

HEALTH TECHNICAL MEMORANDUM 06-02

Electrical safety guidance for low voltage systems Electrical safety handbook

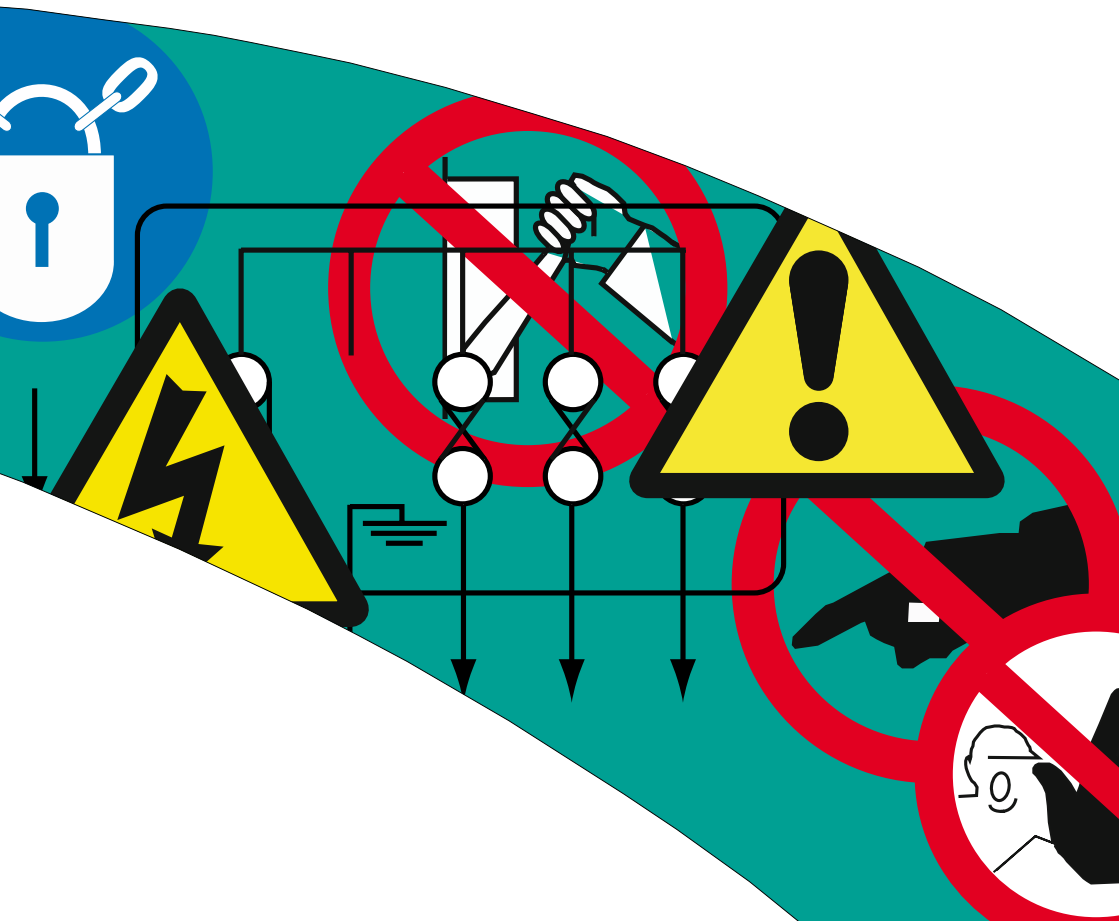
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1 Definitions

1.1 With regard to this safety guidance (LV), the following definitions apply.

Personnel

Designated Person

1.2 The Designated Person is an individual appointed by a healthcare organisation (a board member or a person with responsibilities to the board) who has overall authority and responsibility for the low voltage electricity system within the premises and who has a duty under the Health and Safety at Work etc Act 1974 to prepare and issue a general policy statement on health and safety at work, including the organisation and arrangements for carrying out that policy. This person should not be the Authorising Engineer (LV).

Duty Holder

1.3 The Duty Holder is a person on whom the Electricity at Work Regulations 1989 impose a duty in connection with safety.

Management

1.4 Management is defined as the owner, occupier, employer, general manager, chief executive or other person in a healthcare organisation, or their appointed responsible contractor, who is accountable for the premises and who is responsible for issuing or implementing a general policy statement under the Health and Safety at Work etc Act 1974.

Authorising Engineer (LV)

1.5 An Authorising Engineer (LV) is appointed in writing by the Designated Person to take responsibility for the effective management of the safety guidance (LV). The person appointed should possess the necessary degree of independence from local management to take action within this guidance.

Authorised Person (LV)

- 1.6 An Authorised Person (LV) is appointed in writing by the management on the recommendation of the Authorising Engineer (LV) in accordance with this safety guidance (LV) and is responsible for the implementation and operation of this guidance with regard to work on, or the testing of, defined electrical equipment.

Competent Person (LV)

- 1.7 A Competent Person (LV) is approved and appointed in writing by an Authorised Person (LV) for defined work, possessing the necessary technical knowledge, skill and experience relevant to the nature of the work to be undertaken, who is able to prevent danger or, where appropriate, injury, and who is able to accept a permit-to-work from an Authorised Person (LV).

Accompanying Safety Person (LV)

- 1.8 An Accompanying Safety Person is a person not involved in the work or test who has received training in emergency first-aid for electric shock and who has adequate knowledge, experience and the ability to avoid danger, keep watch, prevent interruption, apply first-aid and summon help. The person is to be familiar with the system or installation being worked on or tested, and is to have been instructed on the action to be taken to safely rescue a person in the event of an accident.

Safety documents

Certificate of authorisation for live working

- 1.9 This is a safety document, which is a form of declaration, signed and issued by an Authorised Person (LV) to the Competent Person (LV) in charge of the work to be carried out live. It makes known to that person exactly what equipment should be worked on, with details of the work to be undertaken live, what safety equipment is to be used, and the safety precautions to be taken.

Limitation-of-access

- 1.10 This is a safety document, which is a form of declaration, signed and issued by an Authorised Person (LV) to a person in charge of work to be

carried out in an area or location which is under the control of an Authorised Person (LV) and for which a permit-to-work (LV) is not appropriate.

Permit-to-work (electrical LV)

- 1.11 This is a safety document, which is a form of declaration, signed and issued by an Authorised Person (LV) to a Competent Person (LV) in charge of work to be carried out. It defines the scope of the work to be undertaken and makes known exactly what equipment is dead, isolated from all live circuit conductors and safe to work on.

Safety signs

Caution sign

- 1.12 This is a temporary, non-metallic sign bearing the words “caution – persons working on equipment” and “do not touch” which is to be used at a point-of-isolation.

Danger sign

- 1.13 This sign is a temporary, non-metallic sign bearing the words “danger live equipment” and “do not touch” which is to be used where there is adjacent live equipment at the place of work.

Switchroom sign

- 1.14 This is a permanent, non-metallic sign bearing the words “electrical switchroom” and “no unauthorised access”.

Voltage range

- 1.15 The ranges of voltage are defined as follows:
- a. **extra low voltage:** a potential not exceeding 50 V ac or 120 V ripple-free dc whether between conductors or to earth;
 - b. **low voltage (LV):** a potential not exceeding 1000 V ac or 1500 V dc between conductors, or 600 V ac or 900 V dc between a conductor and earth;
 - c. **high voltage (HV):** a potential normally exceeding low voltage.

General definitions

Additional earth: earthing equipment of an approved type applied after the issue of a safety document (for example an earth applied at a point-of-work).

Audit: the structured process of collecting independent information on the efficiency, effectiveness and reliability of the safe system of work, and drawing up plans for corrective action. (“Independent” does not necessarily mean external to the organisation.)

Authorised Person (LV)’s key: a key that controls access to the key cabinet.

Authorised Person (LV)’s key box: a single locked box that is used for the control of the Authorised Person (LV)’s key.

Complex circuit: a circuit which is normally operated at low voltage and which requires more than one point-of-isolation from known voltage sources to ensure safety at the point-of-work.

Conductor: a conductor of electrical energy.

Danger: risk of injury or death.

Dangerous condition: a condition that is likely to lead to a dangerous occurrence.

Dangerous occurrence: an incident involving a source of electrical energy which may be dangerous to any person, whether or not an accident has occurred.

Dead: a conductor that is neither “live” nor “charged”.

Department: Department of Health or its appointed agent.

Earthed: connected to the general mass of earth in such a manner as will ensure at all times an immediate discharge of electrical energy without danger.

Electrical equipment: anything used, intended to be used or installed for use in order to generate, provide, transmit, transform, rectify, convert, conduct, distribute, control, store, measure or use electrical energy.

Injury: death or personal injury from electric shock, electric burn, electrical explosion or arcing, or from fire or explosion initiated by electrical energy, where any such death or injury is associated with the generation, provision, transmission, transformation, rectification, conversion, conduction, distribution, control, measurement or use of electrical energy.

