

Guidance Note, GN024

INSPECTION AND TESTING OF PORTABLE ELECTRICAL EQUIPMENT

This is a guidance document for Schools and Support Services. Units should use the guidance to help them develop their own local health and safety arrangements.

Items of portable electrical equipment should be inspected and, if necessary, tested periodically to check that they are in a safe condition and have not been damaged or otherwise abused.

In offices and related areas throughout the University the inspection and testing is arranged by the Estates Section who will usually bring in contractors to carry out the work. This will be done every 2 to 3 years. Equipment which has been inspected/tested and which is deemed to be safe will be marked with a green sticker. Computer equipment will not be tested but any multiway extension cables used with computer equipment will be tested.

Schools must make their own arrangements for carrying out inspection and testing in laboratories and workshops. A similar frequency of 2 to 3 years is recommended.

Technicians who have had suitable training can carry out this work. Inspection and testing of portable electrical equipment is not any more technically complex than many of the other activities which technicians carry out in laboratories. As with these other activities, Technical Resource Managers and Team Leaders should determine which of their staff are competent to carry out inspection and testing. Training and supervision should be provided as required.

Audiovisual equipment will be inspected and tested by staff from DIT.

There are some areas in the University where equipment needs to be tested more frequently than every 2 to 3 years. These are areas where equipment is more likely to be damaged. Examples include equipment used in kitchens, halls of residence and in maintenance activities such as grounds maintenance. Advice should be sought on inspection and testing frequencies for these higher risk areas.

Studies carried out by the Health and Safety Executive have shown that around 95% of faults and damage with portable electrical equipment can be found just by looking – the visual inspection. A small number of faults cannot be picked up on visual inspection, particularly lack of continuous earths. Therefore most items of earthed equipment should also have combined inspection and test to check for these other faults.

Further guidance from the Health and Safety Executive is provided in their leaflet on [Maintaining Portable Electrical Equipment – ref INDG236](#) which is on the HSE website.

An outline of how inspection and testing should be undertaken in a laboratory follows below.

Inspection and testing of portable electrical equipment in the laboratory

- Remember that the visual inspection is the most important part of the inspection and test. The HSE say that around 95% of faults with electrical equipment can be found just by looking at the equipment.
- Make sure that you understand the difference between earthed (or Class 1) equipment and equipment which is not earthed (Class 2 equipment). See the HSE's leaflet for details. Class 1 equipment needs both visual inspection and testing for a continuous earth. Class 2 equipment needs only a visual inspection.
- Extension leads should also be inspected and tested.
- After inspection/testing, both Class 1 and Class 2 items of equipment should be marked with a green sticker to show that they have passed. The date of inspection/test and the initials of the person carrying it out should be written on the sticker. Old stickers should be removed or defaced before new stickers are applied.
- Equipment which fails inspection/test should be labelled as faulty and taken out of use until it can be repaired.
- Inspection and testing should always be carried out by arrangements with those in charge of the laboratories concerned. Lab managers (or their equivalents) may have concerns about the testing of certain items of complex or high-value equipment. In such cases a visual inspection may be sufficient or advice on testing can be sought from those who maintain the equipment when they next visit.
- Supervisors should ensure that those carrying out inspection and testing have been shown how to do it and have demonstrated that they understand how to do it. This should be no different to the way in which technicians are shown how to operate any item of lab equipment, i.e. they have to demonstrate that they know how to do the task before being allowed to do it unsupervised.
- Equipment used for testing should be checked for calibration periodically (every 2 to 3 years is the suggested frequency for the simple testers which indicate just Pass/Fail). This should be done by an organisation which can issue a calibration certificate for the equipment. The manufacturers or suppliers of the equipment usually offer this service.

Advice and assistance with inspection and testing should be sought from supervisors and line managers who can, if necessary, seek advice from the University Safety Adviser.

A Step-by-Step Guide to Visual Inspection of Electrical Equipment *(reproduced here by kind permission of Safety and Environmental Protection Services at the University of Glasgow)*

What to Inspect?

