 7671, i.e. the existing part of the circuit is installed to BS 7671:2001(2004) and the new addition is installed to BS 7671:2008. Therefore, upon completion of the installation and the certificate is issued, one certificate will be issued and this certificate will be to the requirements of the 17th Edition.

Further, it is worth noting that a standard is a framework or plan, to which, when followed, provides the ability to reiterate a process or method and not redesign all elements from scratch each time.

The legal requirements

As stated earlier, BS 7671 is not a statutory document and it is not a legal requirement to follow the practices referred to within. Primarily, there are two pieces of legislation to consider. The first being the Electricity at Work regulations, the second being the Building Regulations. The EWR applies to those undertaking electrical work as part of their job; the Building Regulations apply to those undertaking electrical work as part of their job and to those carrying out DIY work.

The Electricity at Work regulations 1989

The EWR states that all systems are to be safe so as to prevent danger and prevent the risk of injury. The Memorandum to the Electricity at work Regulations 1989, HS(R)25, records that the IEE Wiring Regulations is widely recognised and accepted in the UK and compliance with them is likely to achieve compliance with relevant aspects of the 1989 Regulations in point 7 of the introduction. Further, point 9 states that installations to which the IEE Wiring Regulations are relevant may have been installed in accordance with an earlier edition, now superseded but then current. That, in itself, would not mean that the installation would fail to comply with the 1989 Regulations.

Installers often find that their client refuses to pay for any remedial work required to bring existing elements of installation up to standard. The installer should always evaluate the existing situation by carrying out a periodic inspection of the installation prior to starting work so that any irregularities can be brought to the attention of the client. If the client refuses to pay for upgrades then the installer simply doesn't take on the job. The issuing of disclaimers by installers, stating that the client was made aware of shortfalls in the existing installation, is no way around the law. If someone is injured due to negligent practice, a covering letter will not prevent prosecution.

The Building Regulations

The Building Regulations, England and Wales, generally requires that installations, e.g. electrical (Part P), ventilation (Part F), accessibility (Part M) must be no worse in terms of the level of compliance with other applicable parts of Schedule 1 to the Building Regulations than before the work was undertaken. There is a similar requirement in the Scottish Building Standards Handbooks which requires that *"any service fitting or equipment is to be a standard no worse than at present"'*. Approved Document P states that *"a way of complying is to follow the technical rules of BS 7671 or an equivalent standard"*. Note that the use of the words "equivalent standard" permits a theoretical alternative as BS 7671 is not a statutory document. Currently in the UK no other electrical installation standard exists. Bear in mind that BS 7671 is based on the technical intent of HD 60364, which in turn was developed from IEC 60364 – therefore, they are not equivalent standards.

Conclusion

When carrying out additions or alterations to existing electrical installations, the reconfigured aspect of the electrical installation should comply with BS 7671:2008. The installer does not simply take responsibility for the newly installed or reconfigured element of the installation but all parts of the circuit(s) worked on - including the need to comment on the continued suitability or otherwise of the equipment belonging to the distributor - this includes the condition of the metering equipment, supply and meter-tails, distribution equipment and the earthing and bonding arrangements. If the client does not want to pay for upgrades to existing equipment, this does not absolve the installer from responsibility, nor does a disclaimer. If the installer undertakes a risk assessment of the situation and decides that it is not necessary to bring the existing element of the installation up to the current standard, then a certificate stating that the installation complies with BS 7671:2008 cannot be issued as the installation clearly does not comply with the 17th Edition. Listing departures on the certificate will only meet the requirements of the Regulations if the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.

Further information and reading

The following publications have either been cited in this article or they will be an aid to further research:

- BS 7671:2008 Requirements for Electrical Installations, IEE Wiring Regulations,17th Edition
- Electricity at Work regulations 1989 - www.opsi.gov.uk/si/si1989/Uksi_19890635_en_1.htm
- Electricity at Work regulations (Northern Ireland) 1991- www.ulster.ac.uk/health+safety/policy_audit/policy/PDFS/3.10.pdf
- Approved Document P - www.planningportal.gov.uk/uploads/br/BR_PDF_ADP_2006.pdf
- Scottish Building Standards technical handbooks - http://www.sbsa.gov.uk/
- Model forms for certification and reporting from the IET's website - www.theiet.org/publishing/wiring-regulations/ forms/

Safe Isolation of low voltage installations

by Jon Elliott

The HSE and other major stakeholders in the electrical installation industry have, for some time been concerned about the number of serious electric shock and burn accidents which have been occurring to experienced electricians and others carrying out electrical work. Many of these incidents can be attributed to a failure to perform safe electrical isolation procedures prior to work on or near conductors or equipment intended to dead.

This article seeks to summarise the statutory and non-statutory requirements for isolation; to raise awareness of the many and various devices now produced to enable virtually all switching devices to be safely isolated and to describe the requirements for voltage indicating devices and the need to confirm their continued suitability for use. The basic procedure for safe isolation is described, followed by an overview of the health implications and legal consequences that may arise as a result of not carrying out safe isolation where required.

Mostly this article seeks to point out that there is no excuse for not being able to safely isolate an installation, circuit or item of equipment.

Statutory requirements

The most important statutory requirement concerning work carried out on or near electrical installations is the Electricity at Work Regulations (EWR) 1989. Those regulations within EWR of particular relevance to safe isolation are numbers 12 (Means for cutting off the supply and for isolation) and 13 (Precautions for work on equipment made dead). Regulation 12 (1) (b) states that where necessary to prevent danger, suitable means shall be available for the isolation of any electrical equipment, where isolation means the disconnection and separation of the electrical equipment from every source in such a way that the disconnection and separation is secure (para (2) refers).