Isolate: disconnect and separate electrical equipment from every source of electrical energy in such a way that this disconnection and separation is secure.

Isolation and earthing diagram: a diagram attached to a permit-to-work illustrating the safety measures taken.

Key cabinet: a cabinet for the sole purpose of retaining all keys relative to the site's LV system(s) to which the Authorised Person (LV) has control.

Live: implies connection to a source of electricity.

Live functional testing: the testing of electrical equipment while live which does not involve live working.

Live working: the connection/disconnection of electrical equipment while live.

Lockable document cabinet: a lockable cabinet suitable for storing the electrical safety documents, temporary safety signs, distribution system records etc used in the application of this safety guidance (LV). This cabinet should not be used to store anything not associated with this guidance.

LV logbook: a book in which all matters relating to the electrical system should be recorded.

NEMA 3S: enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust; and in which the external mechanism(s) remain operable when ice-laden.

Operational procedure manual: a ring-binder containing information relating to the control and operation of the low voltage system.

Operational restriction: a written safety instruction, issued via the Authorising Engineer (LV), modifying or prohibiting the normal operating procedures associated with a particular make and type of equipment.

Personal supervision: supervision is given by a person having adequate technical knowledge and experience, who is present at all times.

Practice improvement notice: a notice issued by the auditor requiring improvements to be made in the observed working practices. The notice will relate to specific task(s) and will give a target date and/or time by which the improvements must be in place before similar task(s) can continue to be carried out.

Protective equipment: equipment used to protect persons from danger in the working environment. Protective equipment includes items such as special tools, protective clothing, insulating screens, safety harnesses, temporary safety signs etc.

Prove dead: demonstrate with the use of approved test equipment designed for the purpose that no electrical potential liable to cause danger is present.

Risk assessment: the analysis of the risks to health and safety inherent in a system and their significance in a particular context.

Safety key box: a box having two locks, each of which is to have only one key: one being labelled “safety key box – Competent Person (LV)”; and the other “safety key box – Authorised Person (LV)”. It is to be so arranged that both locks must be released before access can be gained to the contents of the box.

Safety locks: these are padlocks having only one key, which is different from all other keys in use on the electrical distribution system. Safety locks are to be indelibly coloured red, and each safety lock and its key are to have the same unique serial number for ease of identification. They are used for securing the means of isolation.

Safety programme: a written programme issued by an Authorised Person (LV) setting out the sequence of operations to be followed before a permit-to-work is issued.

Single line drawing: a single line drawing of the whole site system showing all major LV equipment in its normal state of operation (that is, switched on-off etc).

Spiking gun: an item of safety equipment used to confirm that a cable is dead.

Suspension notice: a notice issued by the auditor requiring specified works in progress to be suspended immediately pending action to ensure that compliance with the existing safe system of work can be achieved or a modified system introduced. This may follow an auditor’s system improvement notice being issued.

Switchroom: a room or enclosure designated by an Authorised Person (LV) which contains low voltage distribution switchgear that can be operated without the use of a tool or key.

System: an electrical system in which all the equipment is, or may be, connected to a common source of electrical energy, including the source and its associated equipment.

2 General precautions

Admittance to switchrooms

- 2.1 All access doors to each switchroom must be kept securely locked when unattended.
- 2.2 Locks are to be identical so that a single key will enable access to be gained to any switchroom over which the Authorised Person (LV) has control or a degree of control on a site.
- 2.3 Each Authorised Person (LV) and Competent Person (LV) should be issued with a key; when a safety document is issued, the recipient of the document may also be issued with a key.
- 2.4 No person other than an Authorised Person (LV) or Competent Person (LV) may enter a switchroom unless they are accompanied by an Authorised Person (LV) or have receipt of a safety document issued by an Authorised Person (LV).
- 2.5 The exception to paragraph 2.4 is when the switchroom is provided with “automatically controlled fire protection”, when the person must be trained for entry into such room.

Security of electrical equipment

- 2.6 All electrical equipment should be secured against unauthorised operation. If the electrical equipment is not located within a switchroom, operation of such equipment should only be by the use of a tool or key.

Availability of electrical supplies

- 2.7 If the supplies of electricity are to be made unavailable or are to be put at risk via working on stand-by generators or uninterruptible power supplies, the Authorised Person (LV) or Competent Person (LV) responsible for the work should contact the person in charge of the area, and a signed “permission to disconnect” form should be obtained before the equipment is isolated.

Safety key boxes

- 2.8 The number of safety key boxes provided for each site for which Authorised Persons (LV) have been appointed is to be decided by the Authorising Engineer (LV):
- a. each safety key box is to bear the name of the site and a serial number ensuring positive identification within the site;
 - b. when in use, each safety key box is to contain the keys to safety locks associated with only one permit-to-work;
 - c. after the safety locks have been applied, and before a permit-to-work is issued, the keys to all the safety locks are to be placed in a safety key box, and both locks of the box are to be secured. When the permit is issued, the Authorised Person (LV) is to retain the Authorised Person (LV)'s key and give the Competent Person (LV)'s key to the Competent Person (LV);
 - d. the Competent Person (LV) is to retain the Competent Person (LV)'s key until the permit-to-work is cancelled;
 - e. when not in use, the keys to safety key boxes are to be kept in the working key cabinet.

Dangerous occurrences

- 2.9 The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) requires certain dangerous occurrences and accidents to be reported to the Health & Safety Executive.
- 2.10 A dangerous occurrence is to be reported to the Authorised Person (LV) by Competent Persons (LV) as soon as reasonably practicable.
- 2.11 The Authorised Person (LV) is, without delay or as soon as practicable, to send a preliminary report of the dangerous occurrence to the Authorising Engineer (LV) and Designated Person.
- 2.12 Any notifications and reports required to satisfy statutory or other management requirements are to be issued.
- 2.13 The Authorising Engineer (LV) is to investigate each dangerous occurrence and issue a report to the Designated Person. The report is to be sufficiently detailed to enable the sequence of events leading to the occurrence to be determined. Where reasonably practicable, the report is to include

photographs taken before any items of equipment involved in the dangerous occurrence are disturbed.

- 2.14 To alleviate potential problems or criticism which may arise at any enquiry into a dangerous occurrence or incident, management should consider:
- a. the questionable conflict of interests and impartiality of any investigation or subsequent report where it is carried out by those directly involved;
 - b. the reliability of evidence involving self-judgement.

Operational restrictions

- 2.15 An operational restriction is a specific written instruction issued via the Authorising Engineer (LV) or the Department of Health in the form of a “hazard notice”, “safety action bulletin” or similar official instruction modifying the normal operating procedures associated with a particular type of equipment. Where the operational restriction is initiated by the Authorising Engineer (LV), it should, when relevant, be forwarded to the Department of Health for circulation nationally.
- 2.16 On receipt of an operational restriction, the Authorised Person (LV) should:
- a. acknowledge the receipt to the Authorising Engineer (LV), indicating whether the equipment is included in the local system(s) or installations;
 - b. record the receipt in the logbook and the action taken;
 - c. place a copy signed by each Authorised Person (LV) in the operational procedure manual.
- 2.17 Where the equipment to which the operational restriction refers forms part of the local systems and installations, the Authorised Person (LV) is to:
- a. place a copy of the operational restriction, signed by each Authorised Person (LV), in the operating and maintenance manual;
 - b. arrange for any inspection and remedial work required;
 - c. where considered necessary, fix warning signs on each item of equipment involved and report the satisfactory completion of any remedial works to the Authorising Engineer (LV).

Location of underground cables

- 2.18 Where it is proposed to carry out excavation work on sites for which Authorised Persons (LV) have been appointed, it is the responsibility of the Authorised Person (LV) when advised to ensure that all underground power cables within the proposed areas of excavation are located and their positions marked before the ground is disturbed.
- 2.19 No person should use cable location and tracing devices unless they are competent to do so and have been specifically trained in their use. A certificate should be issued by the instructor on successful completion of the training. A copy of this should be placed in the operational procedure manual.
- 2.20 Training in the use of cable location and tracing devices should normally be given by the manufacturers of the equipment, but alternatively it may be given by a Competent Person (LV) who has been trained and certified by the manufacturers or an approved training provider.

Switching methods

Safety switching

- 2.21 Planned switching on any complex circuit or switching in preparation for the issue of a permit-to-work should be in accordance with the following sequence of events:
- a. Write a safety programme (which details all switching and requires notification to users of any disconnections) and arrange for another Authorised Person (LV) to check the programme if reasonably practical.
 - b. The programme should be written a reasonable period in advance of the proposed start of the job.
 - c. Complete necessary switching and issue of safety documents as detailed in the safety programme. Record times of each switching action/ document issue.
 - d. Enter summary details of switching undertaken and safety documents issued in the logbook. Reference serial numbers of safety programme and permit(s).