You should inspect all equipment that is portable. Generally this means equipment that has a cable and a plug that can be inserted into a 13A socket outlet. Schools should make alternative arrangements for equipment that is permanently wired to the mains (e.g. via fused outlets). The testing and inspection of the fixed wiring installation within buildings is the responsibility of Estates.

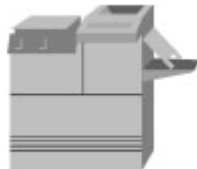
When to Inspect

The intervals between inspections are not fixed by legislation. Schools must determine the frequency that is appropriate to each piece of equipment based on risk.

Equipment that is rarely moved and is not at risk of damage (e.g. computers) is likely to be low risk and requires less frequent inspection than equipment that is frequently moved, might be used in a damp environment (e.g. kettles, water baths) or may be subject to damage.

Office equipment - levels of risk (Low to Medium)

Low risk



Medium risk



Equipment used in an office environment is rarely of the type that would be considered high risk. High risk equipment includes equipment such as portable electrical hand tools.

Non-Office Equipment - Levels of Risk (High)

High risk



Who should carry out inspections?

It is not necessary to have an electrician carry out equipment inspections. Many members of University staff will possess the skills to perform this task if given the correct guidance.

OK so what needs to be done?

By following the simple steps laid out below most staff should be able to carry out visual inspections of electrical equipment both safely and competently.

Now work through each of these steps - but remember
If you are in any doubt about what you are doing - STOP - and seek assistance.

As the title visual inspection implies, all you really need to do is look closely at the equipment. More than 90% of equipment faults can be found by visual inspection.

Step 1 - before you start inspecting

SWITCH OFF THE POWER AND UNPLUG THE EQUIPMENT

Never open the casing of the equipment. If you suspect there is a fault inside the casing you should seek help from someone appropriately qualified.

Step 2 - the electrical cable

Run the cable slowly through your hands and feel for any lumps, cuts or rough areas. At the same time inspect all round the cable whilst working down it a little section at a time. Watch out for any areas that are discoloured, this might indicate an area of damage.

Be particularly vigilant with any part of the cable that may be prone to having equipment sat on it or that may be habitually curved or twisted. These are sections that are likely to become damaged.

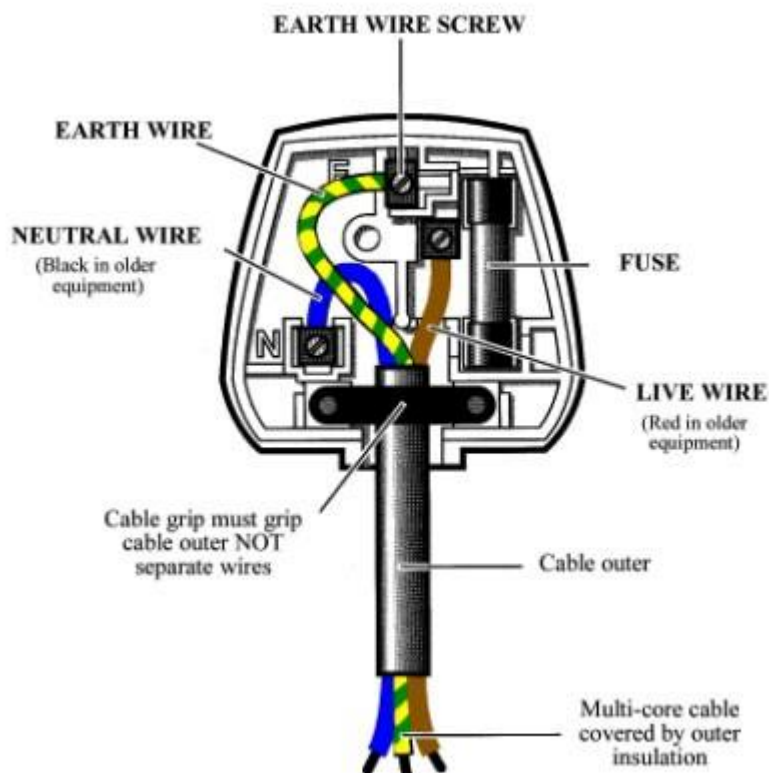
Uncover any areas of cable that have been covered (e.g. with tape or a label) as they may be obscuring joints or areas of damage. Cables should not generally have any joints that are made by means other than standard connectors. Be suspicious of any joints if they are not formed by fully enclosed, solid, standard connectors. Have them checked by someone suitably qualified.