The Memorandum of Guidance on the Electricity at Work Regulations 1989 (HS(R) 25) published by the Health and Safety Executive advises with reference to Regulation 12 (1) (b) above that isolation is the process of ensuring that the supply to all or a particular part of an installation remains switched off and that inadvertent reconnection is prevented.

The issue of preventing inadvertent reconnection is covered in Regulation 13 (of EWR 1989) which requires that *"Adequate precautions shall be taken to prevent electrical equipment , which has been made dead in order to prevent danger while work is being carried out on or near that equipment, from becoming electrically charged during that work if danger may thereby arise"*.

The coverage of Regulation 13 in HS(R) 25 highlights the need to lock off any switching device being used to provide isolation, or where isolation has been achieved by a fuse, by their removal and retention in a safe place during the isolation period.

Non-statutory Requirements

Within BS 7671:2008, the following are of particular relevance in terms of safe isolation:

- Regulation 132.15.1 contains the following fundamental principle:

  Effective means, suitably placed for ready operation, shall be provided so that all

voltage may be cut off from every installation, from every part thereof and from all equipment, as may be necessary to prevent or remove danger.

- Regulation group 537.2 contains the requirements relating to isolation

- Regulation group 537.3 contains the requirements for switching off for mechanical maintenance.

Table 53.2 summarises the suitability of particular protective, isolation and switching devices to be used as an isolator, an emergency switch, or a functional switch and is reproduced overleaf.

Electrical installation work trainees and apprentices that have attended college for appropriate initial training should have been taught how to carry out safe isolation, including securing the device in the "OFF" position. However, adoption of incorrect isolation procedures 'in the field' still appears to be far too frequent. Clearly, the commonly occurring practices of simply switching circuit-breakers off, and placing insulation tape over them, when a circuit needs to be isolated, or merely removing a fuse and leaving it on top of the distribution board are not acceptable and do not give compliance with Regulation 13 as stated above. Moreover, to leave a circuit which is intended to be safely isolated unsecured is totally unnecessary and potentially dangerous.

It should be noted at this point that it is not necessary to lock off a means of isolation which remains, at all times, under the control of the person who is dependent upon the continued isolation of the circuit or item of equipment in question, although doing so may still be wise where this is possible.

HSE and SELECT (the Electrical Contractors Association of Scotland) have produced a guide on safe isolation procedures. This may be accessed and downloaded at the following internet address:

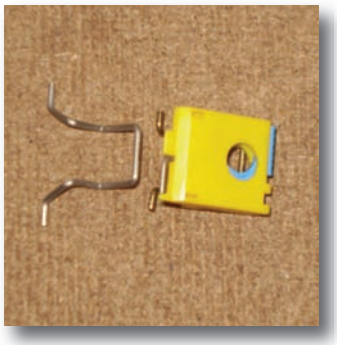
http://www.select.org.uk/downloads/publications/Select%20-%20Safe%20Isolation%20Procedures.pdf

The HSE / SELECT guide was used as the basis of a similar, later guide produced by the Electrical Safety Council in association with a number of organisations having an interest in electrical safety, including the IET. This guide may be accessed at the following internet address:

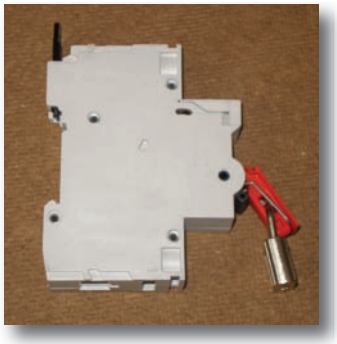
http://www.esc.org.uk/pdfs/business-and-community/electrical-industry/BPG2_08.pdf

Locking devices

Employers should ensure that appropriate locking devices are made available to their employees (as defined in the Health and Safety at Work etc Act 1974) and to ensure that they are used when it is necessary to isolate circuits or items of equipment fed from live distribution boards. Most switchgear manufacturers now produce



Examples of readily available lock-out devices for use with circuit-breakers



Examples of lock-out devices which may be obtained from switchgear manufacturers free of charge