- e. On completion of work, cancel safety documents (destroy permit original) and complete switching to restore supplies to normal as detailed in the safety programme. Record times of each action.
- f. File completed safety programme (which shows times of each switching action and issue/cancellation of permit(s)) in the operational procedure manual.
- g. Place permit-to-work book containing cancelled permit in the copy key cabinet (or agreed store).

Fault-switching

- 2.22 Fault-switching is the switching on of the LV network to disconnect a faulty part of the network and restore supply to the remaining healthy part of the system that was affected by the fault. Fault-switching is not emergency switching. Healthcare premises should have stand-by generators and uninterruptible power supply systems (UPS) to enable them to cope with a sudden unexpected loss of supply without an immediate life-threatening situation being created. However, loss of supply is a serious problem which could develop into an emergency – prompt action is therefore required to restore supply.
- 2.23 If more than one person is switching, one Authorised Person (LV) should be in overall command of the fault-switching and should maintain an accurate record of the operational state of the network. This person will act as a control engineer and will direct and sanction all fault-switching.
- 2.24 The essential steps in fault-switching are:
- a. remain calm and assess the situation as it develops;
 - b. record in writing what protection operated as the result of the initial fault;
 - c. inspect all switchgear for signs of distress before operating it;
 - d. plan fault-restoration switching a few steps at a time and write down planned switching before carrying it out. Record all switching times;
 - e. reset lifts, pumps etc as required.

Emergency switching

- 2.25 Emergency switching is switching that is required to remove an immediate threat to life, for example opening an incoming switch to disconnect

supplies to an LV board in which an electrician has accidentally made contact with live busbars.

- 2.26 Emergency switching, when required, may be undertaken without the need to complete any of the sequence steps detailed for planned or fault-switching.
- 2.27 Persons who undertake emergency switching should do so in a manner that does not put themselves or others at risk of injury.

Fire protection equipment

Automatic control

- 2.28 Before work or inspections are carried out in any enclosures protected by automatic fire-extinguishing equipment:
 - a. the automatic control must be rendered inoperative by the Authorised Person (LV) and the equipment left on hand-control. A caution sign should be attached and displayed whenever the automatic fire-extinguishing system is inoperative;
 - b. precautions taken to render the automatic control inoperative must be noted on any safety document issued for work in the protected enclosure;
 - c. the automatic control will be restored by the Authorised Person (LV) immediately after the persons engaged on the work or inspections have withdrawn from the protected enclosure.

Portable extinguishers

- 2.29 Only carbon dioxide (CO₂) or dry-powder extinguishers may be used near live electrical equipment, and a safety clearance of at least 300 mm should be maintained. After the discharge of portable extinguishers in an enclosed space, personnel must withdraw from that space.
- 2.30 After any explosion or fire, or after the discharge of extinguishers in an enclosed space, the space must be thoroughly ventilated before entry of personnel, unless suitable breathing apparatus is worn.

Access to, and work in, underground chambers, vessels and confined spaces

2.31 The following points apply:

- a. barriers, doors or gates restricting access to underground chambers or similar confined spaces, in which dangerous fumes or other hazards are present or likely to be present, should normally be kept locked and the control of keys should be maintained in accordance with an approved procedure;
- b. when any person has to enter any such place or similar confined space in which the above dangers are present or likely to be present, to such an extent as to involve risk of persons being overcome or otherwise endangered, precautions should include the issue of a limitation-of-access safety document in accordance with this document;
- c. arrangements for access and work, and the precautions to be taken, should be in accordance with the Confined Spaces Regulations 1997.

Protective equipment

- 2.32 Appropriate protective equipment is to be provided by management. It should be readily available at all times to those who need it and have training in its use. It is to be worn or used whenever necessary to avoid danger and injury, and as required by this safety guidance (LV).
- 2.33 Only protective equipment suitable for the purpose is to be provided by the management and its contractors. Protective equipment provided by the Competent Person (LV) employed by a contractor may be used if the Authorised Person (LV) agrees. Such use is to be recorded on the permit.
- 2.34 Protective equipment is to be inspected by the user for visible defects before and after use. Any suspect item is not to be used; suspect items are to be reported to the Authorised Person (LV), who is to consider its withdrawal and its replacement.
- 2.35 Unless more frequent intervals are specified, an Authorised Person (LV) is to inspect each item of safety equipment provided by the management at least once a year for defects and wear, and is to take remedial action where necessary. These inspections are to be recorded in the logbook.

Test equipment

- 2.36 The Authorised Person (LV) on duty is to arrange for the necessary test equipment to be available when required.
- 2.37 Test equipment is to be inspected by the user for visible defects on each occasion before and after use.
- 2.38 Unless more frequent intervals are specified, the Authorised Person (LV) is to inspect each item of test equipment provided by the management at least once a year for defects and is to take remedial action where necessary. These inspections are to be recorded in the logbook.
- 2.39 Test equipment is to be maintained and, where appropriate, recalibrated in accordance with the manufacturer's instructions.
- 2.40 The location of protective equipment, test equipment and portable earthing equipment is to be prominently displayed adjacent to the working key cabinet.

Cable identification

- 2.41 Phase conductors in a new installation or an alteration/addition to an existing installation should be coloured as in BS 7671:2001. Other phase conductors may be brown, black, red, orange, yellow, violet, grey, white, pink or turquoise.
- 2.42 In a two- or three-phase power circuit, the phase conductors may all be of one of the permitted colours, and either identified L1, L2, L3 or marked brown, black, grey at their terminations to show the phases:
- brown phase – L1;
 - black phase – L2;
 - grey phase – L3;
 - blue phase – N.

Circuit identification

- 2.43 The NICEIC (National Inspection Council for Electrical Installation Contractors) recommend within distribution boards that the circuit number comes first and then the phase identification:
- a. circuit 6 brown phase is marked – 6L1;

- b. circuit 8 black phase is marked – 8L2;
 - c. circuit 10 grey phase is marked – 10L3;
 - d. circuit 7 blue (neutral) is marked – 7N.
- 2.44 Circuit identification on drawings etc should be in the same manner, with the distribution board identification coming first:
- a. distribution board LP6 on circuit 6 – LP6/6/L1;
 - b. distribution board L4 on circuit 8 – L4/8/L2;
 - c. distribution board P2 on circuit 10 – P2/10/L2;
 - d. distribution board C6 on circuit 7 – C6/7/N.

Note

Three-phase circuits should be numbered in a similar manner, that is, LP6/6/L1L2L3.

3 Safety precautions and procedures for work on low voltage systems made dead

General

- 3.1 All work on low voltage electrical equipment including conductors should be carried out while such electrical equipment and conductors are dead and isolated from all sources of supply, and after being proved dead at the point-of-work. The only exceptions to this rule are for the circumstances described in [Chapter 4](#) or when working on low voltage equipment requiring isolation from a high voltage system. The latter would require a permit-to-work issued in accordance with Health Technical Memorandum 06-03 – ‘Electrical safety guidance for high voltage systems’.
- 3.2 Before any work can begin, the electrical equipment and conductors need to be identified and then proved dead at the point-of-work by means of an approved voltage testing device, which must itself be tested in an approved manner immediately before and immediately after its use.
- 3.3 When work is to be carried out on low voltage equipment made dead, all reasonably practicable steps must be taken to prevent the electrical equipment and/or conductors being made live inadvertently during the course of the work, including locking-off any switchgear, removal of any fuses, links or similar approved methods. Unless a key safe is used, the person working on the equipment should retain any locking-off keys, fuses and links.
- 3.4 If electrical equipment and conductors cannot be isolated and proved dead at the point-of-work, the “live working” guidance given in [Chapter 4](#) should apply.
- 3.5 Making electrical equipment and/or circuit conductors dead or live by means of a signal or prearranged understanding after an agreed interval of time is not an acceptable practice.

Isolation

- 3.6 In achieving isolation, the following steps should be carried out where reasonably practicable:
- the application of a safety system to prevent the circuit breaker or switch being closed or fuse replaced whenever the equipment allows its use. Use of special locking devices to allow the use of safety locks is recommended;
 - a visible break in air should be obtained (whenever possible);
 - a caution sign should be fixed.
- 3.7 A caution sign should be fixed at each point-of-isolation. It is recommended that an individual's name is added to each caution sign to aid location of the person in charge of the work.
- 3.8 Circuits to be worked on must be isolated from all known voltage sources including alternative energy sources (wind generators, photovoltaic cells etc) and generators or battery systems. Consideration must also be given to the need to isolate from all possible voltage sources.

Note

Work on a final circuit can be safely carried out with isolation at the controlling distribution board fuse-way only – that is, isolation from the known voltage source only, since the likelihood of supply via a generator connected to the same circuit is considered remote. However, work on the busbars of a sub-main switchboard would require isolation of all circuits connected to the board (not just the incomer or known voltage supply), since it is feasible for a generator to be connected to one of the many circuits normally supplied from the sub-main board.

