

Safety in electrical testing – switchgear and control gear

HSE information sheet

Engineering Information Sheet No 37 (Revision 1)

Introduction

This information sheet contains specific advice about avoiding injury during the electrical testing of switchgear and control gear, including those with power electronic components installed.

The guidance is for those who carry out electrical testing on switchgear and control gear. It is also relevant to those who manage this type of work.

Hazards and risks

The most significant danger to people carrying out electrical testing work is electric shock. An electric shock can lead to serious, sometimes fatal, injury.

Any simultaneous contact by a part of the body with a conductor that is live at a dangerous voltage, eg connected to the mains supply, while another part of the body is connected to an earth, will result in electric shock.

There is a risk of burn injuries resulting from arcing when conductors are accidentally short-circuited. In addition, injuries can occur when a person reacts to an electric shock, eg by falling or touching another hazard.

Factors likely to increase the risk of receiving an electric shock include:

- Testing, servicing and repair may be carried out at a customer's premises. In this case, there is a particular, extra need to consider the safety of people other than the person doing the work, eg the customer's employees.
- A lot of equipment will have large areas of earthed metal that is easily touched, increasing the possibility of electric shock from contact with a live conductor.
- High-voltage insulation (flash) testing can be particularly hazardous when several parts of the equipment are simultaneously energised for a period of time.
- Some equipment could be using water in its operation. This can lead to an increased risk of shock, as water can conduct electricity and reduces the resistance of the skin.
- The use of Class I test instruments (eg many oscilloscopes) when taking measurements of dangerous voltages can increase the risk of injury if they are used without the earth (protective) conductor connected. This can result in the metal enclosure of the instrument becoming live at dangerous voltages. Such use also defeats the equipment manufacturer's primary protection concept for Class I protection and should be discouraged.

Precautions

Your employer will have carried out a general risk assessment and identified precautions that are necessary to carry out electrical testing work safely (guidance on risk assessment can be found at www.hse.gov.uk/risk). You must follow these precautions, but be aware that there may be more specific risks within the different premises that you are working at than those covered by the general risk assessment. You will need to consider any additional risks and take appropriate precautions to ensure that you work safely at all times. The following questions should help you to determine if you can work safely before you start a job:

- Can the work be done with the equipment dead? Where possible, the law says work should be done with the equipment dead. Otherwise, adequate precautions, which should be identified in your risk assessment, must be taken to ensure safety.
- Is it absolutely necessary for someone to be working on or near equipment that is live at dangerous voltages or current levels?
- Have you taken suitable precautions to avoid danger and prevent injury?
- Are you competent (ie do you have the necessary knowledge, or experience) for that type of work, or if not, are you adequately supervised?

Managing testing

When carrying out testing at a customer's premises, agree the management of the testing activity and its implications (eg downtime) with the customer. Preferably do this at an early stage, eg when the work request is raised or when a contract is placed. A record of the agreement should be kept although this is not a legal requirement. The person carrying out the testing should, where possible, be accompanied by supervisory staff provided by their employer or the customer.

The person carrying out the testing must have received adequate training and, if appropriate, be competent to make an on-site risk assessment. This should take account of the ability of the customer's employees to heed any warnings that might be given, in order to prevent unauthorised people from approaching the unit under test.

The following precautions should be considered as part of the safe system of working for electrical testing of switchgear and control gear.

Test areas

In a workshop, the test area should be a separate, designated area where access by unauthorised employees is prevented while testing is in progress.

In a customer's premises, temporary barriers should be used to form an enclosure within which testing work is to be carried out. The enclosure should be suitable to prevent unauthorised people accessing the danger area. This arrangement should be discussed early on with the customer.

Precautions

Where possible, the work should be done with the equipment dead (this is a requirement of the Electricity at Work Regulations 1989). Otherwise, adequate precautions, which should be identified in your risk assessment, must be taken to ensure safety. Be aware of the following in carrying out your risk assessment:

- During functional testing, the level of safety should be the same as that provided for the user of the equipment after it is installed for service.
- It may be possible to test equipment (if only partially) by energising it with non-hazardous voltages and current levels. This should always be considered as the first option before deciding to use dangerous voltages and current levels.
- Local protection of exposed conductors, including earthed metalwork in the immediate vicinity of the test area, should be provided where necessary. This may be in the form of temporary insulation using, for example, flexible sheet material or

transparent screens (with apertures for applying test instrument probes). These may be purpose built so that they can be reused.