If any part of the outer insulation of the cable is breached, or if you have reason to believe that the wires within it may be damaged, refer immediately to Step 5.



Step 3 - the plug

This illustration shows a correctly wired plug:

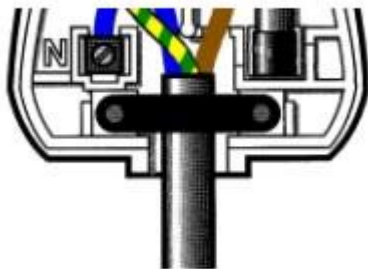


Cable entry to the plug

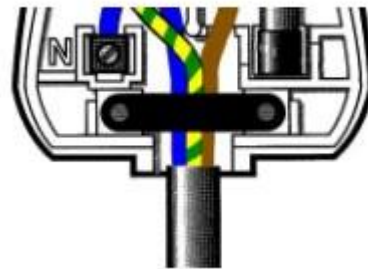
Begin your inspection of the plug by looking at the point where the cable enters it. The outer insulation of the cable should be tightly gripped by the plug cable grip and none of the thinner internal wires should be visible from the outside of the plug.

Cable Entry to the Plug

Correct:



NOT like this:



The plug casing

Next look at the plug itself. The casing should not be cracked, chipped or damaged. There should be no bent pins.

If the plug is not permanently bonded to the cable you should be able to open the casing using a small screwdriver. Again look closely at the point where the cable enters the plug through the cable grip, this time examining it from the inside of the plug. As before, the outer cable should be securely gripped and the thinner inner cables should emerge from the outer only beyond this point.

The wires within the plug

Next examine each of the individual thinner cables. It is not necessary to unwire the plug to do this.

Make sure that the BROWN wire (RED in older equipment) is connected to the LIVE terminal (usually labelled L), that the BLUE wire (BLACK in older equipment) is connected to the NEUTRAL terminal (usually labelled N) and that the GREEN and YELLOW wire is connected to the EARTH terminal (often labelled E, this is at the top of the plug).

Ensure that there are no damaged parts on any of the cables and make sure that there is no excess cable that may snag or be trapped when the plug is re-assembled. If any of the smaller cables are too long you may see rub or pinch marks on the outer insulating surface.

You should check the point where the inner wires are connected to the plug terminals and ensure that there is not an excessive amount of bare wire exposed. Ideally the insulating outer should cover the inner conducting wire entirely and no conducting wire should be visible. In practice this is often difficult to achieve and it may be necessary to have a gap of about one millimeter of conductor showing between the insulating material and the terminal.



Finally check the connections at each terminal. Ensure that the conducting wire is securely housed and that no stray wires are sticking out. Make sure that the terminal screws are securely tightened.

What if there are only two wires inside the plug?

Remember that some appliances have a cable that contains only two wires (e.g. some desk lamps). If you see only two wires when you open the plug take a close look at the end of the cable where these wires emerge. Make sure that there isn't a third wire that has been cut off. You should also check that the two wires are connected correctly. This means that the BROWN (RED in older equipment) wire should be connected to the LIVE terminal and the BLUE (BLACK in older equipment) wire to the NEUTRAL just as they are when three wires are present.

In this case the only wire that should be missing is the GREEN and YELLOW connection to the EARTH terminal.