- 3.9 Where a permit-to-work is not required and isolation is achieved by the removal of fuses or links, and it is not practicable to apply a safety lock, the Competent Person (LV) responsible for the work or test must securely retain the removed fuses or links. A caution sign should be displayed.
- 3.10 The Authorised Person (LV) should isolate any circuits before a permit-to-work is issued.
- 3.11 The keys to safety locks should be retained by the Competent Person (LV) who applied them. If an Authorised Person (LV) applies the safety lock

before the permit-to-work is issued, the key must be placed in a key safe – one key to the key safe being retained by the Authorised Person (LV), and the other being issued to the person in receipt of the permit.

Work on low voltage electrical equipment and conductors made dead

- 3.12 When work is to be carried out on low voltage electrical equipment and conductors that have been made dead, suitable precautions additional to those referred to in [paragraphs 3.1](#) and [3.11](#) should be taken where necessary by approved screening or other approved means in order to avoid danger from inadvertent contact with live conductors in the zone of work.
- 3.13 Caution signs should be securely fixed at all points-of-isolation for the electrical equipment and conductors that have been made dead, and on which work is to be carried out. Danger signs must be attached where reasonably practicable for any adjacent live circuit conductors (or electrical equipment containing live circuit conductors) that are adjacent to the point-of-work.
- 3.14 In cases where the work is concerned only with the external earthed metal parts of electrical equipment and no contact can be made with live conductors, or where the connected electrical equipment is physically removed from its normal location, the Authorised Person (LV) may allow some of the measures under [paragraphs 3.1](#) and [3.11](#) to be omitted providing they are satisfied that the measures taken are still adequate to prevent danger.

Working on cables

Identification and spiking of LV cables

- 3.15 Before the conductors of a cable are cut or exposed, a point-of-isolation for the cable and the point-of-work on the cable are to be identified with certainty.
- 3.16 Identification of a mains voltage or street-lighting cable other than at a labelled termination point may be regarded as clear and certain if the cable can be seen throughout its length, or if it can be clearly seen between the point-of-isolation and the point-of-work.

- 3.17 In the absence of clear and certain identification of a cable, it is to be spiked at the point-of-work. Before spiking, it may be necessary to carry out signal injection using the cable cores. Further tests can be repeated after spiking and the results compared. Where only one cable exists in a given location and accurate records indicate that only one cable is present, signal injection may be dispensed with if the Authorised Person (LV) agrees.
- 3.18 The spiking of cables may only be carried out under the direct supervision of an Authorised Person (LV) and by a person who has been specifically trained in the operation of the equipment to be used.
- 3.19 Where more than one cable exists on a single route, the Authorised Person (LV) must identify and label the cable to be worked on. All other cables must be regarded as live, and danger signs attached.
- 3.20 Approved live-working methods may be used as an alternative to spiking. Such work is usually only undertaken by specialist contractors (for example electricity supply companies). If these methods are used, a “certificate of authorisation for live working” should be issued in accordance with **Chapter 4**.

Additional precautions for work on generating plant

- 3.21 When work is to be carried out on generating plant, **paragraphs 3.1 to 3.11** apply.
- 3.22 When work is carried out on generating plant (including combined heat and power plant) and directly connected equipment, the following additional precautions should be taken:
- a. the generator must be at rest and isolated from all sources of supply;
 - b. the field circuit must be isolated and locked off where it is energised from a separate supply;
 - c. where motor-driven exciters are provided, the switch controlling the motor must be isolated and locked off;
 - d. the prime mover providing the motive power to the generator, and any associated valves controlling the flow of fuel or steam, should be isolated and locked off;
 - e. in the case of an internal combustion engine prime mover, the starting equipment should also be made inoperative;

- f. danger and caution signs should be prominently displayed at all points-of-isolation referred to in (b) and (c);
 - g. to ensure a safe system of work, the permit-to-work procedures identified in paragraphs 3.28–3.31 should be operated.
- 3.23 When manual barring gear is to be used on generating plant, a permit-to-work must be issued.
- 3.24 Generating plant must not be allowed to operate with any part of its protective enclosures (mechanical or electrical) removed – unless for special test purposes, when it should be the subject of a risk assessment by an Authorised Person (LV). The risk assessment should establish whether any additional precautions or procedures to those already being implemented are considered necessary to ensure a safe system of work, and these should be confirmed in writing.

Uninterruptible power supply systems

- 3.25 Under normal circumstances, any work or test undertaken on uninterruptible power supply systems (UPS) will be carried out with the equipment completely isolated from all sources of supply in accordance with [Table 3](#).
- 3.26 Equipment of this type is supplied with an internal bypass designed to allow automatic changeover to the mains supply in the event of a UPS failure. In some instances this bypass is arranged to provide a no-break changeover to mains supply for maintenance, which will not allow the complete isolation.
- 3.27 The Authorising Engineer (LV) in conjunction with the Authorised Person (LV), and where considered necessary the manufacturers of the equipment, is to survey each fixed UPS system and carry out a risk assessment to document the risks involved and to develop operating procedures to be applied before routine maintenance, minor repairs or major repairs can be carried out. In some instances this may involve live working or, in the longer term, modification to the equipment.

Permit-to-work

- 3.28 A permit-to-work should be issued for work:
- a. on a complex circuit;

- b. on a main or sub-main LV switchboard;
 - c. on cable external to a building;
 - d. on stand-by generators;
 - e. whenever the Authorised Person (LV) deems it necessary to ensure a safe system of work.
- 3.29** A permit-to-work should be issued by an Authorised Person (LV) to a Competent Person (LV). The permit holder (recipient) must immediately supervise all members of the working party so as to ensure that only work as detailed on the permit is undertaken and that this is done in a safe manner.
- 3.30** The Authorised Person (LV) should ensure that the Competent Person (LV) who is to receive the permit fully understands all details and safety precautions required to undertake the work safely as detailed on the permit. The Authorised Person (LV) should confirm the recipient's understanding of permit requirements by:
- a. fully explaining at the point-of-work where the circuit has been proved dead and all safety precautions to be taken;
 - b. listening to the recipient read the permit aloud (permits should be completed in capitals, that is, printed to aid clarity) and confirming accuracy;
 - c. questioning the recipient by asking relevant open questions (those which require more than a simple "yes" or "no" reply).
- 3.31** A permit-to-work should only be issued after:
- a. the electrical equipment/conductors to be worked on have been isolated from all voltage sources and wherever possible the means of isolation secured by locking;
 - b. the equipment/conductors have been proved dead at the point-of-work by the Authorised Person (LV) who is to issue the permit in the presence of the Competent Person (LV) who is to receive it;
 - c. the Authorised Person (LV) is satisfied that the potential recipient fully understands all the necessary safety precautions to complete the task as detailed on the permit.

Issue of a permit to a contractor

- 3.32 A contractor's employee may be issued with a permit-to-work, providing the Authorised Person (LV) completes the actions required by this Health Technical Memorandum and is satisfied of the capability and competence of the individual.
- 3.33 The manager who approved the issue of the contract to the contractor's company clearly also has a duty to ensure the capability and competence of the company and its employees.
- 3.34 The Authorised Person (LV) should be given confirmation that checks have been made to determine the satisfactory technical and safety competence of the company by taking into account such considerations as:
- company safety policy;
 - company accident record;
 - qualifications and training of employees – adequate insurance;
 - adequate physical resources (tools, safety equipment etc);
 - quality assurance checks during the progress of work on site.

Safety programmes and isolation and earthing diagrams

- 3.35 A safety programme together with an isolation and earthing diagram are required for all planned work and/or tests which require the issue of a permit-to-work.
- 3.36 The safety programme and isolation and earthing diagram must be written by the Authorised Person (LV) who is responsible for the issue of the permit-to-work.
- 3.37 If the equipment to be worked on is a complex circuit, the safety programme and isolation and earthing diagram should be countersigned by another Authorised Person (LV) with knowledge of the site and system.

Summary

- 3.38 **Tables 1–3** summarise the procedures to be carried out for work/tests undertaken on low voltage systems that have been made dead.