Devices	Standard	Isolation[5]	Emergency switching[2]	Functional switching
Switching device	BS 3676: Pt 1 1989	Yes[4]	Yes	Yes
	BS EN60669-1	No	Yes	Yes
	BS EN60669-2-1	No	No	Yes
	BS EN60669-2-2	No	Yes	Yes
	BS EN60669-2-3	No	Yes	Yes
	BS EN60669-2-4	Yes	Yes	Yes
	BS EN60947-3	Yes[1]	Yes	Yes
	BS EN 60947-5-1	No	Yes	Yes
Contactor	BS EN 60947-4-1	Yes[1]	Yes	Yes
	BS EN 61095	No	No	Yes
Circuit-breaker	BS EN 60898	Yes	Yes	Yes
	BS EN 60947-2	Yes[1]	Yes	Yes
	BS EN 61009-1	Yes	Yes	Yes
RCD	BS EN 60947-2	Yes[1]	Yes	Yes
	BS EN 61008-1	Yes	Yes	Yes
	BS EN 61009-1	Yes	Yes	Yes
Isolation Switch	BS EN 60669-2-4	Yes	Yes	Yes
	BS EN 60947-3	Yes	Yes	Yes
Plug and socket-outlet (≤32 A)	BS EN 60309	Yes	No	Yes
	IEC 60884	Yes	No	Yes
	IEC 60906	Yes	Yes	Yes
Plug and socket-outlet (>32 A)	BS EN 60309	Yes	No	No
Device for the connection of luminaire	BS IEC 61995-1	Yes[3]	No	No
Control and protective switching device for equipment (CPS)	BS EN 60947-6-1	Yes	Yes	Yes
	BS EN 60947-6-2	Yes[1]	Yes	Yes
Fuse	BS88	Yes	No	No
Device with semiconductors	BS EN 60669-2-1	No	No	Yes
Luminaire Supporting Coupler	BS 6972	Yes[3]	No	No
Plug and unswitched socket-outlet	BS 1363-1	Yes[3]	No	Yes
	BS 1363-2	Yes[3]	No	Yes
Plug and switched socket-outlet	BS 1363-1	Yes[3]	No	Yes
	BS 1363-2	Yes[3]	No	Yes
Plug and socket-outlet	BS 5733	Yes[3]	No	Yes
Switched fused connection unit	BS 1363-4	Yes[3]	Yes	Yes
Unswitched fused connection unit	BS 1363-4	Yes[3] (removal of fuse link)	No	No
Fuse	BS1362	Yes	No	No
Cooker Control Unit switch	BS4177	Yes	Yes	Yes

Yes - Function provided No - Function not provided

[1] Function provided if the device is suitable and marked with the symbol for isolation (see BS EN 60617 identity number S00288).

[2] See Regulation 537.4.2.5

[3] Device is suitable for on-load isolation, i.e. disconnection whilst carrying load current.

[4] Function provided if the device is suitable and marked with ◎

[5] In an installation forming part of a TT or IT system, isolation requires disconnection of all the live conductors. See Regulation 537.2.2.1.

Table 53.2: Guidance on the selection of protective, isolation and switching devices

locking devices that allow a range of moulded case circuit breakers (MCCBs), circuit-breakers (formerly known as MCBs) and RCBOs to be padlocked in the OFF position.

A number of manufacturers will now provide lock-out kits designed for use with their

Universal lock-out device shown separately and securing a consumer unit main switch in the OFF position

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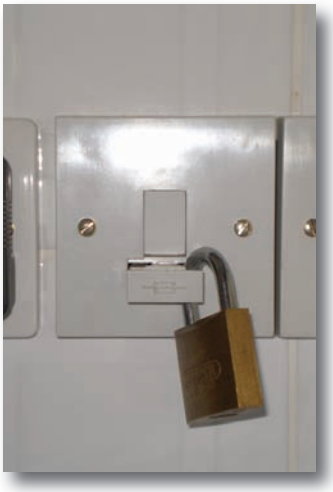
Examples of lock-out devices permitting more than one person to apply a lock for reasons of safety



Fused connection unit isolated by means of a small padlock

products free of charge upon request.

There are also a number of manufacturers of safety equipment that produce a range of universal circuit-breaker locking kits and other products allowing the secure isolation of virtually any type of switching device or even domestic and industrial type plugs and socket-outlets.

In situations where a number of persons are reliant upon a single isolation device remaining in the OFF position, a number of devices which permit the use of multiple locks are also available as can be seen above.

In many cases fused connection units (commonly, but incorrectly referred to as fused spurs) can have the fuse carrier secured in the OPEN position as shown using a padlock thus providing an effective means of isolating equipment being supplied by the connection unit.

Whenever an electrical installation, circuit or item of equipment is secured in the OFF position by use of a lock, the key to the lock should be taken away and kept under the control of the person relying upon the safe isolation remaining effective. Similarly where a fuse has been removed to effect isolation, the fuse and any spare fuses in close proximity to the distribution board or consumer unit should be retained under the control of the person relying upon the isolation remaining effective.

Use of proving unit to verify functionality of voltage indicator

Voltage indicating devices and proving units

In order to carry out the safe isolation of an installation or part thereof it will be necessary to use a voltage indicating device. HSE state clearly in guidance note GS 38 - *Electrical test equipment for use by electricians* that contact type voltage detectors and test lamps specifically designed to identify whether or not a voltage is present should be used for this purpose. The use of multi-range instruments is not recommended as it is possible to select an inappropriate range setting; the leads may not be sufficiently robust; and the probes may have excessive bare metal exposed; all of which may possibly put the user in danger. Reliance on non-contact type voltage indicators is also not recommended for use as the sole means of confirming that a circuit or piece of equipment has been made dead.

A wide range of contact type voltage indicating device are available as can be seen from the images included in this article.

The general condition of a voltage indicator should be checked prior to each use and especially if the instrument has not been used for some time. Particular attention should be paid to the outer casing, leads, and probes. Only the minimum amount of probe should be exposed to allow the instrument to be used correctly. If a voltage indicator shows significant damage or deterioration, the voltage indicating device, or where appropriate, the component parts in question, such as tips and lamps, should be replaced before further use.

The functionality of a voltage indicating device must be confirmed prior to each use. This can be achieved by checking on a known supply or perhaps more conveniently by using a proving unit such as the one shown.

Basic Safe isolation procedure

The following steps are the minimum that would be expected in terms of confirming safe isolation of a circuit or item of equipment.

