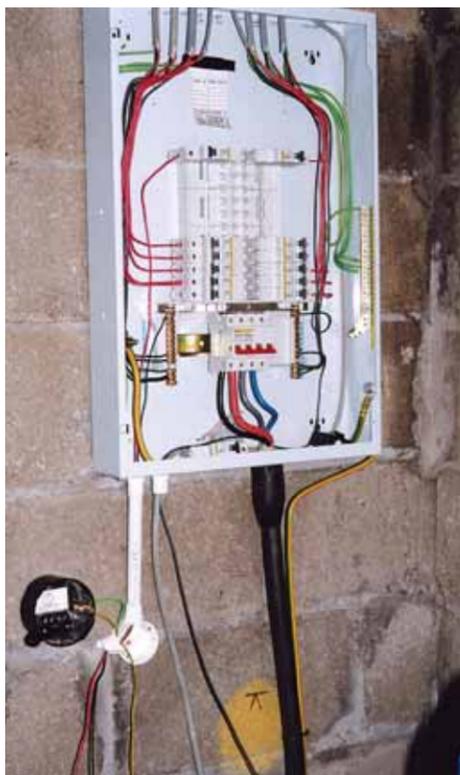




## Introduction

Every year, people working on construction sites suffer electric shock and burn injuries some of which, tragically, are fatal. Members should be aware that some of these accidents are a direct consequence of electrical contractors not implementing safe isolation procedures. An example of one such fatal incident that occurred recently in Scotland is provided in the box below.



An electrician working on a new-build construction project installed the 3-phase and neutral distribution board shown in the photograph. He energised the supply to the distribution board before the circuits connected to it were complete, to provide a supply to a socket outlet.

He was connecting the supply cables to a wall-mounted timer unit, with the phase conductor connected to the circuit breaker at the top left hand side of the busbar assembly. The circuit breaker had not been securely isolated and was ON as he stripped the insulation from the end of the cable. He touched the live copper conductor of the cable and was electrocuted.

The distribution board was manufactured to a high standard of safety. However, if he needed to energise the board before it was complete, he should first have replaced the cover and switched off and locked the circuit breakers supplying unfinished or incomplete circuits. He should also have ensured that circuits were not connected into circuit breakers until after they were complete and had been tested.

This brochure has been produced in conjunction with the Health and Safety Executive (HSE), and its purpose is to provide practical guidance on low voltage safe isolation procedures during construction projects and is aimed at preventing these types of incidents, and protecting employees and other workers against serious or fatal electrical injuries. The guidance is particularly relevant to circumstances where work is being carried out in the presence of other trades, and to sites where more than one electrician is employed, although the principles will apply generally.

## Legislation

The Health and Safety at Work etc. Act 1974 sets out the general health and safety duties of employers, employees and the self-employed. The Electricity at Work Regulations 1989, which were made under the Act, require precautions to be taken against the risk of death or personal injury from electricity in work activities. Duties are placed on employers to ensure, among other things, that employees engaged in such work activities on or near electrical equipment implement safe systems of work, have the technical knowledge, training or experience to carry out the work safely, and are provided with suitable tools, test equipment and personal protective equipment.

Employees are required to co-operate with their employer to enable the requirements of the Regulations to be met; this includes complying with any instructions given on matters such as safe systems of work.

The Management of Health and Safety at Work Regulations 1999 require employers to make a suitable and sufficient assessment of the risks to the health and safety both of their employees and of other persons arising out of, or in connection with, the conduct of their undertakings. Where five or more persons are employed, the employer must record the significant findings of the risk assessments.

## HSE Guidance

Guidance on devising safe working practices for work on electrical equipment is provided in the Health and Safety Executive (HSE) booklet entitled *Electricity at Work – Safe Working Practices* (HSG85). It provides information on isolation procedures when working on both Low Voltage (LV) and High Voltage (HV) systems. This brochure covers LV systems only; extra precautions need to be taken when working with HV equipment and circuits, and reference should be made to the detailed guidance provided in HSG85 and other publications.

To comply with Regulation 13 of the Electricity at Work Regulations, precautions need to be taken on equipment that has been made dead. As explained in HSG85, this includes securing the means of disconnection in the OFF position, putting a notice or label at the point of disconnection, and proving dead at the point of work using proprietary voltage detectors.

To comply with Regulation 14 of the Electricity at Work Regulations, dead working should be the normal method of carrying out work on electrical equipment or circuits. Live working should only be carried out in particular circumstances where it is unreasonable to work dead, such as some fault finding and testing, where the risks are acceptable, and where suitable precautions can be taken against injury. The pressure to carry out live work is becoming more common in areas such as construction sites, high-cost manufacturing and in retail outlets operating twenty-four hours per day. The requirements of the Regulations still apply in such situations and live working should only be carried out when justified using the criteria explained in HSG85.

## Site Safety Management

It is essential from the outset that effective management and control of the system, apparatus and equipment used on site is achieved and maintained, thereby ensuring that the hazards and risks which can arise are minimised.

