Safe Electrical Isolation of Low Voltage Systems
City & Guilds Accredited

Further information 1 Day Course
Procedures for Safe Electrical Isolation

Procedures for the Safe Electrical Isolation of Low Voltage Equipment

Course Aims

At the end of this course you should:-

Have an understanding of the relevant safety rules with respect to low voltage electrical systems.

Be aware of the need to assess the risks related to low voltage electrical systems.

Be able to recognise different types of electrical isolating devices and methods of isolation.

Be able to carry out isolation also proving or verifying the Isolation.

Controlling isolation and returning the equipment to normal operation.
Section 1  
Introduction

Overview and Relevance of Low voltage safety rules.

The Legal Requirements

Health & Safety at Work etc. Act 1974
Management of Health & Safety at Work Regulations 1999
Electricity at Work Regulations 1989
Provision & Use of Work Equipment Regulations 1998

Any current company electrical safety rules have to be read in conjunction with the following standards and guidance in order to provide a more in depth requirement for satisfaction of the ruling content:-

- Electrical Safe System of Work and Risk Reduction
- Preparation of Electrical Maintenance Schedules
- BS EN 50110-1 – Operation of Electrical Installations
- BS 7671 Guidance Note 5 – Protection against electric shock
- BS 7671 Guidance Note 2 – Isolation and Switching
- HSG107 – Maintaining Portable & Transportable Electrical Equipment
- INDG 231 Electrical safety and You
- HSG 85 Electricity at Work – Safe Working Practices
- GS38 Electrical test equipment used by electricians

Definition of LOW VOLTAGE & EXTRA LOW

A voltage which does not exceed 1,000 Volts AC or 1,500 Volts DC, and includes extra low voltage systems. Extra Low Voltage those which do not exceed 50 Volts AC or 120 Volts DC. Extra low voltages are classed as “touch safe” under normal conditions.

Fig.1-1

A.C. Alternating Current or Voltage

D.C. Direct Current or Voltage

Note: - Even 50 Volts A.C could be dangerous under “adverse conditions”.

Sample
Section 1: Introduction

Relevant Parts of the Electricity At Work Regulations 1989

Regulation 15 (Absolute):

Working space, access and lighting

For the purposes of enabling injury to be prevented, adequate working space, adequate means of access, and adequate lighting shall be provided at all electrical equipment on which or near which work is being done in circumstances, which may give rise to danger.

Regulation 16 (Absolute):

Persons to be competent to prevent danger and injury

“No person shall be engaged in any work activity where technical knowledge or experience is necessary to prevent danger or, where appropriate, injury, unless he possesses such knowledge or experience, or is under such degree of supervision as may be appropriate having regard to the nature of the work”.

Key points about ‘Competency’

- It is a criminal offence under the Health & Safety at Work Act (1974) Section 33 to contravene this regulation. It should be noted that it is the failure to prevent danger, which constitutes an offence; the event of an accident is not a necessary prerequisite of prosecution.

- A person cannot be described as competent per se, (i.e. for every possible task or circumstance) - neither does someone’s title (e.g. ‘electrician’) guarantee competence.

- The notion of competency is task-related - this means that before we can decide whether someone is competent we have to ask the question - ‘to do what?’. Someone may be competent to do one job - but not another.

- Competency is not just about personal proficiency - even the most skilled craftsman may not be legally competent if he is not in possession of all necessary information - which goes for ‘electricians’ too!

Note: - Anyone may be liable to prosecution
Section 2: Basic Risk Assessment Prior to Working

The hazards associated with access to electrical panels \ enclosures are generally, as follows:

<table>
<thead>
<tr>
<th>Table 2-1</th>
<th>The Electrical Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrocution \ electric shock due to direct contact with live parts</td>
</tr>
<tr>
<td>2</td>
<td>Electrocution \ electric shock due to indirect contact with conductive parts.</td>
</tr>
<tr>
<td>3</td>
<td>Burns associated with hot surfaces of certain electrical components.</td>
</tr>
<tr>
<td>4</td>
<td>Burns and or shock due to possible “shorting” of live parts to each other or earth.</td>
</tr>
</tbody>
</table>

The above carry the associated risk(s) of injury ranging in severity from a slight discomfort to death!