- Locate / positively identify correct isolation point or device
- Check condition of voltage indicating device
- Confirm that voltage indication device is functioning correctly
- Switch off installation / circuit to be isolated
- Verify with voltage indicating device that no voltage is present
- Re-confirm that voltage indicating device functions correctly on known supply / proving unit
- Lock-off or otherwise secure device used to isolate installation / circuit
- Post warning notice(s)

Any warning notice posted should convey in simple terms that the installation, circuit or item of equipment has been

deliberately disconnected from the supply. It should inform the reader that care must be taken to ensure the safety of persons who are reliant upon the continued effectiveness of the isolation and should state that the installation, circuit or equipment should not be reenergised until it has been confirmed that it is safe to do so.

The health implications

The health implications which may be experienced as a result of a failure to correctly isolate before working on or near conductors or equipment intended to be dead are

- Physiological shock – in the short term this might be manifested as nausea and disorientation and in the longer term, a loss of confidence
- Involuntary muscular action resulting in injury – in such cases, injury may occur directly as a result of a muscular reaction sufficiently violent to tear muscle, break bones or dislocate joints, or indirectly as a result for example of falling from a ladder or from impact with objects in close proximity to the person receiving the shock
- Burns and tissue damage – depending upon the amount of energy expended at the points of contact (an electric shock characteristically leaves both an entry and an exit wound), burns may range from relatively superficial levels of tissue damage causing discomfort but no long term damage, through to deep seated burns causing a medical condition known as *compartment syndrome* the effects of which can be necrosis (tissue death). This may necessitate amputation of fingers or limbs to prevent the onset of complications such as gangrene.

Any current will travel along the path to earth offering the least resistance. In the case of human tissue, nerves and blood vessels offer the least resistance whilst bones offer the highest resistance. As a result, damage to the circulatory and nervous system occur frequently

- Renal (kidney) damage, which may range from being minor to long term and severely debilitating
- Atrial fibrillation - an irregularity in the rhythm of the heartbeat somewhat less severe than ventricular fibrillation. In most cases, a condition that can be reversed with typically few or no long term complications
- Myocardial infarction - heart attack caused by the presence of a blood clot within the coronary artery
- Ventricular fibrillation – the most common cause of death from electrocution, which generally occurs immediately

In the case of an alternating current and assuming a hand contact, the average person will be aware of a current passing through their body at around 0.5 mA. Such a current level will not have a detrimental effect. A person generally loses the ability to break contact with the live part at around 10 mA and beyond this level, ventricular fibrillation (an erratic heart beat characterised by an inability to circulate sufficiently oxygenated blood around the body) may occur and may result in death. Currents above 2 A will result in the heart stopping.

The likelihood of ventricular fibrillation occurring is dependent upon a number of factors:

- Skin resistance – sweat dramatically lowers resistance of skin whilst hardness (typical of manual labour activities), dryness and presence of dirt typically raise skin resistance
- The path of the current through the body – by way of example, the risk factor is 2 ½ times higher for a hand to foot contact than for a hand to hand contact. It is worth mentioning at this point that hand to hand contact electric shocks are thought to account for approximately 60% of fatalities
- The magnitude and type of current – human tissue is most sensitive to currents at frequencies between 40 Hz and 150 Hz
- The duration of the current – the more prolonged the contact time, the greater the damage caused by the shock
- The magnitude of the voltage – in general, the higher the voltage the higher the risk of shock
- When, during the heart's cycle, the shock occurs

The legal consequences

Employers or employees who commit an offence as a result of a failure to comply with the requirements of the Electricity at Work Regulations 1989 can be prosecuted under the Health and Safety at Work etc. Act 1974.

On 16th January 2009 the Health and Safety (Offences) Act 2008 came into force. This Act has the effect of increasing penalties and providing courts with greater sentencing powers for those who break health and safety legislation.

To summarise, the Health and Safety (Offences) Act 2008 introduces a new schedule 3A to the Health and Safety at Work etc. Act 1974 and to the Health and Safety at Work (Northern Ireland) Order 1978.

This new schedule:

- Raises the maximum fine which may be imposed in the lower courts to £20,000 for most health and safety offences
- Allows certain offences, which were previously only pursuable in the lower courts, to be triable in either the lower or higher courts
- Makes the imposition of a prison sentence an option for more health and safety offences in both the lower and higher courts

Prosecutions are likely to be made against employers and employees considered to have breached health and safety legislation.

References (and useful sources for further reading)

- BS 7671: 2008 - IET
- DD IEC/TS 60479-1: 2005 – Effects of current on human beings and livestock. Part 1 General characteristics
- Electrical injuries and lightning strikes – www.patient.co.uk
- Electrical test equipment for use by electricians (GS 38) – HSE
- Electricity at Work Regulations (EWR) 1989 – The Stationery Office Ltd
- Health and Safety (Offences) Act 2008 – The Stationery Office Ltd
- Memorandum of Guidance on the Electricity at Work Regulations 1989 (HSR 25) – HSE

Acknowledgements

Images of Martindale voltage indicator, Martindale proving unit and Drummond test lamp were reproduced with the kind permission of Martindale Electric Company Ltd
Thanks are also extended to Schneider Electric Limited and Hager Engineering Ltd for providing samples of lock-out devices and circuit-breakers for use in some of the images contained in this article. ■

The Institution prepares regulations for the safety of electrical installations for buildings, the IEE Wiring Regulations (BS 7671), which has now become the standard for the UK and many other countries. It has also prepared the Code of Practice for Installation of Electrical and Electronic Equipment In Ships (BS 8450) and recommends, internationally, the requirements for Mobile and Fixed Offshore Installations. The Institution provides guidance on the application of BS 7671 through publications focused on the various activities from design of the installation through to final test and certification with further guidance for maintenance. This includes a series of eight Guidance Notes, two Codes of Practice and model forms for use in wiring installations.