Table 1 Procedures for Competent Persons (LV) working on, or testing, cables and other equipment on the load side of a final circuit

Steps ¹	Procedure ²
1 Identify and inform	Identify circuit to be worked on. Before any work or testing can begin, permission must be obtained from the person in charge of the area to be affected by the work or testing.
2 Isolate and fix signs	(i) Isolate from all sources of supply. (ii) Make equipment safe to work on or test. (iii) Fix caution signs at points-of-isolation and where practicable prevent unauthorised connection or operation by fixing safety locks. (iv) Fix danger signs on live equipment adjacent to the point-of-work or test.
3 Prove dead	(i) Ensure that the equipment to be worked on or tested is the equipment that has been isolated. (ii) Where practicable, prove dead with a voltage test indicator at the points-of-isolation and at the places where the work or test is to be carried out.
4 Confirm dead	Where it was not practicable in Step 3 to prove the equipment dead, the Competent Person, using appropriate tools and protective equipment where necessary, is to confirm it dead at the point-of-work or test as soon as conductors have been made accessible to a voltage test indicator.
5 Undertake the work or test	Undertake or directly supervise the work or test.
<p>Notes:</p> <p>1 The Competent Person (LV) is responsible for all tasks.</p> <p>2 For main intake switches, switchboards, and equipment having two or more sources of supply, cables and other equipment on the supply side of a main intake switch, refer to the Authorised Person (LV) (see Table 2).</p> <p>Except where a risk assessment indicates otherwise, equipment operating at extra low voltage is exempt from these procedures.</p>	

Table 2 Procedures to be carried out by an Authorised Person (LV) to enable work on main intake switches, distribution circuits, switchboards, equipment having two or more sources of supply, and cables and other equipment on the supply side of a final circuit

Steps¹	Procedure
1 Prepare a safety programme	(i) Prepare a safety programme plus an isolation and earthing diagram in duplicate, and obtain countersignatures from another Authorised Person (LV) if required. (ii) Before any work can begin, permission must be obtained from the person in charge of the area to be affected by the work or test.
2 Isolate and fix signs	(i) Isolate from all sources of supply. (ii) Fix caution signs at points-of-isolation and where practicable prevent unauthorised connection or operation by fixing safety locks. (iii) Fix danger signs on live equipment adjacent to the point-of-work or test.
3 Prove dead and earth	(i) Where practicable, prove dead with a voltage test indicator at all the points-of-isolation and at the point-of-work or test. (ii) If the manufacturer's earthing equipment is available, earth conductors at points-of-isolation and fix safety locks. (iii) Identify cables with certainty or spike underground cables at the point-of-work if the conductors are to be cut or exposed
4 Issue the permit-to-work	(i) The Competent Person (LV) is to be shown the isolation and earthing diagram and the safety arrangements at all the points-of-isolation and at the point-of-work or test. (ii) Issue to the Competent Person (LV): <ul style="list-style-type: none"> • the permit-to-work; • the isolation and earthing diagram; and • the Competent Person (LV)'s key to the safety key box.

Steps¹	Procedure
5 Confirm dead	Where it was not practicable in Step 3 to prove the equipment dead, the Authorised Person (LV), using appropriate tools and protective equipment where necessary, is to confirm dead at the point-of-work as soon as conductors have been made accessible to a voltage test indicator.
6 Undertake the work	The Competent Person (LV) is to undertake or directly supervise the work and on completion, or when the work is stopped and made safe, is to return the original of the permit-to-work, the isolation and earthing diagram and the Competent Person (LV)'s key to the safety key box to the Authorised Person (LV) on duty, and complete part 3 of the permit retained in the pad.
Notes: 1 The Authorised Person (LV) is responsible for all tasks.	

Table 3 Procedures to be carried out by an Authorised Person (LV) to enable work on generators¹ and UPS systems²		
Steps³	Procedure for generators	Procedure for UPS systems
1 Prepare a safety programme	<ul style="list-style-type: none"> (i) Comply with any particular safety procedures applicable to the location. (ii) Prepare a safety programme and isolation and earthing diagram in duplicate and obtain countersignatures from another Authorised Person (LV). (iii) Before any work starts, permission must be obtained from the person in charge of the area to be affected by the work. 	
2 Isolate and fix signs	<ul style="list-style-type: none"> (i) Inhibit engine start, isolate generator. Where practicable, prevent unauthorised connection, operation or starting by fixing safety locks. (ii) Fix caution signs at all the points-of-isolation and, clearly visible, on the engine start panel. (iii) Fix danger signs on live equipment adjacent to the point-of-work. 	<ul style="list-style-type: none"> (i) Isolate from all sources of supply. (ii) Isolate mains supply, battery supply, output supply and any stand-by generator supply. (iii) On parallel UPS systems and those having an external bypass, isolate the output supply terminals of the unit(s) to be worked on from all sources of supply. (iv) If the battery installation is to be worked on, follow the rules applicable to work on live equipment, disconnect the battery from its charger and disconnect the battery earth. (v) Prevent unauthorised connection or unauthorised operation by fixing safety locks and caution signs at points-of-isolation. (vi) Fix danger signs on adjacent live equipment to the point-of-work.

Steps ³	Procedure for generators	Procedure for UPS systems
3 Prove dead and earth	(i) Where practicable, prove dead with a voltage test indicator at all the points-of-isolation and at the point-of-work. (ii) If the manufacturer's earthing equipment is available, earth conductors at points-of-isolation, and fix safety locks.	
4 Issue the permit-to-work	(i) The Competent Person (LV) is to be shown the isolation and earthing diagram and the safety arrangements at all the points-of-isolation and at the point-of-work. (ii) Issue the permit-to-work, isolation and earthing diagram and the Competent Person (LV)'s key to the safety key box to the Competent Person (LV).	
5 Confirm dead	Where it was not practicable in Step 3 to prove the equipment dead, the Competent Person, using appropriate tools and protective equipment where necessary, is to confirm dead at the point-of-work as soon as conductors have been made accessible to a voltage test indicator. Where practicable, earth the conductors after they have been confirmed dead.	
6 Undertake the work	The Competent Person (LV) is to undertake or directly supervise the work and on completion, or when the work is stopped and made safe, is to return the original of the permit-to-work, isolation and earthing diagram and the Competent Person (LV)'s key to the safety key box to the Authorised Person (LV) on duty and complete part 3 of the permit retained in the pad.	
Notes: 1 Stand-by generating sets started by manual initiation or automatically on receipt of a signal. 2 Fixed uninterruptible power supply equipment (excluding portable self-contained "plug-in" units). 3 The Authorised Person (LV) is responsible for all tasks.		

4 Safety precautions and procedures for live working and testing low voltage equipment

Work on or near live equipment

- 4.1 The exceptions to **Chapter 3** which involve a Competent Person (LV), authorised in writing, working on or near live equipment are::
- all forms of testing, fault-finding or adjustment where practicalities dictate live working is essential;
 - the removal and replacement of fuse carriers in final circuits;
 - the removal and replacement of plug-in components;
 - basic battery maintenance (cleaning/topping up only);
 - work on battery systems if more than 25 V and/or 10 Ah (ampère-hours).
- 4.2 When work of the type referred to in paragraph 4.1 is carried out:
- the extent of work should be kept to a minimum;
 - approved test equipment to the standard recommended in Health & Safety Executive Guidance Note GS38 'Electrical test equipment for use by electricians' should be used, together with any additional approved safety equipment which significantly reduces the risk of injury;
 - if the equipment is not to IP2X or IPXXB standard, a self-check live working form (LW1) should be completed;
 - the removal of components from connections or terminals is not allowed – if disconnection of terminals or connectors is required, the work should be carried out as outlined in **Table 1**.
- 4.3 Live working other than that specified in paragraph 4.1 should not normally be considered. The Electricity at Work Regulations 1989 make it

illegal to work on or near live equipment, without first complying with Regulation 14:

“Regulation 14

No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless: it is unreasonable in all the circumstances for the conductors to be dead and

it is reasonable in all the circumstances for the person to be at work on or near the conductor while it is live

and

suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.”

The above represents a very severe legal test on the need to work live. Dead working should always be the first choice and live working only the very last method chosen when all other possibilities of providing alternative supplies or arranging out-of-hour shut-downs of supply etc have been carefully evaluated.

Note

Except for work on batteries, it is unlikely that situations will occur in healthcare premises which necessitate live working under the terms of a certificate of authorisation for live working (that is, removal and/or replacement of components with the circuit energised). (Live testing, fault-finding or making adjustments are all forms of live working (which can only be undertaken by suitably authorised Competent Persons (LV) using appropriate safe methods) but they do not require the issue of a certificate of authorisation for live working, since components are not removed or replaced.)

Work on the essential board or final circuits in a critical care area is often offered as an example of a situation which requires live working because of the need to maintain the electrical supply to critically ill patients. However, if careful planning is applied to finding a way of doing the job dead, a solution can be found. ➤

Auxiliary supplies via extension leads from an adjacent ward – run so as not to restrict corridors to “crash teams” (extension leads taped to skirting boards and a wooden frame constructed to bridge the corridor) – was a practical solution used in one critical care facility. Clearly, such solutions are time-consuming to organise and more expensive than live working, but the electrical risks from shock etc to those doing the work have been greatly reduced, and this is what the law requires.

