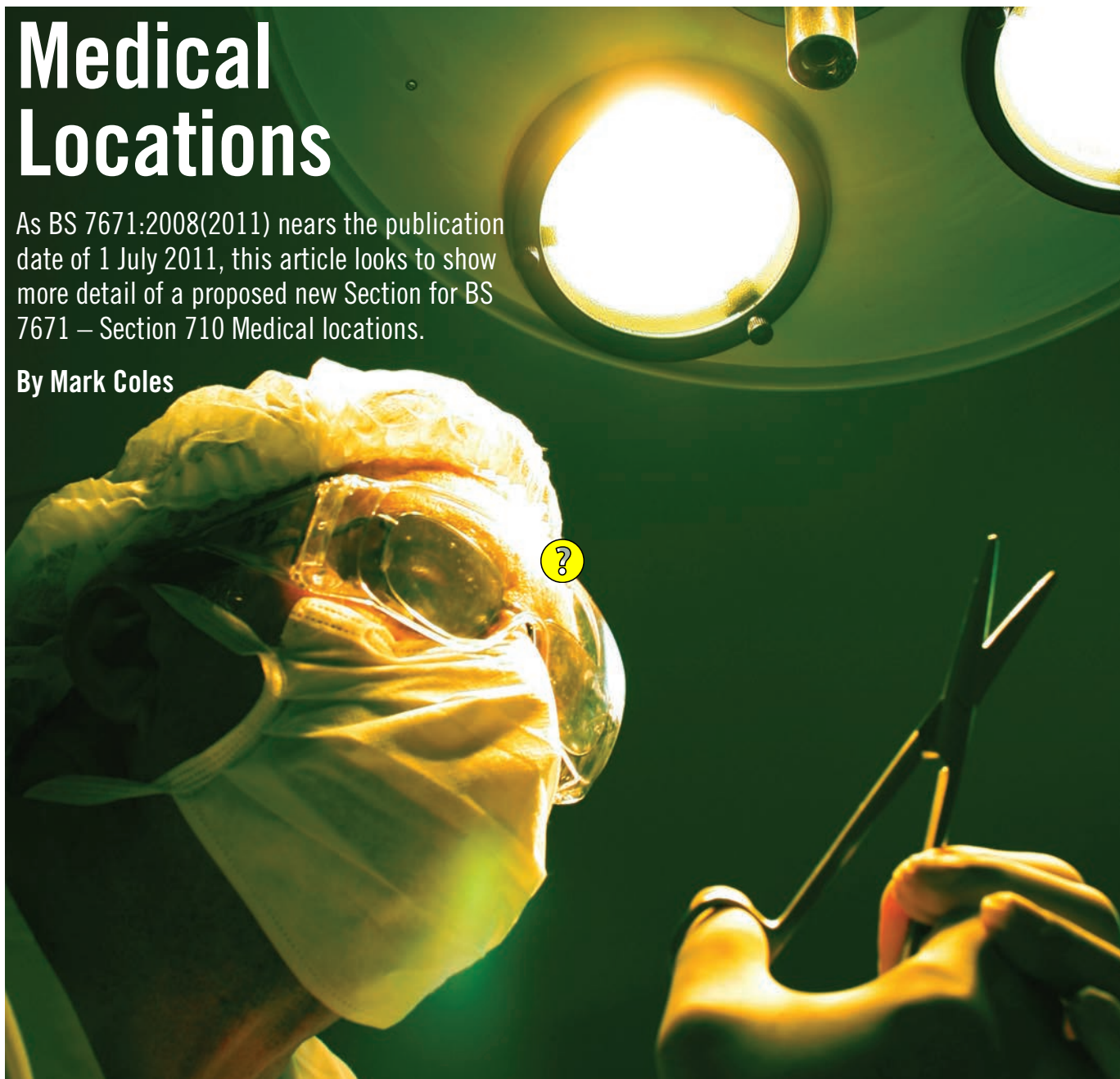


Medical Locations

As BS 7671:2008(2011) nears the publication date of 1 July 2011, this article looks to show more detail of a proposed new Section for BS 7671 – Section 710 Medical locations.

By Mark Coles



SECTION 710 has its origins in IEC 60264-7-710, the current and first edition being 2002. As with other areas of BS 7671 and the Treaty of Rome, the agreement is that the UK adopts the technical intent of European CENELEC Harmonised Documents. At present though, the HD has yet to be published but it is in the final stages of development.

Work on IEC 60364-7-710 began in 1988 and it has been a mammoth task to achieve standardisation across Europe in medical locations.

Scope of Section 710

The Scope of Section 710 is intended to cover areas such as hospitals, private clinics, medical and dental practices, healthcare centres, dedicated medical rooms in the workplace and veterinary clinics. There are, of course, many different types of medical procedure and the new section is arranged to reflect the electrical risks to patients and medical staff.

The risks in medical locations

The proposed new section is allocated a 'Seven' designation, i.e. included in Part 7 of

BS 7671, which recognises the onerous nature of the procedures or task that will take place in these areas.