An authorised person should be appointed, with responsibility for the supervision of the installation of switchgear, equipment, cables, jointing, etc. throughout the contract. The authorised person should also have responsibility for the safe working practices of the operatives, as well the control of appointed sub-contractors; sub-contractors must provide appropriate method statements and risk assessments for their works.

The authorised person may delegate (in writing) his authority in total or for specific tasks and procedures to competent persons having appropriate training and competence in the performance of these tasks and procedures.

Once switch-rooms and risers are made available by the main contractor for the services installation to proceed, and before installation of equipment commences, it should be ensured that suitable doors are fitted to all switch-rooms and riser entrances and that heavy duty locks, or padlocks, and keys are provided. Also ensure that access doors are locked when not working in these areas. Plant and materials should not be stored in electrical switch-rooms or electrical risers.

Always try to avoid energising any outgoing electrical distribution services until the distribution switchgear and all connected circuits are complete and have been inspected and tested. If live services are required by others, distribution boards and circuits should only be energised following a written request from the main contractor or agent and with the agreement of the authorised person for the installation. Once distribution services are energised, where necessary implement the safe isolation procedures explained in the rest of this brochure.

Before energising any final circuit (i.e. lighting, power, etc.) it should be checked that the wiring system within the area has been completed and equipment, including luminaires and accessories, fitted. This check should ensure that earthing arrangements and protective conductors including equipotential bonding are in place, and that the final circuit is tested as far as possible.

If the service in question is energised for the testing and commissioning of equipment/system, it must be switched OFF and locked upon completion of this work, unless stated otherwise on the written instruction and agreed with the authorised person.

When live services are provided prior to final commissioning, warning signs should be displayed on each item of live switchgear, plant and along cable routes that pass through the work areas in exposed positions. This is particularly important where switchgear and cables are exposed to damage that may be caused by other trades or the environmental conditions.

Persons or trades entering completed and energised areas, working under instructions from the main contractor or client agent, must be made aware of the extent of the live services within the respective areas by the electrical contractor, main contractor or client agent.

## Safe Isolation Practice

For work on LV electrical equipment or circuits, it is important to ensure that the correct point of isolation is identified, an appropriate means of isolation is used and the supply cannot inadvertently be reinstated while the work is in progress. Caution notices should also be applied at the point(s) of isolation, and the conductors must be proved to be dead at the point of work before they are touched.

A fundamental principle is that the point of isolation should be under the control of the person who is carrying out the work on the isolated conductors.

The means of isolation can be an adjacent local isolation device such as a plug and socket, switch-disconnector, circuit breaker, fuse etc, as appropriate, which is under the direct control of the competent person carrying out the work. These devices can be used without further precautions provided there is no foreseeable risk that the supply could be reinstated by others.

**When there is no such local means of isolation or there is a risk of reinstatement of the supply as above, the circuit or equipment to be worked on should be securely isolated by one of the following methods.**

### ***Isolation using a main switch or distribution board (DB) switch-disconnector***

Isolation of equipment or circuits using the main switch or DB switch-disconnector is the preferred method. The point of isolation should be locked off using a unique key or combination retained by the person carrying out the work. In the case of multiple isolations on a DB, a multi-lock hasp can be used to prevent access to a main isolator until such time that all persons working on a system have completed their work and removed their padlocks from the hasp.

If locking-off facilities are not provided on the relevant switch then a locked DB door or locked switch-room door is acceptable provided the key or combination is unique, and is retained by the person doing the work. Again, multi-lock hasps can be used to control multiple isolations, although a key box or similar system may be needed to retain and control access to the main door key.

Where it is intended that more than one person will be working on circuits supplied from a DB, (i.e. multiple isolations) and a multi-lock hasp cannot be used to secure the main point of isolation, individual isolation of each circuit by one or more of the methods shown below is recommended, to prevent inadvertent reinstatement of the supply. The principle is that each person carrying out such work should have control of their own point(s) of isolation and not rely on others to prevent inadvertent energisation.

### ***Isolation of individual circuits***

Where it is not practical to isolate a distribution board, individual circuits supplied from it can be isolated by one of the methods described below, depending on the type of protective device used. However, bear in mind the overriding advice to avoid energising any outgoing electrical distribution services, preferably until the distribution switchgear and all connected circuits are complete and have been inspected and the relevant tests carried out.

If any items required to carry out the procedures recommended below are not manufactured for the DB in question or cannot be obtained through retail/trade outlets, it is acceptable to disconnect the circuit from the DB as long as the disconnected tails are made safe by being coiled or insulated. Suitable labelling of the disconnected conductors is important to prevent the supply being re-instated, particularly if other electricians are present.

It should be remembered that work carried out inside a live DB is regarded as live working when there is access to exposed live conductors. In this case the appropriate precautions should be taken as described in HSG85 with respect to Regulation 14 of the Electricity at Work Regulations.

### ***i. Isolation of individual circuits protected by circuit breakers***

Where circuit breakers are used the relevant device should be locked-off using an appropriate locking-off clip with a padlock which can only be opened by a unique key or combination. The key or combination should be retained by the person carrying out the work.

