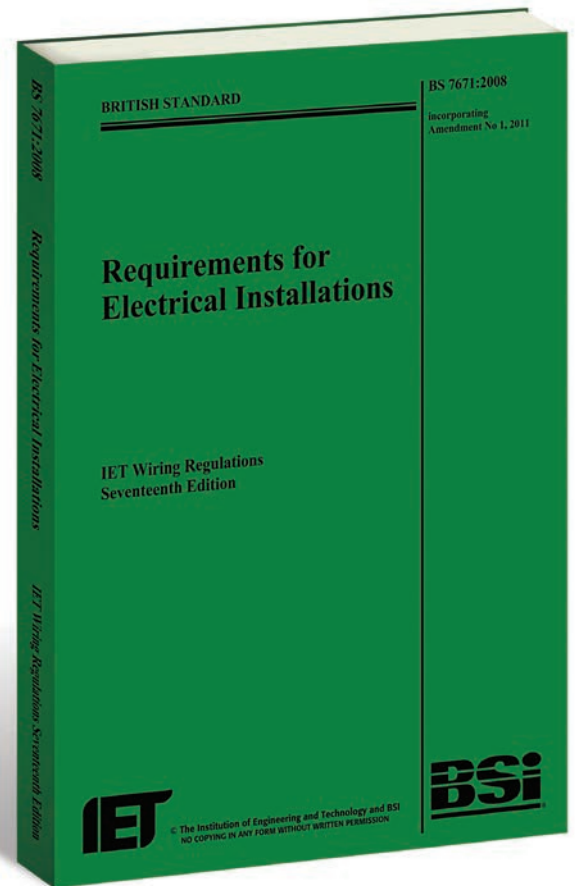


# 17<sup>th</sup> Edition (BS 7671:2008) incorporating Amendment No 1

Installations designed from the 1<sup>st</sup> January 2012 are to comply with Amendment number 1.



## Geoff Cronshaw

The first amendment to the 17<sup>th</sup> edition came into effect on the 1<sup>st</sup> January 2012, and includes many new requirements that users of the wiring regulations need to be aware of. These range from medical locations, EMC, and surge protection, through to changes in the fuse standards and the associated maximum values of earth fault loop impedance for the new fuses.

Significant changes have been made for all those involved in periodic inspection and testing of electrical installations. The periodic inspection report in the 17<sup>th</sup> edition (BS 7671:2008) has been replaced with a new “Electrical Installation Condition Report” with inspection schedule and new observation codes in

Amendment No 1. In this article we look at the impact of some of the changes.

### 1. CHANGES TO THE PERIODIC INSPECTION REPORT

Appendix 6, Model forms for certification and reporting, now includes a new electrical installation condition report that replaces the periodic inspection report. In addition there is a condition report inspection schedule for domestic and similar premises up to 100 A supply.

For larger installations greater than a 100 A supply there is a list of examples of items requiring inspection instead of the inspection schedule. Finally, a schedule of test results is required to be completed for every distribution board and/or consumer unit for all

installations.

The periodic inspection report that was in the 17<sup>th</sup> edition has been modified to form the new electrical installation condition report in Amendment No 1. For example, within the observations section the four codes: 1 (requires urgent attention), 2 (requires improvement), 3 (requires further investigation), 4 (does not comply with BS 7671:2008 amended to ...) have been replaced by three codes: code 1 Danger present, code 2 potentially dangerous, code 3 improvement recommended.

The changes to the coding system and the condition report inspection schedule for domestic and similar premises up to 100 A supply represent a major change from the 17<sup>th</sup>

edition of the wiring regulations. For example, under this new coding system a summary of the condition of the installation in terms of safety should be clearly indicated in Section E of the condition report. Observations, if any, should be categorised in Section K of the condition report using the coding C1 to C3 as appropriate. Any observations given a C1 or C2 classification should result in the overall condition of the installation being reported as unsatisfactory, where as under the 17<sup>th</sup> edition only a number 1 (requires urgent attention), allocated to an observation would normally result in the overall assessment of unsatisfactory.

The new inspection schedules for domestic and similar

premises provide a detailed breakdown of the inspection required on each aspect of the installation to ensure that the work is carried out in an organised and efficient manner. For example, the schedule includes over 60 check points. Each item listed on the schedule which requires checking is accompanied with the relevant regulation number for ease of reference to the wiring regulations.