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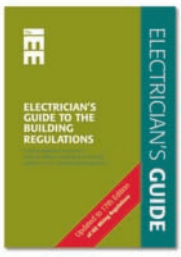

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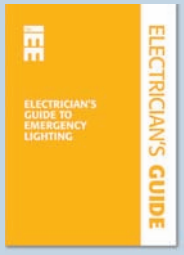

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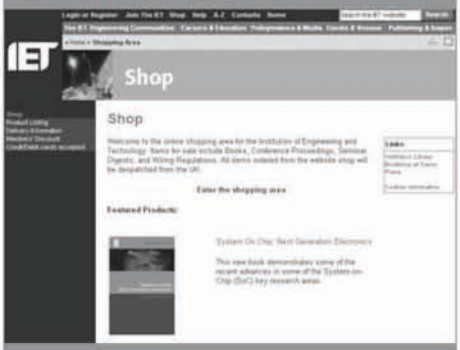

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Protective Measures & Special Installations or Locations **(Part 1)**

by Paul Bicheno

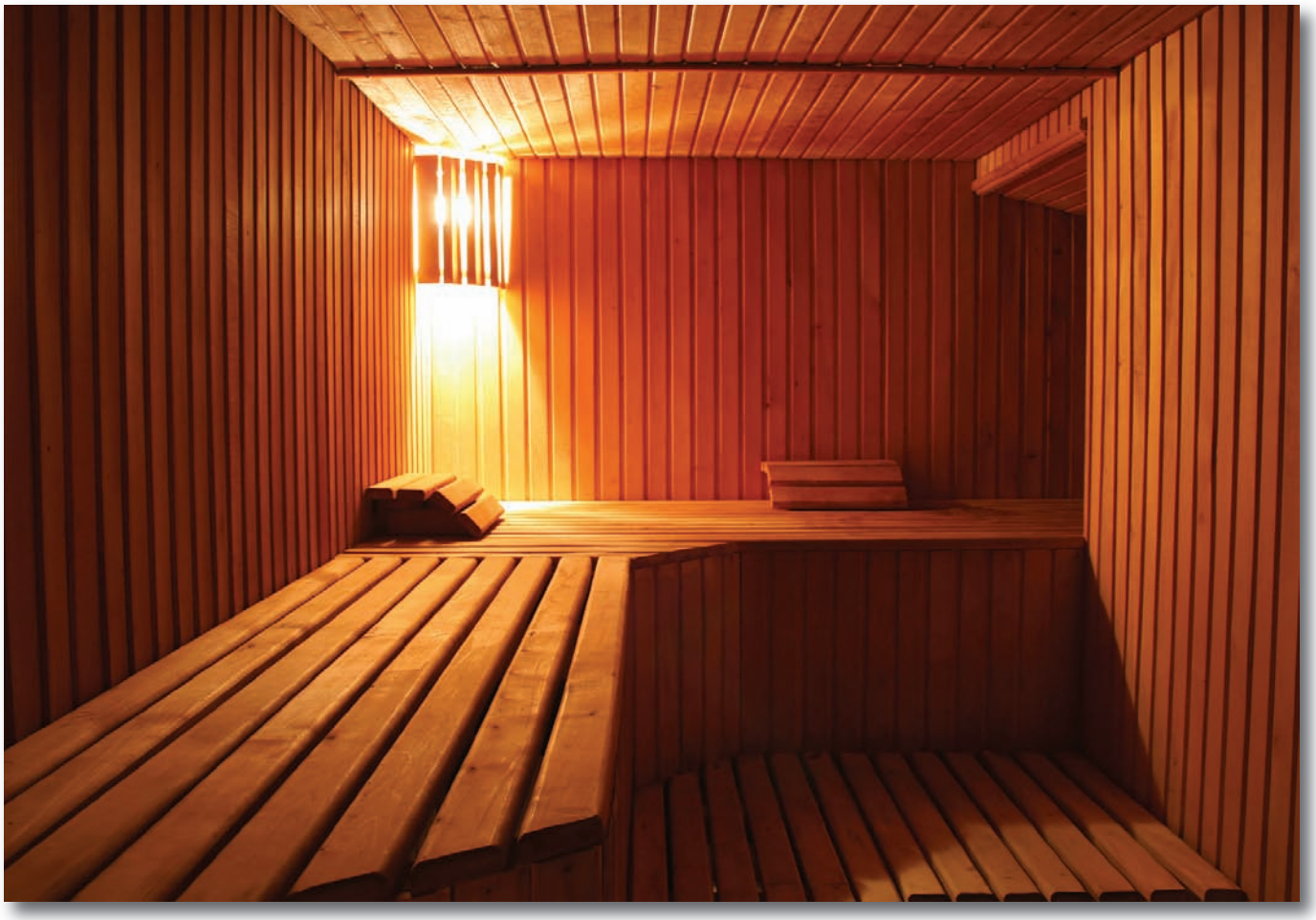
There are a number of measures to protect against electric shock. This article, which is the first part of two, looks at summarising these protective measures applied to Special Installations or Locations as defined in Part 7 of the 17th Edition of the IEE Wiring Regulations (BS7671:2008). In particular this article looks at Sections 701 to 711.

