GUIDE TO THE TESTING OF ELECTRICAL EQUIPMENT
(SINGLE PHASE, 240 VOLTS)

1. INTRODUCTION

The requirements for testing all electrical equipment are set out in University Electrical Policy and Guidance.

Most electrical equipment is rated up to 240 volts. Equipment rated above 415 volts should only be tested by specialists. This guide only deals with the testing of equipment up to 240 volts.

Testing is the third level of maintenance following user checks and formal visual inspections.

The object of the testing is to pick up faults that are unable to be readily seen, primarily high earth path resistance (or no earth path at all) and a breakdown in the electrical insulation of the equipment.

**Earthing**

Most equipment is earthed. If a fault occurs and the metal work of the equipment becomes live the current should pass down the earth path. If a person touches the faulty equipment most of the current should pass along the designed earth path and not pass through them. However, if the earth path has too high a resistance or there is no earth path at all, most or all the current will flow to earth through a person touching the equipment and they will receive an electric shock, the severity of which will depend on circumstances.

The **earth bond test** is to establish that the correct earth path is in an efficient state. Equipment that is earthed is referred to as Class 1 equipment.

Some equipment is double insulated. This equipment is not earthed and will fail an earth bond test.

Double insulated equipment relies on an extra layer of insulation protecting the user in the event of a fault: e.g. electrical hand tools with plastic cases. The plastic case is the second (double) layer of insulation. Equipment that is doubled insulated is referred to as Class 2 equipment and will be marked with this symbol:

![Symbol]

**Insulation**

Insulation prevents 'live' wires and live components coming in contact with each other and the other parts of the equipment. It takes the form of sheathing on wires and non-conducting material between components. If the insulation begins to break down short circuits can occur leading to a risk of fire and electrocution.

For earthed equipment the **insulation resistance** test ensures the integrity of the insulation of the live and neutral conductors to earth. For double insulated equipment it tests the integrity of the live and neutral conductors to the casing.

**Other tests**

There are four other tests that are sometimes carried out: i.e. flash, load, operation and earth leakage.

However these tests are not necessary for the equipment most people will be testing and are not covered in this guide.
Testing equipment
The equipment available for testing ranges from the simple to the very sophisticated. They can be linked to computer systems to allow automatic downloading of results. The two main variations are equipment which only indicates pass/fail and equipment which gives a reading which then has to be interpreted. The advantages of a meter reading are that trends in the condition of equipment can be picked up. However for most situations pass/fail is sufficient. Testing equipment is referred to as a 'Portable Appliance Tester'.

2. PROCEDURE FOR CARRYING OUT AN EARTH BOND AND INSULATION RESISTANCE TESTS

Warning: Before any testing is carried out the appliance to be tested must be disconnected from the power supply. Do not touch the appliance while it is being tested.

1. Carry out a formal visual inspection
   I. Remove the top of the plug and ensure that:
      • the correct fuse is fitted,
      • the cable terminations are correct and secured,
      • the cord grip is effective,
      • there is no sign of internal damage, overheating or ingress of liquid or foreign matter.

   If the plug is the molded on type and cannot be opened just check for signs of damage, that the correct fuse is fitted and that the cable is firmly held in the plug body.

   II. Ensure the mains wire or power cord is not damaged and is securely fitted to the appliance;

   III. Ensure the appliance shows no signs of overheating, ingress of liquid or any other damage.

   If the appliance passes the formal visual inspection then testing can be carried out. If the appliance fails the formal visual inspection it must be taken out of service and repaired before being tested.

2. Carry out tests
   I. Connect the test lead to the portable appliance tester and connect the tester to the mains supply (unless battery powered).

   II. Plug the appliance into the tester using the three pin plug and switch the appliance to the 'on' position.
      (Note: Only a test voltage flows into the appliance via its mains lead and returns via the test lead.)

   III. Class 1 appliance:
      Attach the test lead clip to each area of exposed metal which is an earth point. Screw heads may provide earth points.

      If metalwork is painted it may be necessary to scrape below the painted surface to make an earth connection. Some exposed metal parts may be insulated from the main body of the appliance so will not provide an earth point. An earth test probe is a convenient way to find earthing points.

      If a piece of equipment has several earthing points then a representative selection should be chosen.
With the clip on each earth point activate the test button on the tester. Some testers have a separate button for the earth bond test and insulation test. These are usually the meter type. Press each test button in turn and record the result. Some testers, usually the pass/fail type, do both tests simultaneously and lights indicate pass/fail. Record the result. Both types of the test buttons should be activated for at least 5 seconds before recording the results. The simple pass/fail type will immediately show if the equipment has passed. The meter type will indicate a scale reading and will be in a pass or fail band.

**Insulation test:** pass if insulation resistance is greater than 2 Mohms  
**Earth Bond test:** pass if resistance is less than 0.25 ohms

**IV. Class 2 appliances:**

If the tester is the pass/fail type proceed as above. The tester will indicate "fail" for the earth bond test. If the tester does each test separately then the earth bond test is not done.

**Insulation test:** pass if insulation resistance is greater than 7 mohms. (This test cannot be done using a simple pass/fail meter)  
**Earth Bond test:** pass if resistance is less than 0.25 ohms

**V.** If the equipment fails then it should be withdrawn from service.

**VI.** The result of the tests should be recorded.

**Reasons why equipment may fail the tests:**
- poor connection between test lead and appliance;
- corrosion on mains plug pins;
- loose wires in plug or appliance;
- damaged power cord;
- fault inside appliance;
- test probe put on an insulated metal point.

**Other points to note:**
- if the equipment has a detachable lead the lead must be tested and labeled separately to the equipment it is used with;
- some information technology equipment and excessively long extension cables may fail the earthing test (seek advice in these circumstances);
- some equipment, e.g. hairdryers, which require a flexible lead, are hand held and are only used for short periods, are permitted to have a lead that is rated less than the appliance. The lead must not exceed two metres in length.

This document, the Electrical Safety Policy and other related documents are available at [https://intranet.birmingham.ac.uk/hr/documents/public/hsu/hsupolicy/18ES.pdf](https://intranet.birmingham.ac.uk/hr/documents/public/hsu/hsupolicy/18ES.pdf)

HSU last updated 31.7.13