Safety precautions and procedures for work on live low voltage electrical equipment and conductors

- 4.4 Other modes of live working other than those specified in [paragraph 4.1](#) should not normally be considered except where all possible alternatives have been considered and eliminated.
- 4.5 Authorised Persons (LV) should consult their Authorising Engineers (LV) before undertaking any work (except for work on a battery) which will require them to issue a certificate of authorisation for live working. Permission should be obtained if a decision is taken to go ahead.
- 4.6 When this condition applies and live working is deemed essential, it will require specific written authorisation in the form of a certificate of authorisation for live working issued by an Authorised Person (LV) to a Competent Person (LV) in accordance with the procedures detailed.
- 4.7 In all circumstances when work is to be carried out on live low voltage electrical equipment and conductors:
- suitable precautions may be taken by the use of screening, insulated tools and other appropriate means to avoid danger from inadvertent contact with live circuit conductors or earthed metalwork;
 - the persons carrying out the work should satisfy themselves by examination that the precautions taken are adequate and, before use, that the equipment to be used is suitable for the task;
 - only approved instruments should be used for electrical, phase rotation or similar measurements;
 - adequate means should be provided to prevent unauthorised access to the zone of work, particularly if working on distribution boards in corridors;

- e. a second person should be present where, in the opinion of the Authorised Person (LV), that person could contribute significantly to ensuring that injury is prevented;
 - f. that person should have adequate knowledge and experience, be trained to recognise and avoid danger and, if necessary, render assistance in the event of an emergency.
- 4.8 Any person authorised for live working must be a Competent Person (LV) over 18 years of age.
- 4.9 Form LW1 should be completed before any live working takes place unless all parts of the live equipment are shrouded to prevent finger access (IP2X). If a certificate of authorisation for live working is to be issued, a copy of the form should be attached to the certificate.

Precautions for working on battery installations

- 4.10 The output from the battery should be isolated when working on the equipment it supplies unless for safety reasons the battery output needs to be instantly and permanently available. The battery charger should be isolated.
- 4.11 Where it is necessary to use tools for working on a battery, they should be of an approved insulated type.
- 4.12 The requirements to implement any or all of the precautions for work on live equipment as detailed in [paragraphs 4.1–4.2](#) to control maintenance work on battery installations should be determined by an Authorised Person (LV).
- 4.13 If work other than simple maintenance (for example topping up electrolyte levels) is undertaken, this work should only be carried out in full accordance with the precautions detailed within Health Technical Memorandum 06-02 – ‘Electrical safety guidance for low voltage systems’, including the issue of a certificate of authorisation for live working.
- 4.14 For work on batteries below 25 V and 10 Ah, Authorised Persons (LV) should undertake a risk assessment of individual installations and issue local instructions if considered appropriate. When working on any battery system, care should be taken to prevent short-circuiting terminals.

- 4.15 Work which may involve a source of ignition must never be undertaken near an enclosed cell or battery unless adequate precautions have been taken to eliminate any risk of danger or injury.
- 4.16 Where any work is to be carried out near, or directly over, a battery installation, specific precautions should be taken to prevent the potential risk of danger or injury which could result from any accidental short-circuiting of the battery terminals.
- 4.17 A supply of sterile water to allow flushing of the eyes should be available during the course of the work.
- 4.18 Personal protective equipment including face visor, acid-resistant gloves and apron should be worn during the work.
- 4.19 In all cases of burns, medical attention should be obtained.

5 Display of permanent posters and safety signs

Display of posters

- 5.1 In each room containing low voltage electrical equipment, the following posters should be prominently displayed:
- a poster showing an approved method of treatment for electric shock;
 - a single line drawing of the low voltage system up to and including final circuit distribution boards under the control of the Authorised Person (LV).
- 5.2 Where management have the responsibility for the danger, the Authorised Person (LV) is to carry out an assessment to determine the requirement and location for the display of information in connection with this guidance. Information is to be displayed permanently in suitable and prominent positions. The areas to be considered for the display of information in connection with this guidance are to include every workshop and each Authorised Person (LV)'s office.
- 5.3 Other information and posters to be displayed may include:
- the Electricity at Work Regulations 1989;
 - a poster showing an approved method of treatment for electric shock;
 - other relevant health and safety information.

Design specification

- 5.4 All signs should be to the sizes indicated.
- 5.5 The design and colours of the signs should be to BS 5499-5:2002. Colours should be to BS 5252: 1976 as follows:
- yellow 08E51;

- blue 18E53;
 - red 04E53.
- 5.6 Signs should be manufactured from laminated plastic or other similar non-metallic weather-resistant material (thickness appropriate to the intended location and application).
- 5.7 Non-corrosive materials are to be used when fixing permanent safety signs. Permanent signs should not be fixed with adhesives.
- 5.8 All temporary signs should be provided with two 5 mm diameter holes for a suspension cord. The holes should be 10 mm from the top edge and 30 mm from each end for 150 mm wide signs, and 50 mm from each end for 200 mm wide signs.
- 5.9 Temporary safety signs are to be suspended from non-conducting cords and fixed and removed only by an Authorised Person (LV).
- 5.10 Permanent safety signs are to be securely and permanently fixed in accordance with the clauses in this section.

Display of permanent safety signs

- 5.11 Where a “gas flooding system” is installed in a switchroom or accommodation where low voltage is present, a safety sign with appropriate text should be installed in a prominent position (Figure 1).

Figure 1 Electrical switchroom safety sign (actual size: 200 x 100 x 1.5 mm white plastic)



Display of temporary safety signs

- 5.12 Caution signs (see Figure 2) are to be prominently displayed and securely fixed at all points-of-isolation before the start of, and for the duration of, any work or testing, and before the issue of any permit-to-work.
- 5.13 Danger signs (see Figure 3) are to be prominently displayed so that they are visible from every angle of approach to a low voltage enclosure before any testing at low voltage is carried out and before the issue of, and for the duration of, any work or testing, and before the issue of any permit-to-work.

Figure 2 Caution sign (actual size: 200 x 100 x 1.5 mm white plastic)

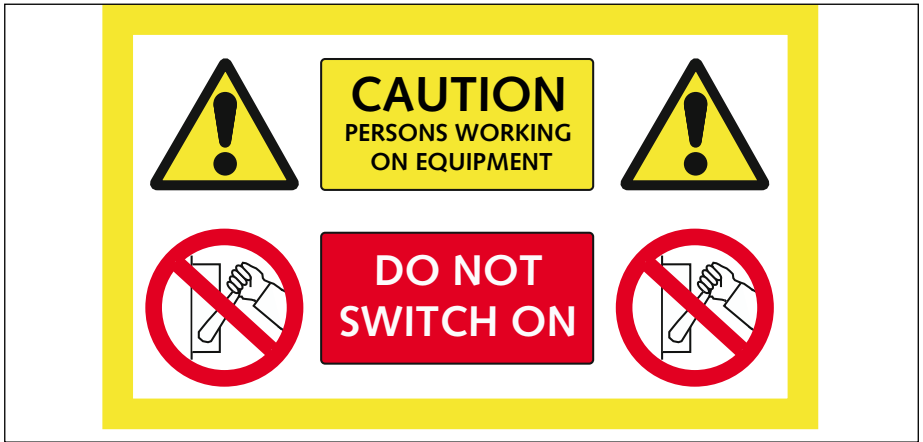


Figure 3 Danger sign (actual size: 200 x 100 x 1.5 mm white plastic)



- 5.14 Danger signs are to be prominently displayed on any equipment which remains live and is adjacent to equipment to be worked on or tested before the start of, and for the duration of, the work or testing, and before the issue of any permit-to-work.
- 5.15 Where work or testing is to be undertaken on any part of a multi-cubicle switchboard, danger signs should be prominently displayed on the cubicles or compartments adjacent to the part being worked on or tested. If the board has rear access, danger signs are to be similarly displayed at both the front and rear of the board. Reliance is not to be placed on the switchboard labelling when identifying parts at the rear of the board. Any discrepancies found are to be reported.
- 5.16 Danger signs are to be prominently displayed on any equipment which is accessible, both in or adjacent to the area which is the subject of the limitation-of-access, before the issue of and for the duration of any limitation-of-access.

6 Testing and inspection

Initial sequence of testing

- (i) Continuity of protective conductors (including main and supplementary equipotential bonding conductors).
- (ii) Continuity of ring final circuit conductors including protective conductors.
- (iii) Insulation resistance (between live conductors and between each live conductor and earth).
- (iv) Polarity: this includes checks that single-pole control and protective devices (for example switches, circuit-breakers, fuses) are connected in the phase conductor only, that bayonet and Edison-screw lamp-holders (except for E14 and E27 to BS EN 60238) have their outer contacts connected to the neutral conductor, and that wiring has been correctly connected to socket-outlets and other accessories.
- (v) Earth electrode resistance.
- (vi) Earth fault loop impedance.
- (vii) Prospective fault current, if not determined by enquiry of the distributor.
- (viii) Functional testing (including RCDs and RCBOs).

New colour harmonisation

6.1 All single-phase wiring will be carried out in the same colours as are now used for appliance flexes, that is:

phase/line conductor – **Brown**

neutral conductor – **Blue**

protective conductor/earth – **Green-and-Yellow**.