One of the fundamental principles for electrical installations is protection for safety (Section 131) in which Regulation 131.2, Protection against electric shock, requires protection to prevent a person or livestock coming into contact with live parts by the provision of basic protection (direct contact) as well as fault protection (indirect contact) to prevent an electric shock when an exposed conductive part becomes live due to a fault. The technical requirements of this principle are dealt with in Part 4 of the Regulations by Chapter 41 "*Protection against electric shock*".

This chapter highlights four general protective measures that are generally permitted (Regulation 410.3.3):

- Automatic disconnection of supply (Section 411)
- Double or reinforced insulation (Section 412)
- Electrical separation for the supply to one item of current using equipment (Section 413)
- Extra –low voltage SELV and PELV (Section 414)

The application of one or more of these protective measures in an installation needs to take into account the external influence. Section 415 also gives requirements to provide additional protection by the provision of a residual current device (RCD) and supplementary equipotential bonding for certain conditions, including Special Installations or Locations. For Special Installations or Locations (Part 7) there are particular requirements for each Section that either supplement or modify the requirements of



	Automatic Disconnection of Supply (411)	Double or Reinforced Insulation (412)	Electrical Separation –supplying single item of equipment (413)	Extra Low Voltage (414)	General Requirements and Additional Protection (415)
Locations containing a bath or shower (701)	All circuits of the location require additional protection by provision of one or more 30 mA RCDs with the characteristics specified in Regulation 415.1.1.	General Regulations of this Section apply	Circuits can only supply one item of current using equipment or there can only be one single socket outlet allowed. Not permitted for electric floor heating systems.	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts in zones 0, 1 and 2 by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures affording a degree of protection at least IPXXB or IP2X in accordance with Regulation 416.2. If SELV is used to supply an electric floor heating system then connection of the metallic grid to the supply circuit is not required.	Local supplementary bonding is required connecting protective conductor of each circuit supplying class I or II equipment to accessible extraneous conductive parts in the location. Note: This can be omitted under certain conditions (See Regulation 701.415.2)
Swimming pools and other basins (702)	All extraneous conductive parts in zones 0, 1 and 2 are to be connected by supplementary bonding conductors to the protective conductors of exposed conductive parts of the equipment situated in the zones. If using this measure for equipment for use in the interior of a basin when not occupied the circuit is to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1 If using this measure for zones 0 and 1 of a fountain then the circuit is to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1 If using this measure for zone 2 then the circuit is to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.	General requirements of this Section apply except where specific zone requirements determine the protective measure	If using this measure for equipment for use in the interior of a basin when not occupied it shall only supply one item of equipment with the source being installed outside zones 0, 1 and 2. (The source can be installed in zone 2 if the supply circuit is protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1) If using this measure for zones 0 and 1 of a fountain then only one item of equipment can be supplied with the source being installed outside zones 0 and 1. If using this measure for zone 2 then only one item of equipment can be supplied with the source being installed outside zone 2. (The source can be installed in zone 2 if the supply circuit is protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1)	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts in zones 0, 1 and 2 by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures affording a degree of protection at least IPXXB or IP2X in accordance with Regulation 416.2. If using this measure for equipment for use in the interior of a basin when not occupied the SELV source is to be installed outside zones 0, 1 and 2. (The source can be installed in zone 2 if the supply circuit is protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1) If using this measure for zones 0 and 1 of a fountain then the SELV source is to be installed outside zones 0 and 1. If using this measure for zone 2 then the SELV source is to be installed outside zones 0, 1 and 2. (The source can be installed in zone 2 if the supply circuit is protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1)	Zones 0 and 1 Except for fountains, in zone 0 only protection by SELV not exceeding a nominal 12 V ac (30 V dc) and in zone 1 not exceeding 25 V ac (60 V dc) is allowed. In either case the source is to be installed outside zones 0, 1 and 2. Equipment for use in the interior of basins that is intended to be used when people are not inside the zone 0 are to be supplied by either SELV, automatic disconnection of supply or electrical separation (refer to each measure for the requirements). If a socket outlet is used to supply this equipment then a notice is to be provided to warn the user that is shall be used only when the basin is not occupied by persons. Zones 0 and 1 specific to fountains These zones shall use one or more of SELV, automatic disconnection of supply and electrical separation (refer to each measure for the requirements) Zone 2 This zones shall use one or more of SELV, automatic disconnection of supply and electrical separation (refer to each measure for the requirements)
Rooms and cabins containing sauna heaters (703)	All circuits for the location require additional protection by providing one or more 30 mA RCDs with the characteristics specified in Regulation 415.1.1. An exception is the sauna heater unless recommended by the manufacturer.	General Regulations of this Section apply	General Regulations of this Section apply	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts in zones 0, 1 and 2 by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures affording a degree of protection at least IPXXB or IP2X in accordance with Regulation 416.2.	Circuits require additional protection by RCDs (refer to automatic disconnection of supply)
Construction and demolition site installations (704)	If using this measure for supplying a socket outlet or hand held piece of electrical equipment not exceeding 32 A then additional protection is required by a 30 mA RCD with the characteristics specified in Regulation 415.1.1 A circuit supplying one or more sockets outlets with a rating exceeding 32 A shall have an RCD not exceeding 500 mA interrupting the supply to the line conductors. Also Regulations 411.3.2.5 and 411.3.2.6 are not applicable A TN-C-S supply shall not be used to supply the site, except for the supply to fixed building(s).	General Regulations of this Section apply except where specific measures are required	If using this measure for supplying a socket outlet or hand held piece of electrical equipment not exceeding 32 A then each socket outlet and hand held piece of electrical equipment is to be supplied by an individual transformer or by a separate winding of a transformer. Special attention to be paid to Regulation 413.3.4 which requires flexible cables and cords to be visible throughout their length if liable to mechanical damage	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures in accordance with Regulation 416.2. SELV is preferred for portable hand lamps in damp or confined spaces	Circuits supplying a socket outlet or hand held electrical equipment not exceeding 32 A is to be protected by either; (i) reduced low voltage (see Section 411.8 of BS7671) (ii) automatic disconnection of supply (refer to protective measure) (iii) Electrical separation (refer to protective measure) (iv) SELV or PELV (general requirements apply) Reduced low voltage is preferred for supply to general portable hand lamps, portable hand tools and local lighting up to 2 kW.