#### **Note**

Some DBs are manufactured with 'Slider Switches' to disconnect the circuit from the live side of the circuit breaker. These devices should not be relied upon as the only means of isolation for circuits as the wrong switch could easily be operated on completion of the work.

### ***ii. Isolation of individual circuits protected by fuses***

Where fuses are used, the simple removal of the fuse is an acceptable means of disconnection. Where removal of the fuse exposes live terminals that can be touched, the incoming supply to the fuse will need to be isolated. To prevent the fuse being replaced by others, the fuse should be retained by the person carrying out the work, and a lockable fuse insert with a padlock should be fitted as above. A caution notice should also be used to deter inadvertent replacement of a spare fuse. In addition, it is recommended that the enclosure is locked to prevent access as stated above under '***Isolation using a main switch or distribution board (DB) switch-disconnector***'.

#### **Note**

**In TT systems, the incoming neutral conductor cannot reliably be regarded as being at earth potential. This means that for TT supplies, a multi-pole switching device which disconnects the phase and neutral conductors must be used as the means of isolation. For similar reasons, in IT systems all poles of the supply must be disconnected. Single pole isolation in these circumstances is not acceptable.**

## Electrical Permits-to-Work

An electrical permit-to-work must be used for work on HV systems that have been made dead, and can be useful in certain situations for LV work. These permits are primarily a statement that a circuit or item of equipment is isolated and safe to work on. They must not be used for live working as this can cause confusion. Details on the use of these permits, including an example form, are given in HSG85.

## Caution Notices

In all instances where there is a foreseeable risk that the supply could be reinstated as above, an appropriate “caution” notice should be placed at the point of isolation. For DBs with ‘multiple isolations’ a single suitably worded notice on each DB, such as the example shown below, would suffice:

**CAUTION: THIS DISTRIBUTION BOARD HAS A NUMBER OF CIRCUITS THAT ARE SEPARATELY ISOLATED. CARE SHOULD BE TAKEN WHEN REINSTATING THE SUPPLY TO AN INDIVIDUAL CIRCUIT THAT IT HAS BEEN CORRECTLY IDENTIFIED.**

## Proving Dead Isolated Equipment or Circuits

Following isolation of equipment or circuits and before starting work it should be proved that the parts to be worked on and those nearby, are dead. It should never be assumed that equipment is dead because a particular isolation device has been placed in the off position.

The procedure for proving dead should be by use of a proprietary test lamp or two pole voltage detector as recommended in HSE Guidance Note GS38, *Electrical test equipment for use by electricians*. Non-contact voltage indicators (voltage sticks) and multi-meters should not be used. The test instrument should be proved to be working on a known live source or proprietary proving unit before and after use. All phases of the supply and the neutral should be tested and proved dead.

## Additional Precautions

### *New installations*

New installations can be a particular hazard as some of the circuits or equipment may require to be modified after the installation has been energised. It is therefore important that every protective device is correctly identified at each distribution board before any energising takes place, and safe isolation procedures, such as locking-off circuit breakers as described above, are adopted, particularly where a number of electricians are working on the same installation.

**The practice of placing PVC insulating tape over a circuit breaker to prevent inadvertent switch-on is not a safe means of isolation.**

### *Neutral conductors*

Care should be taken when working on neutral conductors of circuits. The practice of ‘borrowing’ neutrals, i.e. making use of the neutral of one circuit for use on another circuit, is not permitted by BS 7671. This dangerous practice, however, is not uncommon. Lighting and control circuits are the most common examples where this practice is found. In these circumstances the neutral conductor can become live when the conductor is disconnected, if a load is connected to that circuit.

It is also difficult to identify specific neutral conductors in ‘bunches’ of single core cables, e.g. where enclosed in trunking or conduit, and care should be taken when severing such cables that the correct conductor has been identified. If doubt exists, live working measures, such as the use of eye protection, electricians insulating gloves, insulated tools etc, should be employed until the circuit has been proved dead.

### *Proving dead unused or unidentified cables*

Where there is uncertainty regarding isolation when removing unidentified cables or proving dead an ‘unused’ cable, particularly where insufficient conductor is exposed to enable the use of test probes, those conductors should be assumed to be live until positively proven to be dead and any work carried out on them should employ live working practices until the conductors are proved dead.

Clamp meters can be used as a means of identifying cables by testing for current flow in the conductors. Non-contact voltage indicators (voltage sticks) can also be useful in these situations to test for voltage where cables without a metallic sheath are to be identified. However, once insulation is pared using live working practices to reveal the underlying conductors, contact voltage detectors should be used as the means of proving dead.

## Safe Systems of Work

The employer must ensure that all employees involved in work on electrical equipment are competent and are instructed on safe systems of work, have been issued with written rules and instructions, and have access to, and use, appropriate locking-off devices, caution notices, a proprietary voltage detector and, where appropriate for the type of voltage detector being used, a proving unit.

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