In addition, the form provides a facility to indicate the outcome of the inspection of each item with either a tick (acceptable condition), a code C1 or C2 (unacceptable condition), a C3 (improvement required), NV (not verified), Lim (limitation), or NA (not applicable); where as under the 17th edition the inspection of a general item would normally only result in a tick in a box.

## 2. SECTION 729 – OPERATING OR MAINTENANCE GANGWAYS.

Amendment 1 now includes Section 729, which applies to restricted areas. These are areas such as switchrooms with switchgear and controlgear assemblies with a need for operating or maintenance gangways for authorised persons.

This is a completely new section. The previous requirements for accessibility of electrical equipment in BS 7671:2008 were contained in Fundamental Principles in Chapter 13. These regulations remain the same. Regulation 132.12 states: Electrical equipment shall be arranged so as to afford as may be necessary: (i) sufficient space for the initial installation and later replacement of individual items of electrical equipment

(ii) accessibility for operation, inspection, testing, fault detection, maintenance and repair.

Regulation 15 of the Electricity at work Regulations has requirements for working space, access and lighting and requires that, for the purposes of enabling injury to be prevented, adequate working space, adequate means of access and adequate lighting shall be provided at all electrical equipment on which or near which work is being done in circumstances which may give rise to danger. Regulation 14 of the Electricity at work Regulations is concerned with work on or near any live conductors.

### Accessibility

Regulation 729.513.2 requires that the width of gangways and access areas shall be adequate for work, operational access, emergency access, emergency evacuation and for the movement of equipment.

In restricted access areas where basic protection is provided by barriers or enclosures Regulation 729.513.2.1 gives the following minimum distances:

- i. Gangway width of 700 mm between: barriers or enclosures and switch handles or circuit-breakers in the most onerous position, and barriers or enclosures or switch handles or circuit-breakers in the most onerous position and the wall
- ii. Gangway width of 700 mm between barriers or enclosures or other barriers or enclosures and the wall
- iii. Height of gangway to barrier or enclosure above floor

(minimum dimension 2000 mm)

iv. Live parts placed out of reach, see Regulation 417.3 (minimum dimension 2500 mm)

Note: Where additional workspace is needed eg for special switchgear and controlgear assemblies larger dimensions may be required.

In restricted access areas where the protective measure of obstacles applies Regulation 729.513.2.2 gives the following minimum distances:

- i. Gangway width of 700 mm between: obstacles and switch handles or circuit-breakers in the most onerous position, and obstacles or switch handles or circuit-breakers in the most onerous position and the wall.
- ii. Gangway width of 700 mm between obstacles or other obstacles and the wall
- iii. Height of gangway to obstacles, above floor (minimum dimension 2000 mm)

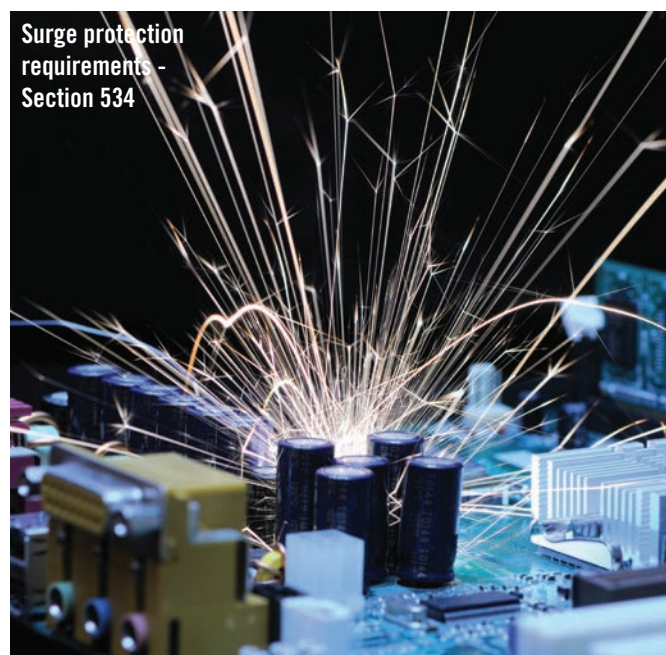
iv. Live parts placed out of reach, see Regulation 417.3 (minimum dimension 2500 mm)

Note: the HSE would not expect to see any new switchboards installed in the UK where there was potential access to live exposed busbars.

