



Safety in electrical testing: Switchgear and control gear

Engineering Information Sheet No 37

What is this guidance about?

This information sheet contains specific advice about some of the ways of avoiding injury during the electrical testing of switchgear and control gear, including those with power electronic components installed. Further advice is given in *Safety in electrical testing at work: General guidance*¹ and other guidance on electrical safety listed under 'Where can I get more information?' on page 3.

How can injuries happen during testing?

The most significant danger to people carrying out electrical testing work is that they might suffer an electric shock. Any simultaneous contact of a part of the body with a conductor that is live at a dangerous voltage, such as one that is connected to the mains supply, while another part of the body is connected to an earth, will result in an electric shock. There is also a risk of burn injuries resulting from arcing when conductors are accidentally short-circuited.

An electric shock can lead to serious injury, sometimes fatal. Injuries can also occur when a person reacts to an electric shock, for example by falling or touching another hazard. Factors likely to increase the risk of receiving an electric shock include the following:

- (a) 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 employees of the customer;
- (b) For a lot of equipment there will be comparatively large areas of earthed metal that is easily touched, increasing the possibility of electric shock from contact with a single live conductor;
- (c) High-voltage insulation (flash) testing can be particularly hazardous when several parts of the equipment are simultaneously energised for a period of time;
- (d) Some equipment could be using water in its operation which can lead to an increased risk of injury, because water conducts electricity and reduces the resistance of the skin;
- (e) The use of Class I test instruments (such as 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.

Carrying out a risk assessment

To help you identify the precautions that are necessary to carry out electrical testing work safely, you need to do an assessment of the risk of injury posed by the work being done. When assessing the risk, you need to think about the hazards that are present; who may be harmed and how; and the effectiveness of existing precautions. Bear in mind the examples of factors given in this guidance which might increase the risk of injury.

When carrying out a risk assessment for electrical testing, ask yourself the following questions:

- (a) Can the work be done with the equipment dead?
- (b) Is it absolutely necessary for someone to be working on or near equipment that is live at dangerous voltages or current levels?
- (c) Have suitable precautions been taken to avoid danger and, where necessary, prevent injury?
- (d) Is the person doing the work competent for that type of work, or if not, 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. Keep a record of the agreement. 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 should have received adequate training and, if appropriate, be competent to make an on-site risk assessment. This should take account of the ability of those employed by the customer 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 this equipment.

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 1989²). Otherwise, adequate precautions, which should be identified in your risk assessment, must be taken to ensure safety. NB:

- (a) 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;
- (b) It may be possible to test the 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;
- (c) 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;
- (d) Insulating rubber floor mats, eg in accordance with BS 921,³ can be used to prevent earth contact through the floor. Remember, however, that they will not provide any protection if a person touches the large areas of metal of the control panel simultaneously with exposed live conductors which are likely to be at earth potential and readily accessible;
- (e) 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 it is recommended that the rated tripping current of the RCD should be no more than 30mA (milliamps).

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 61010,⁴ BS EN 61557⁵ or BS EN 61243-3.⁶

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

- (a) 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 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;
- (b) Test equipment connecting leads, probes and connectors should be sufficiently protected to prevent accidental contact when being applied to and removed from live parts;
- (c) Where practicable, place the equipment under test into interlocked enclosures. This allows connections to be made while the equipment is isolated;
- (d) 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:
 - (i) appropriate and convenient for the intended use;
 - (ii) suitably located;
 - (iii) readily identifiable (eg by durable marking) as to which circuits or part of the test area is served;
 - (iv) provided with adequate means to prevent the supply isolator being switched on (either inadvertently, mistakenly, or by an unauthorised person).

What are the legal requirements?

The Electricity at Work Regulations 1989² 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 1999⁷ 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 *Safety in electrical testing at work: General guidance* Leaflet INDG354 HSE Books 2002 (single copy free or priced packs of 5 ISBN 0 7176 2296 7)
- 2 *Memorandum of guidance on the Electricity at Work Regulations 1989. Guidance on Regulations* HSR25 ISBN 0 7176 1602 9
- 3 BS 921: 1976 *Specification. Rubber mats for electrical purposes*
- 4 BS EN 61010: 1993 *Safety requirements for electrical equipment for measurement, control and laboratory use* (full document is in 11 parts)
- 5 BS EN 61557: 1997 *Electrical safety in low voltage distribution systems up to 1000 V ac and 1500 V dc. Equipment for testing, measuring or monitoring protective measures*
- 6 BS EN 61243-3: 1998 *Live working. Voltage detectors. Two-pole low voltage type*
- 7 *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance L21* (Second edition) HSE Books 2000 ISBN 0 7176 2488 9

Where can I get more information?

Electrical test equipment for use by electricians
Guidance Note GS38 ISBN 0 7176 0845 X

BS EN 50191: 2001 *Erection and operation of electrical test equipment*

Electricity at work: Safe working practices HSG85
ISBN 0 7176 0442 X

A design guide for the electrical safety of instruments, instrument/control panels and control systems (Ref 178)
Engineering Equipment and Materials Users Association (EEMUA), 45 Beech Street, London EC2Y 8AD
Tel: 020 7496 8990 ISBN 0 85931 080 9

While every effort has been made to ensure the accuracy of the references listed in this publication, their future availability cannot be guaranteed.

Further information

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British Standards are available from BSI Customer Services, 389 Chiswick High Road, London W4 4AL
Tel: 020 8996 9001 Fax: 020 8996 7001
Website: www.bsi-global.com

<p>This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.</p>

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