6.2 The new colours were adopted for appliance flexes in 1975.

- 6.3 Europe has been using **Black** or **Brown** in any combination for the three-phase colours. The UK proposed brown only for single-phase (as in flexes) and **Brown**, **Black** and **Grey** for the three-phases, and this was accepted. This enables line (phase) colours to be identified without ambiguities.
- 6.4 As of 1 April 2004, the new colours to be used in installations were introduced. For installations starting on or after 1 April 2006, only the new colours can be used.

Mixed installations

- 6.5 Care has to be taken where additions or alterations are made to installations in the old colours with cables in the new colours. Bearing in mind the present sizeable building stock, it will be 20 years or more before there is any significant change in the body of colours installed in the UK.

Single-phase installations

Conductor	Old colours	New colours
Phase	Red	Brown
Neutral	Black	Blue
Protective conductor	Green-and-Yellow	Green-and-Yellow

Three-phase installations

- 6.6 There is a need to identify cores specifically. The following marking is:

Conductor	Old colours	New colours
Phase	Red	Brown
Phase	Yellow	Black
Phase	Blue	Grey
Neutral	Black	Blue

7 Maximum permitted earth loop impedance

7.1 The tables below provide maximum permissible measured earth-fault loop impedances (Z_s) for compliance with BS 7671 where conventional final circuits are used at an ambient temperature of 20°C.

Maximum permitted earth-fault loop impedance permitted for cables at 20°C when the overcurrent protective device is a:

BS 88 (0.4-second disconnection time)

Protective conductor (mm ²)	Fuse rating in amperes							
	6	10	16	20	25	32	40	50
1.0	7.39	4.43	2.35	1.53	1.24	0.71	NP	NP
1.5	7.39	4.43	2.35	1.53	1.24	0.90	0.69	NP
2.5 to 16.0	7.39	4.43	2.35	1.53	1.24	0.90	0.7	0.53

BS 88 (5-second disconnection)

Protective conductor (mm ²)	Fuse rating in amperes							
	6	10	16	20	25	32	40	50
1.0	11.73	6.43	3.32	1.82	1.28	0.71	NP	NP
1.5	11.73	6.43	3.32	2.52	1.66	1.16	0.69	NP
2.5	11.73	6.43	3.32	2.52	1.99	1.58	1.17	0.58
4.0	11.73	6.43	3.32	2.52	1.99	1.58	1.17	0.84
6.0 to 16.0	11.73	6.43	3.32	2.52	1.99	1.58	1.17	0.90

NP = Not permitted

BS 1361 (0.4-second disconnection time)

Protective conductor (mm ²)	Fuse rating in amperes				
	5	15	20	30	45
1.0	9.06	2.85	1.47	0.83	NP
1.5	9.06	2.85	1.47	0.99	0.35
2.5 to 16.0	9.06	2.85	1.47	0.99	0.49

BS 1361 (5-second disconnection time)

Protective conductor (mm ²)	Fuse rating in amperes				
	5	15	20	30	45
1.0	14.22	4.34	1.82	0.83	NP
1.5	14.22	4.34	2.32	1.24	0.35
2.5	14.22	4.34	2.43	1.60	0.55
4.0	14.22	4.34	2.43	1.60	0.72
6.0 to 16.0	14.22	4.34	2.43	1.60	0.83

BS EN 60898 or an RCBO to BS EN 61009 (0.4- and 5-second disconnection times)

Circuit breaker type	Fuse rating in amperes											
	6	10	16	20	25	32	40	50	63	80	100	125
B	6.65	3.99	2.49	1.99	1.60	1.24	0.99	0.80	0.63	0.49	0.39	0.31
C	3.32	1.99	1.24	0.99	0.80	0.62	0.49	0.39	0.31	0.24	0.19	0.15
D	1.66	0.99	0.62	0.49	0.39	0.31	0.24	0.19	0.15	0.12	0.09	0.08

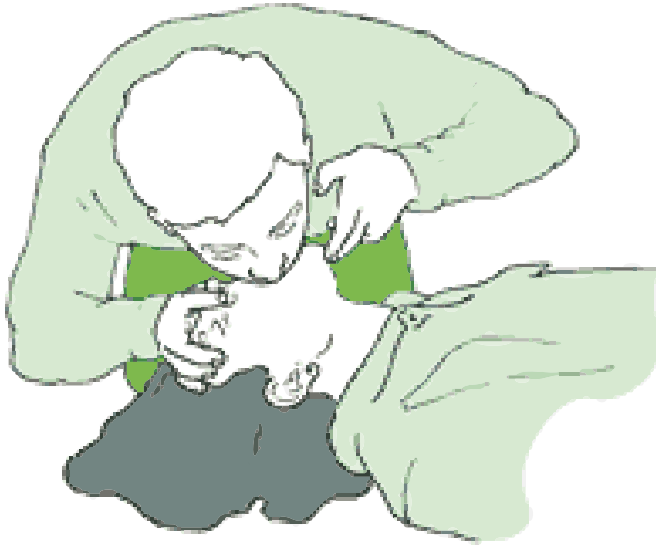
BS 3871

MCB type	Fuse rating in amperes												
	5	6	10	15	16	20	25	30	32	40	45	50	63
1	9.98	8.32	4.99	3.32	3.12	2.49	1.99	1.66	1.56	1.24	1.10	0.99	0.79
2	5.69	4.75	2.84	1.90	1.77	1.42	1.13	0.95	0.89	0.71	0.63	0.57	0.44
3	3.99	3.32	1.99	1.33	1.24	0.99	0.80	0.66	0.62	0.49	0.43	0.39	0.31

8 First-aid

Treatment for electric shock – free from contact

- 8.1 Switch off supply immediately or send someone to do so. Do not attempt to remove a person from contact with high voltage unless suitable articles insulated for the system voltage are used for this purpose. When attempting to free a person from contact with low voltage use rubber gloves, boots, or mat, or insulated stick, but if these are not available use a loop of rope, cap or coat to drag the person free. Whatever is used should be dry and non-conducting. (An adult is considered to be anyone aged eight or over for the purposes of these instructions.)

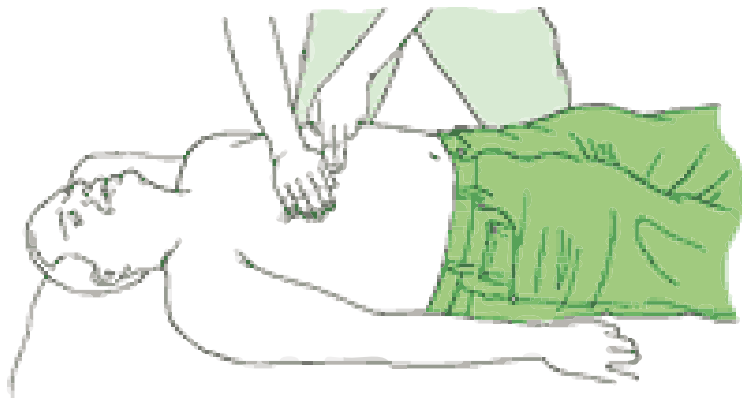


- 8.2 After release:
- Do not waste time. If possible, lay casualty on a firm, dry surface and if there is no sign of breathing, immediately commence artificial respiration. If possible, send for an ambulance and doctor.
 - Ensure the airway is open.

- c. Pinch nose firmly closed.
- d. Take a deep breath and seal your lips around the casualty's mouth.
- e. Blow into the mouth until the chest rises.
- f. Remove your mouth and allow the chest to fall.
- g. Repeat once more, then check for circulation.
- h. If circulation is absent, commence chest compressions.
- j. Check for circulation after every ten breaths.
- k. If breathing starts, place in recovery position.
- m. If the chest fails to rise during inflation, the airways are blocked; external cardiac compression must not be carried out until the airways are unblocked. Check that the jaw is lifted, the head tilted back and that the mouth and throat are clear. If there are still no obvious signs of recovery, check the pulse, and if it is felt, continue with artificial respiration. If the neck pulse is not felt, commence cardiac resuscitation.

Cardiac resuscitation

- 8.3 With the hand cup-shaped, strike the chest over the heart position once without follow-through weight. If the heart restarts, indicated by signs of recovery and a pulse which can be felt, continue with lung inflations.
- 8.4 If still no pulse, start external cardiac compression.

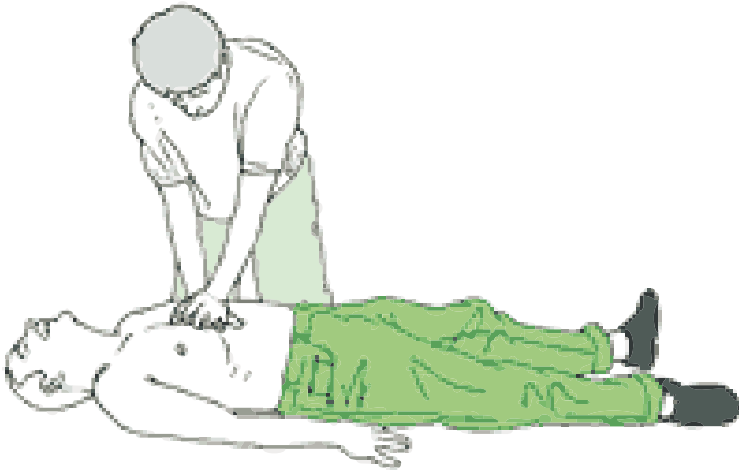


Chest compressions

Note

Chest compressions must always be combined with rescue breaths.