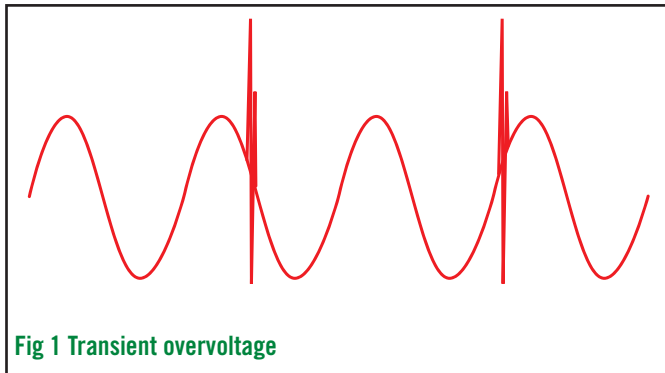
Regulation 729.513.3 has requirements for access of gangways. For closed restricted access areas with a length exceeding 6 m, accessibility from both ends is recommended. However, gangways longer than 10 m must be accessible from both ends.

The Regulation recognises that this may be accomplished by placement of the equipment a minimum of 700 mm from all walls or by providing an access door, if needed, on the wall against which the equipment is positioned. However, closed restricted access areas with a length exceeding 20 m must be accessible by doors from both ends.

Finally, Annex A of Section 729 contains a number of ►



Surge protection requirements - Section 534



**Fig 1 Transient overvoltage**

additional requirements for closed restricted access areas in order to permit easy evacuation. The annex considers two cases; these include a minimum passing width of 700 mm with switchgear in position and 500 mm with circuit breakers completely extracted.

Persons involved in this work are advised to seek advice from the HSE.

### 3. NEW SECTION 534

The new Section 534 contains requirements for the installation of SPDs to limit transient overvoltages where required by Section 443 of BS 7671:2008 or where otherwise specified by the designer. See Fig 1.

An SPD is a device that is intended to limit transient overvoltages and divert damaging surge current away from sensitive equipment. SPDs must have the necessary capability to deal with the

current levels and durations involved in the surges to be expected at their point of installation. All SPDs are to comply with BS EN 61643.

As mentioned in a previous article, SPDs can operate in one of two ways, based on the component technologies within them. One way is as a voltage switching device where under normal conditions, the device is an open circuit. However at a certain threshold voltage the SPD conducts and diverts the current through it. It has two states ON and OFF, hence the name of voltage switching. Spark gaps, gas discharge tubes, thyristors (silicon controlled rectifiers), and triacs are examples of voltage switching devices.

Another way is as a voltage limiting device. Voltage limiting type SPDs again present an open circuit under normal circuit conditions. When an over voltage is detected the device begins to conduct,

dropping its resistance dramatically such that the overvoltage is limited and the surge current is diverted away from the protected equipment. Metal Oxide Varistors (MOVs) are a common example of voltage limiting devices. Advanced SPDs often utilise hybrid technologies combining voltage switching with voltage limiting components. See Fig 2.

### Selection of SPDs

All SPDs are to comply with BS EN 61643. Typically, Type 1 SPDs are used at the origin of the installation, Type 2 SPDs are used at distribution boards and Type 3 SPDs are used near terminal equipment. Combined Type SPDs are classified with more than one Type, e.g. Type 1+2, Type 2+3.