A two wire plug:



Is there more than one plug on the cable?

In some cases the cable may not be permanently fixed into the equipment but may have a plug or connector for that purpose. In this case you should also examine this for any sign of damage and to ensure that the outer cable is securely held in such a way that the inner cables are not visible. It is usual for this type of connector to be sealed and as a result no internal inspection is possible.

An example of a two plug lead:



Step 4 - the fuse

Any plug that is designed to make a connection between a piece of equipment and a mains socket should be fitted with a cartridge fuse. In the case of sealed plugs this fuse is located in a compartment that can be opened from outside the plug. This compartment is located on the face of the plug from which the pins protrude.

In unsealed plugs the fuse is located inside the body of the plug and is connected to the LIVE terminal next to the BROWN wire. When you open an unsealed plug to inspect the cables and connections the fuse should be readily visible.



In sealed plugs the fuse is accessed from a compartment located between the plug pins. An example is shown below:



When carrying out a visual inspection you should ensure that the plug has a fuse and that it has not been replaced by some other device (such as a piece of wire or silver foil).

It is also necessary to make sure that the fuse is of the correct type (rating). As a general rule, most office equipment should be fitted with a 5 amp fuse. Heaters, kettles etc and appliances that use more power often require a 13 amp fuse.

The following table gives an indication of the fuse that should be used in some of the more common office equipment.

Equipment type = Fuse rating	
Equipment Type	Suggested Fuse Rating (Amps)
Desk lamp	3
Kettle	13
Electric Fire	13
Computer	5
Vacuum Cleaner	13

It is possible to calculate the fuse rating required for equipment if you know how much electricity the equipment uses. Most equipment has a small plate or label (usually on the base or rear panel) giving the energy usage.

This is expressed as a certain number of WATTS (the initial W is frequently used as

an abbreviation) for example a desk lamp may say 100W maximum.
If you know the energy usage then the correct fuse rating can be calculated using the table below:

'Wattage' of Equipment = Fuse Rating

'Wattage' of Equipment	Fuse Rating
Up to 600 Watts	3 Amps
Between 600 Watts and 1000 Watts (1KW)	5 Amps
Between 1KW and 3KW (3000 Watts)	13 Amps

Step 5 - Putting the equipment back into service

No faults observed

If you have found no faults it is now a simple matter to reassemble the plug. Before putting the equipment back into use you should label the plug or the equipment to show that an inspection has been carried out. This label should give details of the date of inspection and who carried out the inspection. Proprietary labels may be purchased, but it is perfectly acceptable to use self-adhesive labels so long as they remain attached until the next inspection.

A possible label layout for showing that equipment has been inspected is

Electrical Appliance Inspection

Date:

17/05/2000

Inspected by:

:h, Astrophysics Dept.

If you found one or more faults:

If you found any of the following simple faults you are likely to be competent to correct them by yourself:

- Incorrect fuse
- Missing fuse
- Connections inside the plug are loose
- Outer cable is not gripped tightly by the cable grip.

After a little practice most people are able to rewire a plug if they have the correct equipment. If you do not have the correct equipment to do this job, or if you feel it is beyond your ability you should seek assistance.

If the cable is damaged you should not attempt to repair this and should seek assistance.

If you have identified faults during the inspection that cannot be immediately fixed then the equipment should be taken out of service until the necessary repairs can be undertaken. This can be achieved by removing it to a secure storage area. If this is

not possible the plug should be removed to prevent use.
In all cases the equipment should be labelled to indicate that it should not be used.

Just before you go

Why don't you try the quiz. See if you can spot the faults in the plugs shown below.
You'll find the answers at the end.

Plug A



Plug B



Plug C



Answers:

Plug A - no outer cable sheath and live and neutral wires reversed.

Plug B - plug broken and taped up

Plug C - wire wrapped round fuse, live wire (brown) too long, protective sheathing cut too far back on earth wire (yellow and green) and so too much wire is exposed.