The probability of injury depends upon many criteria such as the following:

<table>
<thead>
<tr>
<th>Table 2-2</th>
<th>The Electrical Hazard (Contributing Risk Factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intended type of work activity. (Installation, testing, reconfiguring or replacing components.)</td>
</tr>
<tr>
<td>2</td>
<td>Individuals level experience and training</td>
</tr>
<tr>
<td>3</td>
<td>Equipment location</td>
</tr>
<tr>
<td>4</td>
<td>Environmental Conditions</td>
</tr>
<tr>
<td>5</td>
<td>Type of equipment</td>
</tr>
<tr>
<td>6</td>
<td>Size of the panel enclosure(s)</td>
</tr>
<tr>
<td>7</td>
<td>Internal electrical supply characteristics</td>
</tr>
<tr>
<td>8</td>
<td>Design &amp; internal layout.</td>
</tr>
<tr>
<td>9</td>
<td>Types of electrical components</td>
</tr>
<tr>
<td>10</td>
<td>Local lighting levels</td>
</tr>
<tr>
<td>11</td>
<td>Numbers of, area and relative position of exposed “live” parts.</td>
</tr>
<tr>
<td>12</td>
<td>.....</td>
</tr>
</tbody>
</table>

Although not mandatory, it can be recommended that as a prerequisite a formalised and documented risk assessment be carried for all electrical hardware that needs to be maintained or accessed. This can be used to decide the appropriate course of action, tools, instruments and any required personnel protective equipment.

A competent electrician or installation \ maintenance engineer could normally carry out the above questioning process.

However anyone with a basic awareness of the dangers presented by an electrical system can visually inspect a system to ascertain or “score” the level of risk involved, considering most of the above criteria and then decides whether or not they feel safe to continue.

If in any doubt they are obliged to consult with someone more qualified or experienced. Or consult any risk assessment documentation that may exist.
Section 2: Basic Risk Assessment Prior to Working

Permits to Work

In general permits to work are not required for working on low voltage equipment, however certain types of “plant systems” or the work activity may require a permit to work. This is dependent on the findings of a formal risk assessment being previously completed. How they are required for high voltage equipment. (>1000 VAC or 1500 VDC)

What are Permits to Work?

Permits-to-work, evolved from the old Factories Act 1961. These provide a formal safety control system aimed at prevention of accidents, damage to property and damage to products, when foreseeable hazardous works are undertaken.

The Health and Safety at Work Act 1974 placed further duties on employers and the self-employed to “provide and maintain plant and systems of work that are, so far as reasonably practicable, safe and without risks to health”.

The permit to work consists of a document which:-

- Details the work to be done.
- Details the precautions to be taken.
- States that all-foreseeable hazards have been noted.
- States the control measures to be implemented.

Permits to work do not, in themselves, make a job free from risk: they rely upon effective control and coordination in order that hazards are identified and risks are suitably and sufficiently assessed and mitigated.
Section 4: Methods of Isolation

Regulations 12 of the Electricity at Work Regulations 1989, requires that all systems must incorporate suitable means of isolation.

A further requirement is that all isolation points should be identified as to what they isolate.

Regulation 13 requires that adequate precautions must be taken to prevent equipment that has been made dead from becoming charged.

Regulation 14 states the no person shall be engaged in any work activity on or so near any live conductor. Unless a range of suitable precautions considered and or taken.

To eliminate all of the risks of injury associated with electrical energy, one must remove all traces of the electrical energy. A procedure for doing this is commonly referred to as a safe isolation procedure.

As previously shown the table below lists the essential parts of a "safe isolation procedure".

<table>
<thead>
<tr>
<th>Recommended Procedures</th>
<th>Steps for Safe Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Correctly identify the equipment or system to be isolated.</td>
</tr>
<tr>
<td>2</td>
<td>Locate all sources of supply to that system, process or machine.</td>
</tr>
<tr>
<td>3</td>
<td>Verify and assess the consequences or risk of isolating part(s) of a system or machine.</td>
</tr>
<tr>
<td>4</td>
<td>Perform the isolation.</td>
</tr>
<tr>
<td>5</td>
<td>Secure the isolation.</td>
</tr>
<tr>
<td>6</td>
<td>Verify and prove the isolation.</td>
</tr>
</tbody>
</table>

Means of isolation

Isolation is the disconnection and separation of the electrical equipment from every source of electrical energy in such a way that this disconnection and separation is secure. The first requirement then, of any means of isolation, is to disconnect and separate that part of the system, which is to be worked on from all sources of supply. There is a subtle difference between the term’s 'disconnection' and 'separation'.

'Disconnection' describes the act of opening the circuit. Any switch that has the appropriate number of poles is capable of achieving disconnection. 'Separation' on the other hand, implies that some form of barrier is used to prevent any kind of reconnection. Separation therefore is infinitely variable (i.e.: there are degrees of separation).

Most low voltage switches use the air between the open contacts as the separating medium.
Section 4: Methods of Isolation

Fuses

With all but the smallest cartridge fuse, removal satisfies the disconnection and separation requirements of isolation. However, this on its own does not constitute safe isolation.

To satisfy the minimum requirements, a safe system of work must be used which both clearly identifies that the fuse has been removed for isolation purposes and enables the isolation to be secure.

One method of achieving this is to use a lockable dummy fuse carrier and a 'tagging out' system. Some companies require the fuse board or enclosure to be locked and although this clearly satisfies the minimum requirements, difficulties may arise when other competent persons require access to the same board.