Often, when a medical or clinical procedure takes place, the skin may be broken and the patient could be bleeding. The natural protection of the human body against electric shock can be considerably reduced when certain clinical procedures are being performed on it. A patient may lose natural or involuntary reactions to voltages and currents as the skin resistance has been broken down or

their defensive capacity has been reduced. During invasive operations, such as open-heart surgery, very small voltages (of the order of a few mv) can interfere with the heart's pumping action leading to ventricular fibrillation.

Designation of areas

Rather like other sections of BS 7671, such as bathrooms or swimming pools, where more onerous practices occur or the risk of electric shock increases, areas are grouped according to the expected risk.

Medical Locations are allocated a grouping signifier, as follows:

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.

Examples of group 0 include consultant examination rooms or massage rooms.

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 externally or invasively to any part of the body except where group 2 applies.



Fig 1 Medical trunking

group 2

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

It is important to be aware of the definition of an applied part:

Applied part

Part of medical electrical equipment that in normal use necessarily comes into

physical contact with the patient to enable ME equipment or an ME system to perform its function.

Protection against electric shock

As medical locations of groups 1 and 2 have more onerous practices occurring within when compared to group 0, a 25 V a.c. or 60 V d.c. limit is imposed between exposed-conductive and/or extraneous-conductive-parts under fault conditions. Group 0 is a location where applied parts

are not intended to be used and is less onerous, in terms of risk of electric shock, when compared to groups 1 and 2, therefore, the common rules of BS 7671 apply in group 0.

The reduced 25 V a.c. limit has been seen before in BS 7671, it was in the 16th Edition, Section 605 Agricultural and Horticultural premises. The requirement disappeared when the 17th Edition was published but now we see its reintroduction.

Further, in light of the reduced voltage limit, the disconnection times for 230 V Uo circuits in medical locations of group 1 and group 2 are also modified from the general rules, i.e. Parts 1 - 7: ►

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Fig 2 Services

◀ Note that with all Part 7 requirements, where an exception is not given, the requirements of the general rules apply, therefore, the disconnection times of Chapter 41 are applicable to group 0.

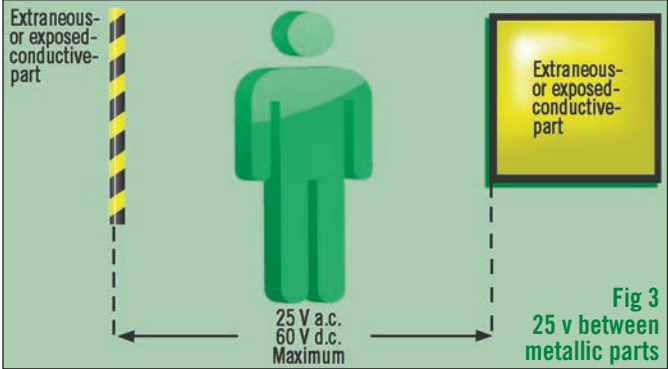
If disconnection cannot be achieved in the required time, BS 7671 requires other additional methods be utilised to protect those in the area.

Additional protection: IT system
In medical locations group 2, an IT system is to be used for final circuits supplying medical electrical equipment intended

for life support systems, surgical applications and electrical equipment used in the patient environment.

An IT system, (I, Isolated; T, Terre), as the term describes, is isolated from earth, usually by means of an isolating transformer. During an important surgical operation, should an earth fault develop, the last thing anyone needs is for automatic disconnection to occur.

Therefore, in the event of a first fault, an insulation monitoring device will warn of the insulation failure, thus allowing the procedure to continue under the managed circumstances. Note that a short-circuit, or fault between line and neutral or line to line, will always disconnect upon



presentation of a first fault. The insulation monitoring device (IMD) is to be in accordance with BS EN 61557-8:2007 and the device should alert of insulation failure when resistance has decreased to 50kΩ. If the response value is adjustable, the lowest possible setpoint value is to be $\geq 50 \text{ k}\Omega$. A test device should be provided and the response and alarm-off time shall be $\leq 5 \text{ s}$.

Additional protection: Supplementary equipotential bonding

In each medical location of group 1 and group 2, supplementary equipotential bonding should be installed between the following parts of the patient environment:

- protective conductors
- extraneous-conductive-parts
- screening against electrical interference fields, if installed
- connection to conductive floor grids, if installed
- metal screens of isolating transformers, via the shortest route to the earthing conductor

disconnection will not occur in the required time, supplementary bonding can also be used to limit any voltages available within the locations.

Patient leakage current flowing through an earthed patient is normally greatest when the equipment's connection to the means of earthing is lost. 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 of the order of $10 \mu\text{A}$ have a probability of 0.2% of causing ventricular fibrillation when applied through the heart.

