



## Safety in electrical testing: Servicing and repair of audio, TV and computer equipment

### Engineering Information Sheet No 36

#### What is this guidance about?

This information sheet contains specific advice about some of the ways of avoiding injury during the servicing and repair of domestic audio, TV, computer and video equipment. Other domestic appliances are dealt with in *Safety in electrical testing: Servicing and repair of domestic appliances*.<sup>1</sup> Further general advice is given in *Safety in electrical testing at work: General guidance*<sup>2</sup> 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, eg 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 which are likely to increase the risk of receiving an electric shock include the following:

- (a) Some equipment may have large areas of earthed metal that can be easily touched. Touching exposed live conductors connected to the mains supply at the same time as touching the earthed metalwork will result in an electric shock;
- (b) Some equipment may internally generate an electrical supply which is earth-referenced. Touching a live conductor of this supply at the same time as an earthed conductor will result in an electric shock;
- (c) Serious injury can also occur if accidental contact is made with the two poles of a supply, whether the supply is earth-referenced or not. In TVs, such supplies are generated internally on printed circuit boards and can be contacted if boards are handled while live or before stored charges have dissipated;
- (d) Aerial sockets of satellite systems might not be isolated from earth, thus introducing an earth conductor into an area which was earth free. Also, the introduction of telephone connections on test benches might compromise the safety concepts of

the test bench, as the modems fitted to some receivers do not operate correctly when supplied via an isolating transformer;

- (e) Some conductors may be small, with sharp edges. A shock injury can become more severe if the sharp end of a conductor penetrates the skin;
- (f) 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;
- (g) Work may be carried out in the customer's home, so people other than those doing the work (including children) may also be at risk;
- (h) Additional risks may be present at the customer's premises if their electrical installation is not electrically sound, eg earthing, insulation resistance, polarity.

#### Carrying out a risk assessment

To help you to 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 within this guidance which might increase the risk.

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

- (a) Can the work be done with the equipment dead? (Repairs and replacements of faulty parts can and should be done with the equipment isolated from the supply. Remove the plug or fuse supplying the equipment (if the fuse is removed, steps should be taken to prevent another person inadvertently replacing it). Remember that there may be some components such as capacitors, and even the cathode ray (TV) tube itself, which may still have some significant remaining charge that should be allowed to dissipate);

- (b) Is it absolutely necessary for someone to be working on or near equipment that is live at dangerous voltages or current levels? (Some testing, fault diagnosis and adjustments may have to be done live. However, some modern equipment may have built-in facilities which allow safer and easier diagnostic testing, fault-finding and adjustments to be done by the service worker. These servicing facilities may involve visual indication and/or displays built into the equipment and may allow more efficient servicing because of built-in software.)
- (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?

### **What precautions should I take?**

Where possible, the work should be done with the equipment dead (this is a requirement of the Electricity at Work Regulations 1989<sup>9</sup>). Otherwise, adequate precautions, which should be identified in your risk assessment, must be taken to ensure safety.

The following precautions are recommended as part of a safe system of working for electrical testing of this equipment.

#### **Test areas**

In all circumstances, it is necessary to create a safe working environment for testing. A test area, in which the work is to be done, should be defined. This should be relatively straightforward in a workshop situation, but may be more difficult when working in a customer's home.

#### *In the customer's home*

When working in a customer's home, the person carrying out the testing should do a site risk assessment to determine the steps necessary to create a safe working environment:

- (a) If you do not think it is safe to work in the home, don't. Remove the equipment to the workshop where you can work safely;
- (b) Consider erecting a temporary barrier to prevent unauthorised people approaching the danger area;
- (c) Make sure that everyone in the home is aware of the dangers arising from the testing work, and that they follow any precautions that are necessary. Ask for children and pets to be kept from the test area;
- (d) Allow plenty of space to work in - if you do get a shock you may be less able to break contact

quickly, if at all, or are more likely to hit something, when working in a cramped area. Remove (or move away from) any objects that may pose a hazard. For example, if an appliance such as a TV is situated in a corner, consider pulling it out and working behind it;

- (e) Never leave equipment unattended when it is in a dangerous condition (eg with live conductors exposed).