- a. Place heel of your hand two fingers' width above the junction of the casualty's rib margin and breastbone.
- b. Place other hand on top and interlock fingers. Keeping your arms straight and your fingers off the chest, press down by 4–5 cm; then release the pressure, keeping your hands in place.



- c. Repeat the compressions 15 times, aiming at a rate of 100 per minute.
- d. Give two rescue breaths.
- e. Continue resuscitation, 15 compressions to two rescue breaths.
- f. Only check for circulation if the casualty's colour improves.
- g. If circulation is present, stop the chest compressions but continue rescue breaths if necessary.

Control of bleeding

Minor cuts, scratches and grazes

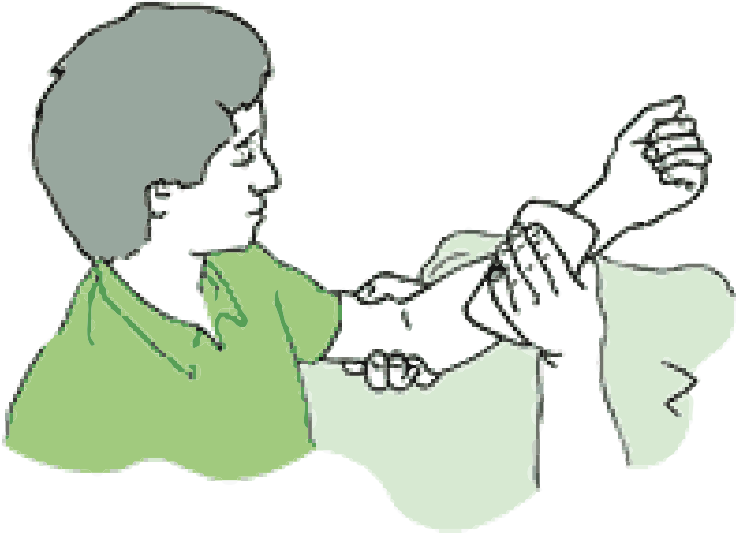
Treatment

- a. Wash and dry your own hands.
- b. Cover any cuts on your own hands and put on disposable gloves.
- c. Clean the cut, if dirty, under running water. Pat dry with a sterile dressing or clean, lint-free material. If possible, raise affected area above the heart.
- d. Cover the cut temporarily while you clean the surrounding skin with soap and water, and pat the surrounding skin dry. Cover the cut completely with a sterile dressing or plaster.



Severe bleeding

Treatment



- a. Put on disposable gloves.
- b. Apply direct pressure to the wound with a pad (for example a clean cloth) or fingers until a sterile dressing is available.
- c. Raise and support the injured limb. Take particular care if you suspect a bone has been broken.
- d. Lay the casualty down to treat for shock.
- e. Bandage the pad or dressing firmly to control bleeding, but not so tightly that it stops the circulation to fingers or toes. If bleeding seeps through first bandage, cover with a second bandage. If bleeding continues to seep through the second bandage, remove it and re-apply.
- f. Treat for shock.
- g. Dial 999 for an ambulance.

Remember

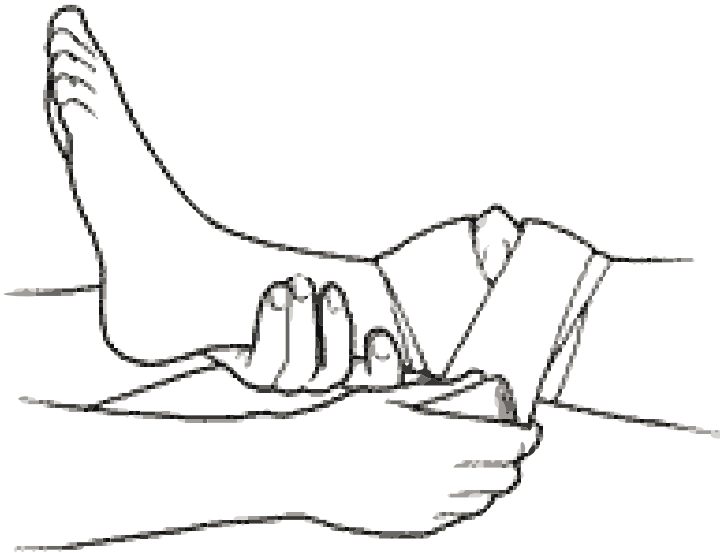
Protect yourself from infection by wearing disposable gloves and covering any wounds on your hands.

If blood comes through the dressing, do not remove it – bandage another over the original.

If blood seeps through both dressings, remove them both and replace with a fresh dressing, applying pressure over the site of bleeding.

Objects in wounds

- 8.5 Where possible, swab or wash small objects out of the wound with clean water. If there is a large object embedded, do the following:



- Leave it in place.
- Apply firm pressure on either side of the object.
- Raise and support the wounded limb or part.
- Lay the casualty down to treat for shock.

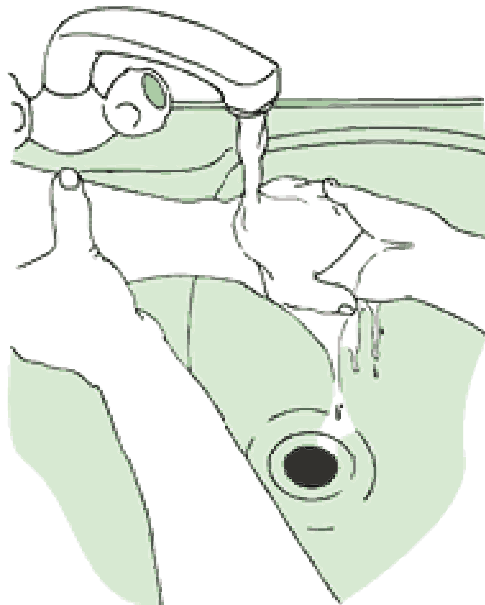
- e. Gently cover the wound and object with a sterile dressing.
- f. Build up padding around the object until the padding is higher than the object, then bandage over the object without pressing on it.
- g. Depending on the severity of the bleeding, dial 999 for an ambulance or take the casualty to hospital.
- h. Apply firm pressure directly to the wound.
- j. Cover with a clean dressing and bandage firmly in place. If bleeding continues, add further dressings on top of the first and increase the pressure by bandaging firmly into place.

Burns and scalds

Severe burns

Treatment

- a. Start cooling the burn immediately under running water for at least ten minutes.
- b. Dial 999 for an ambulance.



- c. Make the casualty as comfortable as possible; lie them down.
- d. Continue to pour copious amounts of cold water over the burn for at least ten minutes or until the pain is relieved.
- e. While wearing disposable gloves, remove jewellery, watches or clothing from the affected area – unless it is sticking to the skin.
- f. Cover the burn with clean, non-fluffy material to protect from infection. (Cloth, a clean plastic bag or kitchen film all make good dressings.)
- g. Treat for shock.

Minor burns

Treatment

- 8.6 For minor burns, hold the affected area under cold water for at least ten minutes or until the pain subsides. Remove jewellery etc and cover the burn as detailed above.
- 8.7 If a minor burn is larger than a postage stamp, it requires medical attention. All deep burns of any size require urgent hospital treatment.

Clothing on fire

Treatment

- a. Stop the casualty panicking or running – any movement or breeze will fan the flames.
 - b. Drop the casualty to the ground.
 - c. If possible, wrap the casualty tightly in a coat, curtain or blanket (not the nylon or cellular type), rug or other heavy-duty fabric. The best fabric is wool.
 - d. Roll the casualty along the ground until the flames have been smothered.
- 8.8 On **all** burns, **do not**:
- use lotions, ointments and creams;
 - use adhesive dressings;
 - break blisters.

- 8.9 Burns should be cooled with cold water, if available. Then cover with a clean, preferably sterile, dressing, and bandage lightly in position. If transfer to hospital is desirable, dial 999 and request the local ambulance service.

First-aid appliances

- 8.10 The first-aid equipment provided should be used only for the purpose intended.
- 8.11 The Health and Safety (First-aid) Regulations 1981 place a general duty on employers to make adequate first-aid provision for their employees if they are injured or become ill at work. Employers must inform their employees of the provision made for them.
- 8.12 Reference should be made to the Health and Safety Executive's 'First-aid at work. The Health and Safety (First-Aid) Regulations 1981. Approved Code of Practice and Guidance L74'.