	Automatic Disconnection of Supply (411)	Double or Reinforced Insulation (412)	Electrical Separation –supplying single item of equipment (413)	Extra Low Voltage (414)	General Requirements and Additional Protection (415)
Agricultural and horticultural premises (705)	Circuits supplying socket-outlets not exceeding 32 A are to be protected by 30 mA RCDs, exceeding 32 A by 100 mA RCDs and all other circuits 300 mA RCDs. A TN-C system shall not be used in the installation (including residences and other premises).	General Regulations of this Section apply	General Regulations of this Section apply	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures affording a degree of protection at least IPXXB or IP2X in accordance with Regulation 416.2.	Supplementary bonding is required in locations where livestock can touch exposed conductive parts and extraneous conductive parts. This includes a metal grid in the floor if installed and extraneous conductive parts in, or on a floor e.g. reinforced concrete. Spaced floor arrangements should also be included. (Where no metal grid is installed in the floor a TN-C-S supply is not recommended).
Conducting locations with restricted movement (706)	This measure can only be used for supplying fixed equipment. Also requires supplementary equipotential bonding of all exposed conductive parts of fixed equipment and conductive parts of the location If a functional earth is required then equipotential bonding is required between all exposed conductive parts and extraneous conductive parts inside the location and the functional earth	This measure can only be used for supplying fixed class II equipment or equipment with equivalent insulation. The supply circuit is to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1	This measure can only be used for supplying a hand held tool or an item of mobile equipment and fixed equipment as long as only one item is connected to a secondary winding of a transformer. The transformer can have more than one winding. The unearthed source is to have simple separation and is to be located outside the location, unless it is part of the fixed installation within the location.	SELV can be used for supplying a hand held tool or an item of mobile equipment, hand lamps and fixed equipment. PELV can be used for supplying fixed equipment provided there is equipotential bonding of exposed conductive parts, extraneous conductive parts inside the location and the connection of the PELV system to earth. Basic protection is to be provided by basic insulation complying with Regulation 416.1 or barriers or enclosures complying with Regulation 416.2	For this type of location the protective measures applicable for the supply to various types of equipment are limited (refer to each measure)
Electrical installations in caravan / camping parks (708)	For a TN system only a TN-S installation can be used, however a TN-C-S system can be used to supply permanent buildings on the site.	General Regulations of this Section apply	General Regulations of this Section apply	General Regulations of this Section apply	Each socket outlet is to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1
Marinas and similar locations (709)	For a TN system the final circuits to pleasure craft and houseboats are not to include a PEN conductor. Socket outlets and final circuits intended for fixed connections to supply houseboats are to be protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1	General Regulations of this Section apply	General Regulations of this Section apply	General Regulations of this Section apply	General Regulations of this Section apply
Exhibitions, shows and stands (711)	Structural metallic parts which are accessible from within the stand, vehicle, wagon, caravan or container shall be connected via main protective bonding conductors to the main Earthing terminal within the unit. A system of type TN shall be TN-S (TN-C-S is prohibited for supply to a caravan or similar construction).	General Regulations of this Section apply	General Regulations of this Section apply	Irrespective of the nominal voltage used there shall be provision of basic protection of live parts by either; (i) Basic insulation complying with Regulation 416.1. (ii) Barriers or enclosures affording a degree of protection at least IPXXD or IP4X in accordance with Regulation 416.2	A cable supplying a temporary structure is to be protected at its origin by an RCD not exceeding 300 mA. It is to incorporate a time delay or be of the S-type to provide discrimination where final circuit RCDs are used. Each socket outlet not exceeding 32 A and all final circuits other than for emergency lighting shall protected by a 30 mA RCD with the characteristics specified in Regulation 415.1.1.

Table 1 – Summary of the general protective measure requirements for Special Installations or Locations (701 to 711)

the protective measures defined in Chapter 41. Table 1 summarises the application of the protective measures for the defined Special Installations or Locations, highlighting the specific supplementary or modified requirements for a protective measure. In certain instances there are additional general requirements as well as additional protection (Section 415) requirements which enhance the protective measures.