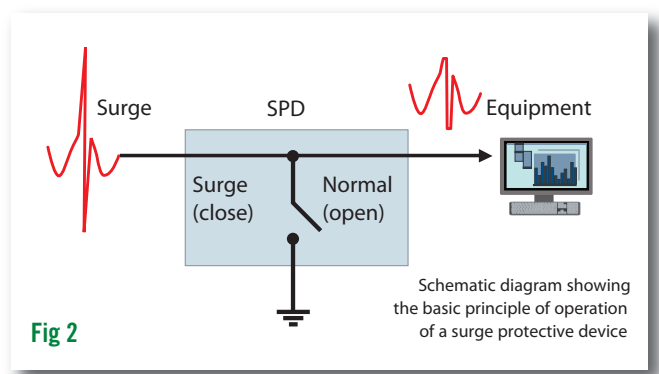
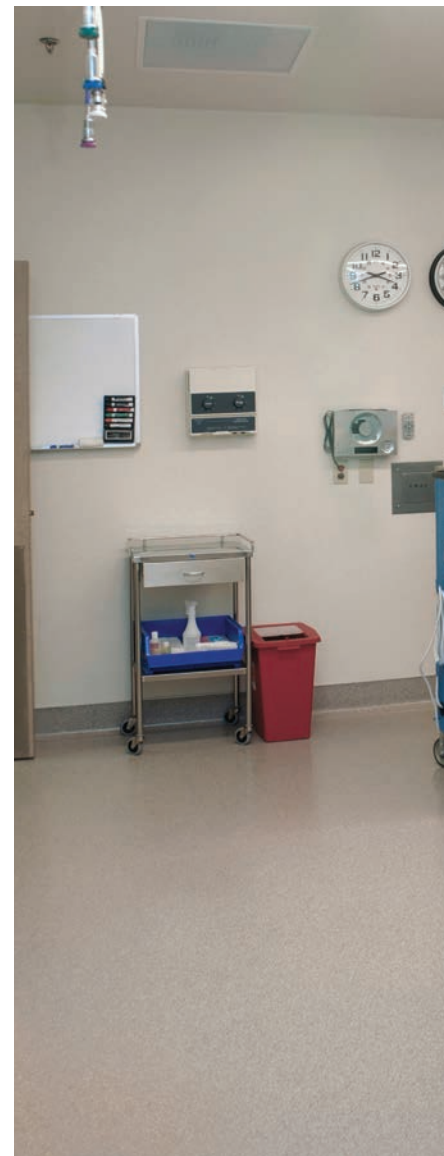
Standards such as BS EN 61643 series (components for low-voltage surge protective devices) define the characteristics of lightning and voltages to enable reliable and repeatable testing of SPDs (as well as lightning protection components). Although these waveforms may differ from actual transients, the standardised forms are based upon years of observation and measurement (and in some cases simulation). They provide a fair approximation of the real-world transient.

The most important aspect in selecting an SPD is its voltage limiting performance during the expected surge event – this parameter is the SPD's protection level  $U_p$ , also known in industry as the SPD's let-through voltage. An SPD with a low limiting voltage or lower (hence better) protection level reduces the risk of flashover causing insulation breakdown and associated hazards (fire or electric shock)

as well ensure adequate protection of the equipment.

It should also be noted that selecting an SPD with a lower value  $U_p$  (compared to the equipment's damage threshold or withstand level  $U_w$ ) results in a lower stress to the equipment which may result not just in a lower probability of damage, but also a longer operating life. As such, the risk assessment within BS EN 62305 defines SPDs with low voltage protection levels  $U_p$  as enhanced SPDs.

According to BS EN 62305, Type 1 enhanced SPDs should have a protection level  $U_p$  (or



let-through voltage) no more than 1600 V whilst Type 2 and Type 3 SPDs should have a protection level  $U_p$  no more than 600 V when tested in accordance with BS EN 61643 series. Given that transients can be present between all conductors or modes (for example line to earth, line to neutral and neutral to earth) it is important to ensure good protection level  $U_p$  in all such modes.

#### Connection of SPDs

One important point to note is that in order to gain maximum protection the supply conductors of the SPD shall be kept as short as possible, to

minimise additive inductive voltage drops across the conductors.

Section 534 contains a number of requirements for the Connection of SPDs depending on the type of supply and system earthing. Therefore, for example, Section 534 requires that SPDs at or near the origin of the installation (if there is a direct connection between the neutral conductor and the protective conductor at or near the origin) shall be connected between each line conductor and the protective conductor/main earthing terminal whichever is the shorter distance.

#### SPD installation in conjunction with RCDs

Clause 534.2.6 of Section 534 is concerned with SPDs and their installation with respect to RCDs. It is ideal to install SPDs on the supply side of the RCD as this prevents the RCD from tripping during a surge event. Where this is not possible and SPDs are installed on the load side of an RCD transients could therefore trip the RCD. In this situation, 534 recommends the use of RCDs which are resistant to surge currents of up to 3 kA.

#### SPD status indication

SPD status indication needs to be provided by a status

indicator local to the SPD itself and/or remote, that the SPD no longer provides (or provides limited) overvoltage protection.

#### 4. 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 ►



Medical locations

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 note 1, below) 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  $\mu$ A have a probability of 0.2 per cent for causing ventricular

fibrillation or pump failure when applied through a small area of the heart. At 50  $\mu$ A (microshock), the probability of ventricular fibrillation increases to the order of 1 per cent (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 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. ■

**Important: this article is only intended as a brief summary of some of the requirements in Amendment 1 of BS 7671:2008. Persons involved in these areas are recommended to consult Amendment 1 of BS 7671:2008 and seek specialist advice. Information on medical locations – IET Guidance Note 7 and UK Health Departments. Information on operating or maintenance gangways – HSE.**