

Safety in electrical testing – service and repair of audio, TV and computer equipment

HSE information sheet

Engineering Information Sheet No 36 (Revision 1)

Introduction

This information sheet contains specific advice about avoiding injury during the servicing and repair of domestic audio, TV, computer and video equipment.

The guidance is for those who carry out electrical testing during the servicing and repair of audio, TV and computer equipment. 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 which are likely to increase the risk of electric shock include:

- 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 earthed metalwork will result in an electric shock.
- 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.
- 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, supplies are generated internally on printed circuit boards and can be contacted if boards are handled while live or before stored charges have dissipated.

- 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.
- 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.
- 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.
- 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.
- Additional risks may be present at the customer's premises if their electrical installation is not electrically sound, eg earthing, insulation, resistance, polarity.

Precautions

Your employer will have carried out a general risk assessment and identified precautions that are necessary for carrying 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 at each site 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.

- If carrying out repairs or replacement of faulty parts have you isolated the appliance 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 on older equipment even the cathode ray (TV) tube itself, which may still have some significant remaining charge that should be allowed to dissipate.
- Is it absolutely necessary for you 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, modern equipment may have built-in diagnostic software and displays which allow safer and more efficient testing, fault-finding and adjustments to be done by the service worker.
- Have you taken suitable precautions to avoid danger and prevent injury?
- Are you competent (ie do you have the necessary knowledge, or experience) for the type of work or, if not, are you adequately supervised?

The following precautions are recommended as part of a safe system of working for electrical testing of audio, TV and computer equipment.

Test areas

In all circumstances, you must 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, determine the steps necessary to create a safe working environment:

- 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.
- Consider erecting a temporary barrier to prevent unauthorised people approaching the danger area.
- Allow plenty of space to work in – if you do get a shock while working in a cramped area you may be less able to break contact quickly, if at all, or are more likely to hit something. Remove (or move away from) any objects that may pose a hazard. For example, if an appliance such as a TV is in a corner, consider pulling it out to work on it.

- 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;
- Never leave equipment or an appliance 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:

- Limit access to the test area, as far as is practicable, to the competent persons carrying out the testing. Provide suitable barriers to help prevent unauthorised entry. Competent persons must have adequate knowledge of the electrical dangers associated with the appliances and the precautions necessary to reduce the risk of electric shock. Training must be provided as necessary.
- If other people enter the test area from time to time, instruct them about the hazards that may be present and, in particular, tell them not to touch anything on the work bench. Limit their access to what is strictly necessary.
- Separate adjacent test positions using barriers that prevent a tester from reaching into another test area.
- Where possible, keep soak test areas separate from the test benches and ensure covers are in place when equipment is on soak test.

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:

- 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.
- Where the dangerous conductors on the equipment being tested are supplied from the mains and the supply 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.
- The power supply should include a residual current device (RCD), with a maximum rated tripping current of 30 mA. This may not be available on all customers' circuits, so provide testers with a portable RCD.

- 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 61010,¹ BS EN 61557² or BS EN 61243-3.³

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 INDG354(rev1) *Safety in electrical testing at work*.⁴

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.

Legal requirements

The Electricity at Work Regulations 1989 are the 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 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
- 2 *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
- 3 *BS EN 61243-3 Live working. Voltage detectors. Two-pole low voltage type*. British Standards Institution
- 4 *Safety in electrical testing at work* Leaflet INDG354(rev1) HSE 2013
www.hse.gov.uk/pubns/indg354.htm

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

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

Safety in electrical testing: service and repair of domestic appliances Engineering Information Sheet EIS35(rev1) HSE Books 2016

BS EN 50191: 2010 Erection and operation of electrical test equipment British Standards Institution

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.

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

British Standards can be obtained in PDF or hard copy formats from BSI: <http://shop.bsigroup.com> or by contacting BSI Customer Services for hard copies only Tel: 0845 086 9001 email: cservices@bsigroup.com.

This document is available at: www.hse.gov.uk/electricity/information/testing.htm

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