In order to limit any potential rise due to the effect of leakage current, the voltage between the hard-wired system and the ERB (Earth Reference Bar) should not exceed 20 mV. A further voltage of 30 mV is allowed between the exposed conductive parts of the medical equipment and the supply cord (BS EN 60601-1).

Supplementary bonding will limit any potential risk due to the effect of leakage currents appearing within the locations due to faults. Chapter 41 recognises that where

	a.c.	d.c.
TN	0.3s	0.5s
TT	0.05s	0.1s

Table 1 - Disconnection times

This means that the maximum obtainable voltage between the exposed conductive parts of the medical equipment and the ERB should exceed not 50 mV. To limit potentials, the maximum resistance between the socket-outlet terminals, fixed equipment terminal or extraneous metalwork should be no greater than 0.2Ω .



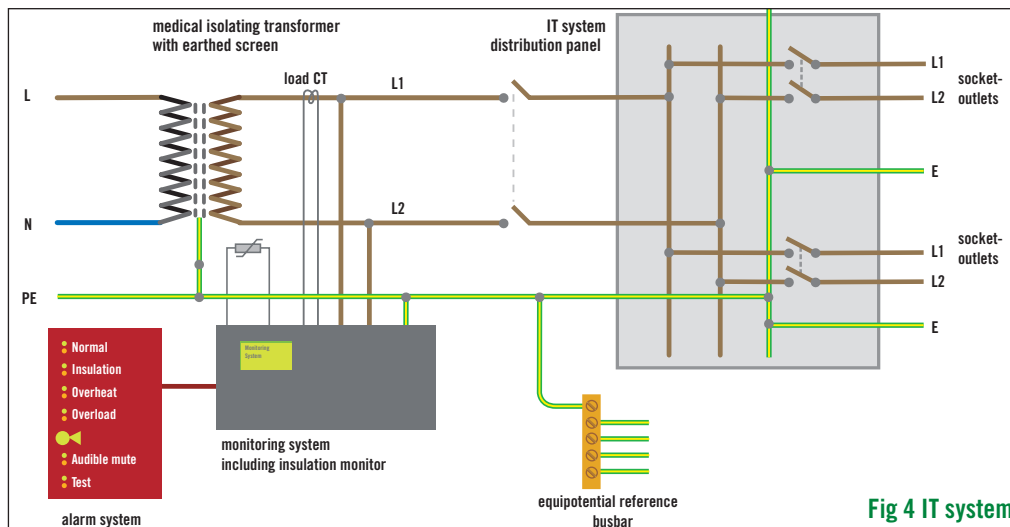
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◀ To aid the reduction of electromagnetic interference, radial wiring methods are to be followed to avoid earth-loops, hence, supplementary bonding in medical location group 2 should consist of single conductors installed between the equipment and an equipotential reference bonding busbar, located in or near the medical location. The connections should be arranged so that they are accessible, labelled, visible and can be disconnected individually.

Safety lighting

It is likely that each emergency luminaire will incorporate its own battery to provide power when the electrical supply has failed. In addition to the requirements given in any lighting code, the necessary minimum illuminance shall be provided for the following:

group 1 – in each such room at least one luminaire shall be supplied from the power supply source for safety services

group 2 – minimum of 90% of the lighting shall be supplied from the power source for safety services.

The luminaires of the escape routes shall be arranged in alternate circuits.

Periodic inspection

In a step not usually taken by BS 7671, recommended periods are given for the periodic inspection of installations falling within the Scope of Section 710. Up to now BS 7671 has recommended that installations are periodically inspected in line with the requirements of the IET's Guidance Note 3 – Inspection and Testing. Therefore, in addition to the requirements of Chapter 62, the following procedures, appearing as a note, are recommended at the given intervals:

- Annually: Complete functional tests of the insulation monitoring

devices (IMDs) associated with the medical IT system including insulation failure, transformer high temperature, overload, discontinuity and the acoustic/visual alarms linked to them.

- Every three years: Measurements of leakage current of the output circuit and of the enclosure of the medical IT transformers in no-load condition
- Annually: Measurements to verify that the resistance of the supplementary equipotential bonding is within limits.

Older installations

BS 7671 is the standard to

follow when designing a new electrical installation or carrying out alterations and additions to an existing installation but the standard is not to be applied retrospectively.

There are many installations in medical locations in the UK that do not currently resemble the proposed requirements of BS 7671:2008(2011). Such installations will have been installed and maintained to the requirements of Healthcare Technical Memorandums (HTM). In time, the requirements of Section 710 of BS 7671 will be implemented in all medical areas as new building and refurbishment work takes place. ■

Thanks to: M. Al-Rafaie - Private Healthcare Consultant, Paul Harris - IHEE, Michael Bernard - AXrEM, Graeme Del - Cableflow International Ltd and Sean Hoban - WCH.

Further reading

IET Guidance Note 7 – Special Locations; IET Guidance Note 3 – Inspection and Testing; IEC 60364-7-710 – Requirements for special installations or locations – Medical Locations HTM 06-01 A and B