#### *In the workshop*

When testing is being done in a workshop, the following precautions should be considered:

- (a) Access to the test area should be limited as far as is practicable to the competent persons carrying out the testing. Suitable barriers may be provided to help prevent unauthorised entry. Competent persons must have adequate knowledge of the electrical dangers associated with the equipment and the precautions necessary to reduce the risk of electric shock. Training must be provided as necessary;
- (b) Other people who may enter the test area from time to time should be instructed about the hazards that may be present and should in particular be told not to touch anything on the workbench. Their access should be limited to what is strictly necessary;
- (c) Adjacent test positions should be separated using barriers to prevent a tester from reaching into another test area;
- (d) Soak test areas should, where possible, be separate from the test benches and, when equipment is on soak test, its covers should be in place.

#### **Access to live parts**

Where diagnostic testing needs to be carried out on live equipment, the risk is most effectively controlled by preventing access to the live parts. This can be achieved in a number of ways:

- (a) Prevent accidental contact with dangerous conductors by the use of temporary insulation. This could be commercially available transparent and perforated material to allow moving parts to be observed and for access to test probes. Additionally, individual sleeves can be placed over conductors. This may be difficult where the conductor areas are small (connection size). In these cases, ensure that a safe system of work, incorporating the other relevant precautions listed below, is being followed.

- (b) Where the dangerous conductors on the equipment being tested are supplied from the mains and the supply is referenced to earth, use isolating transformers or earth-free features where practicable. These will help to prevent the risk of injury from an accidental single-live contact, but not from contacting two live conductors simultaneously.
- (c) The power supply should include a Residual Current Device (RCD), with a rated tripping current of, at most, 30mA. This may not be available on all customers' circuits, so a portable RCD should be available.
- (d) When printed circuit boards are being tested and are taken out of the normal working position, secure them in purpose-built jigs to provide adequate support and to prevent them from falling.

### **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,<sup>4</sup> BS EN 61557<sup>5</sup> or BS EN 61243-3.<sup>6</sup>

Purpose-built test equipment must be designed and constructed to the same standards of safety as proprietary equipment. Where equipment is mains powered, it must be safe to use as a piece of electrical equipment in its own right. In addition, the arrangements for connecting it to the equipment under test must be safe.

See also advice given in *Safety in electrical testing at work: General guidance*<sup>2</sup> on the use of test equipment.

### **Power supply earthing**

When working on Class I (earthed enclosure) equipment it is important that the earthing of the power supply to the equipment is adequate and efficient. In customers' premises this is likely to be unknown so it is important to carry out a test to demonstrate the efficacy of the earthing. The safe way to do this is to measure the earth loop impedance of the power supply using an instrument designed for that purpose. Make sure that you know how to use the testing device and how to interpret the results obtained. If the test indicates an inadequate earth, the customer must be informed that the work cannot continue until it has been rectified.

Remember that simple 'Go/No go' plug-in testers will in general only provide a polarity check and an indication that an earth may be present, but not its effectiveness.

### **What are the legal requirements?**

The Electricity at Work Regulations 1989<sup>3</sup> 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<sup>7</sup> 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: Servicing and repair of domestic appliances* Engineering Information Sheet EIS35 HSE Books 2001
- 2 *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)
- 3 *Memorandum of guidance on the Electricity at Work Regulations 1989. Guidance on Regulations* HSR25 HSE Books 1989 ISBN 0 7176 1602 9
- 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* GS38 HSE Books 1995 ISBN 0 7176 0845 X

*Electricity at work: Safe working practices* HSG85 HSE Books 1993 ISBN 0 7176 0442 X

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

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

## Further information

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA Tel: 01787 881165 Fax: 01787 313995 Website: [www.hsebooks.co.uk](http://www.hsebooks.co.uk) (HSE priced publications are also available from bookshops.)

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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](http://www.bsi-global.com)

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

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