The type of dummy fuse carrier is specific to the type of board or standard in the example (Ref. fig.20 RED SPOT.) However other types of fuse “lockout” devices are available.

![Blank Inserts for BS88 Fuse Carriers](image)

It should also be mentioned that where high prospective fault currents are present, replacing a fuse under fault conditions (e.g. with a short circuit on the load) could cause an explosion.

**Fuses should not be withdrawn or inserted on-load,** this also regarded as a dangerous practice. In order to avoid potential injury or damage it is recommended to use a clamp meter to verify that no current is present.
Section 5: Proving or Verifying an Isolation

This step should be performed using an approved voltage indicator\tester (Ref. Figs 4-19 to 22). One prerequisite, being the individual(s) having been trained and authorised by their employer.

The Electricity at Work Regulations state that a circuit cannot be said to be dead until it is proved neither live nor charged. If the test is performed correctly, and the sequence prescribed in this section is followed, the test will not only prove that the circuit is dead but will also prove the correct operation of the isolation point. Some control systems may feature special built in supply voltage indicators.

It should be noted that the definition of dead is 'proved neither live nor charged'. The term “charged” refers to stored or induced electrical energy. This could also include battery-powered UPS systems. As used for auxiliary electrical supplies i.e. Emergency lighting systems.
Section 6: Removing an Isolation

Once the work has been completed it will be required to remove the isolation and return the equipment or system to normal operation. For small or self-contained pieces of equipment such as emergency lighting systems a quick visual inspection, essential safety tests and the required documents.

The isolation can then be removed and that’s it. However the larger more complex process & systems more detailed considerations and care is required.

In order to minimise danger, it is advised that this process should be done in a controlled manner. The table below as a guide represents some recommended steps. The last individual(s) to complete their work tasks may be required to follow similar steps in order to safely hand over the equipment.

The number and type steps taken depend upon the size, complexity, and nature of the equipment or system and or on the type of work that had been carried out.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>If required notify the occupiers that the system is going to be being tested.</td>
</tr>
<tr>
<td>2</td>
<td>Verify that no one in the vicinity can be harmed. (It may be required to leave barriers or notices in place.)</td>
</tr>
<tr>
<td>3</td>
<td>Verify that equipment or system is ready physically &amp; or electrically sound</td>
</tr>
<tr>
<td>4</td>
<td>Remove all padlocks and notices from all the isolated points.</td>
</tr>
<tr>
<td>5</td>
<td>Verify that the system is in the correct mode ready for operation i.e. (Manual or Auto)</td>
</tr>
<tr>
<td>6</td>
<td>Close all isolators or switches from largest to the smallest.</td>
</tr>
<tr>
<td>7</td>
<td>Observe when testing that the equipment is working normally.</td>
</tr>
<tr>
<td>8</td>
<td>Complete any required documentation or completion or test certificates.</td>
</tr>
</tbody>
</table>

Table 6-1

However if there is problem at switch on or shortly after the number of trips for the protection devices, appropriate for that equipment or system should not be exceeded. The isolation process will have to be repeated on that equipment before fully investigating the problem.

When you energise a system always verify that certain areas are clear! Stay within the operational remit, i.e. do not replace or up-rate fuses unless trained and authorised to do so, as incorrect fuse types and sizes will almost definitely create hazards and may lead to expensive problems.

Note: - Depending on the extent, if an electrical installation has been altered or electrical equipment repaired it may be a requirement to perform essential tests for safety (Ref. BS7671:2008, BSEN 60204, BSEN 60335). Or according to the nature of the work other safety tests may be required.
Thank you for contacting Centrica Business Solutions.

Your company might have to entrust electrical isolation tasks not only to electrical personnel, but also to non-electrical staff with some experience of electrical systems (and who may require authorisation to carry out isolation for maintenance purposes).

Including formal Permit to Work procedures for on-site operation, this course provides staff with the knowledge needed to perform safe isolation of low voltage systems and equipment.

The end of course multi choice assessment is open book with a 75% pass mark. Any courses can be delivered either onsite on dates to suit your operational requirements or at a Centrica public venue across the UK.

Our training centres have been trading for over 12 years establishing their brand and helping to improve the standards and quality of electrical training within the industry.

---

Chris Cole  
Business Development  
T  0800 9808150 / 07769 541399  
E  christopher.cole@centrica.com

---

Tell us what you think...

We’re always keen to improve our services and I personally would welcome your feedback on your learning journey. If you have any comments, negative or positive, please feel free to contact me.  
Email: lynsey.partlow@centrica.com

Keep up to date with legislation changes, training updates, offers and industry relevant news by following us on Facebook, Twitter and LinkedIn.

@CBSElectricalSolutions  
@CentricaSoln_UK  
Centrica Business Solutions UK & Ireland

We look forward to welcoming you on a City & Guilds Accredited Safe Isolation course in the future.

Lynsey Partlow  
Head of Training Services