As well as the general protective measures already described there is the protective measure of obstacles and placing out of reach (Section 417). It is worth highlighting that this is a protective measure that only provides basic protection and would only be applicable in installations that are restricted to skilled or instructed persons under the supervision of skilled persons. There are also other protective measures that are applicable in an installation that is controlled or under the supervision of skilled or instructed persons (Section 418) to avoid unauthorized changes, these are:

	Obstacles and placing out of reach (417)	Non-conducting Location (418.1)	Earth free local equipotential bonding (418.2)	Electrical separation – supplying more than one item of equipment (418.3)
Locations containing a bath or shower (701)	Not permitted	Not permitted	Not permitted	See Note 2
Swimming pools and other basins (702)	Not permitted	Not permitted	Not permitted	See Note 2
Rooms and cabins containing sauna heaters (703)	Not permitted	Not permitted	Not permitted	See Note 2
Construction and demolition site installations (704)	Not permitted	See Note 1	See Note 1	See Note 2
Agricultural and horticultural premises (705)	Not permitted	Not permitted	Not permitted	See Note 2
Conducting locations with restricted movement (706)	Not permitted	Not applicable as it is a conducting location	See Note 3	See Note 2
Electrical installations in Caravan / camping parks (708)	Not permitted	Not permitted	Not permitted	See Note 2
Marinas and similar locations (709)	Not permitted	Not permitted	Not permitted	See Note 2
Exhibitions, shows and stands (711)	Not permitted	Not permitted	Not permitted	See Note 2

Note 1:
Although the use of this measure is not specifically restricted by a Regulation in Part 7 for this location this method of protection is not recognised for general application and is only to be applied where the installation is under the supervision of skilled or instructed persons so that unauthorized changes cannot be made. There are specific requirements for some locations that effectively restrict the use of this measure (refer to Table 1).

Note 2:
Although the use of this measure is not specifically restricted by a Regulation in Part 7 for this location this method of protection is only to be applied where the installation is under the supervision of skilled or instructed persons so that unauthorized changes cannot be made. There are specific restrictions in the use of electrical separation supplying only a single piece of equipment for some locations that effectively restricts the use of this measure (refer to Table 1).

Note 3:
Although the use of this measure is not specifically restricted in Part 7 by a Regulation for this location this measure would not be permitted due to the requirements for specific equipment types and allowable protective measures (refer to Table 1).

Table 2 – Specific protective measures applied to Special Installations or Locations (701 to 711)

- Non-conducting location (Section 418.1)
- Earth-free equipotential bonding (Section 418.2)
- Electrical separation for the supply to more than one item of current using equipment (Section 418.3)

Due the nature of these types of protective measures there are a number of restrictions in relation to Special Installations or Locations. Table 2 summarises the application of the above protective measures for the defined Special Installations or Locations (Sections 701 to 711).

The IET Guidance Note 7 – Special Locations deals with Special Installations or Locations. This is being aligned and updated to the 17th Edition and will provide additional guidance to the information provided here. ■

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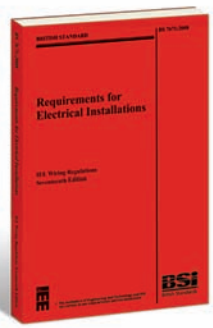

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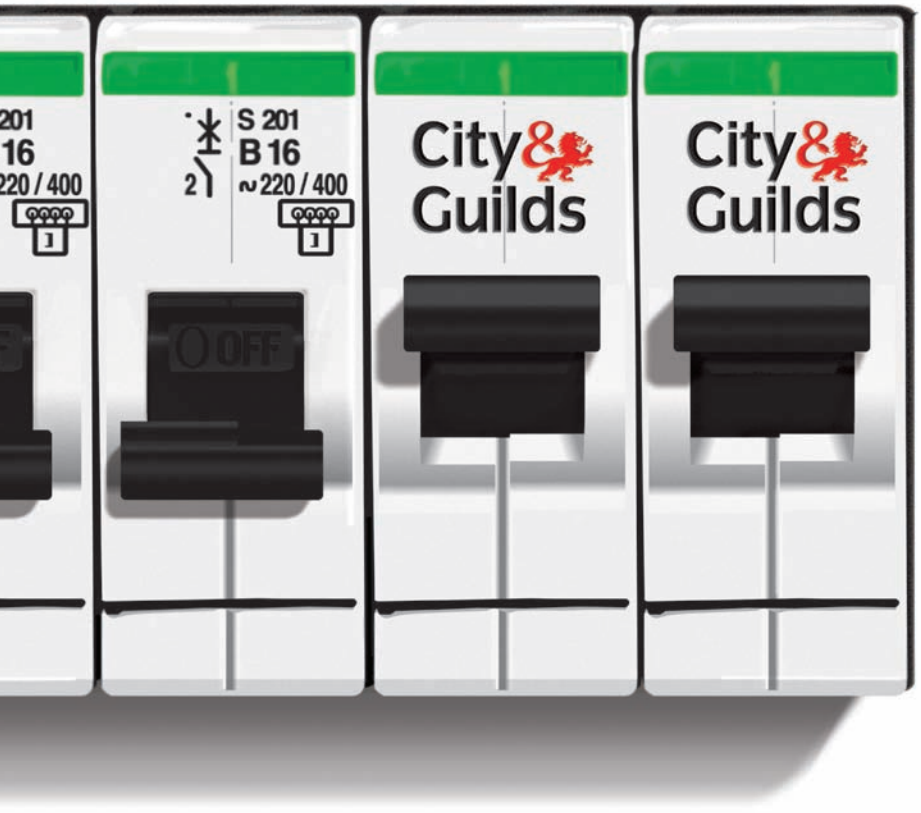

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