- Insulating rubber floor mats, eg in accordance with BS EN 61111¹ can be used to prevent earth contact with the floor. However, they will not provide any protection if a person touches the large metal areas of the control panel simultaneously with exposed live conductors which are likely to be at earth potential and readily accessible.
- Where practicable, the power supplies to the unit under test and to the mains powered instrumentation should include a residual current device (RCD) used as supplementary protection. For personal protection the maximum rated tripping current of the RCD should be 30 mA.

Test equipment

Where possible, test equipment should be of a proprietary design. In this case the manufacturer should have taken account of its safety performance during use. Where applicable, test equipment should be manufactured to BS EN 61010,² BS EN 61557³ or BS EN 61243-3.⁴

Test equipment, leads and cables should be handled carefully to avoid injury. The following precautions are recommended:

- All leads and cables which can be energised at dangerous voltages should be robustly insulated and properly terminated. All connections of conductors which can be energised at a dangerous voltage should be electrically and mechanically robust to prevent conductors becoming accidentally exposed. There should be no exposed conductors at dangerous voltages at any purpose-built connectors or jigs into which the product is fixed for testing.
- Test equipment connecting leads, probes and connectors should be sufficiently protected to prevent accidental contact when being applied to and removed from live parts.
- Where practicable, place the equipment under test into interlocked enclosures. This allows connections to be made while the equipment is isolated.
- Where practicable, apply test leads while the equipment is isolated and then energise it. To make sure that the equipment is isolated, a suitable isolating device should be used which must be:
 - appropriate and convenient for the intended use;
 - suitably located;
 - readily identifiable (eg by durable markings) as to which circuits or part of the test area they serve; and
 - provided with adequate means to prevent the supply isolator being switched on (either inadvertently, mistakenly, or by an unauthorised person).

Legal requirements

The Electricity at Work Regulations 1989 are the principal legislation relating to electrical testing activities and regulation 14 is particularly relevant to live testing activities. In addition, employers are required under regulation 3 of the Management of Health and Safety at Work Regulations 1999 to assess the risks to the health and safety of their employees while they are at work, in order to identify and implement the necessary precautions to ensure safety.

References

- 1 *BS EN 61111 Live working. Electrical insulating matting* British Standards Institution
- 2 *BS EN 61010 Safety requirements for electrical equipment for measurement, control, and laboratory use*. Various publications for different situations (full document is in 11 parts) British Standards Institution
- 3 *BS EN 61557 Electrical safety in low voltage distribution systems up to 1000 V ac and 1500 V dc. Equipment for testing, measuring or monitoring protective measures*. Various publications for different situations British Standards Institution
- 4 *BS EN 61243-3 Live working. Voltage detectors. Two-pole low voltage type*. British Standards Institution

Further reading

HSE's electrical safety webpages
www.hse.gov.uk/electricity/index.htm

Information on managing health and safety
www.hse.gov.uk/managing/index.htm

Safety in electrical testing at work Leaflet
INDG354(rev1) HSE 2013
www.hse.gov.uk/pubns/indg354.htm

The Electricity at Work Regulations 1989. Guidance on Regulations HSR25 HSE 2015
www.hse.gov.uk/pubns/books/hsr25.htm

Electricity at work: Safe working practices HSG85
(Third edition) HSE 2013
www.hse.gov.uk/pubns/books/hsg85.htm

Electrical test equipment for use on low voltage electrical systems GS38 (Fourth edition) HSE 2015
www.hse.gov.uk/pubns/books/gs38.htm

A design guide for the electrical safety of instruments, instrument/control panels and control systems (EEMUA Publication 178) Engineering Equipment and Materials Users Association
www.eemua.org/Products/Publications/Print/EEMUA-Publication-178.aspx

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

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