4. GENERAL PRINCIPLES OF MAINTAINING ELECTRICAL EQUIPMENT

Three main factors need to be considered when maintaining electrical equipment:

- the equipment is safe to use
- the equipment works correctly and efficiently when required
- the user fully understands how the equipment works and knows its limitations

1. Safety

If it is misused or poorly maintained, electrical equipment can be the cause of death and fire.

If it is well maintained, electrical equipment can save life, improve the quality of lives and reduce capital expenditure.

Electrical equipment should always be treated with respect. Manufacturer's instructions must be provided with every piece of equipment; if they are missing, contact the supplier.

The following are simple maintenance instructions:

Socket outlets and plugs

Because there are many different electrical socket outlets and plugs in use throughout the world, it is essential that the following questions are considered in relation to any new piece of equipment (Figure 4).

- Is there a convenient socket outlet available?

  Long flexible leads are dangerous and leads should be as short as possible Socket outlets should be at least 2m from a sink or wash-hand basin, and NEVER IN A BATHROOM OR SHOWER ROOM.

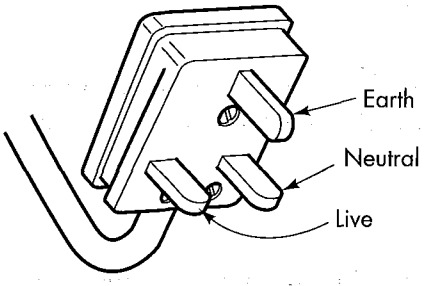
- Has the socket outlet an adequate electrical capacity for the equipment?

- Does the equipment need to be earthed/grounded?

  This will depend on the type of equipment being used. If it has only two wires in the power cable and/or the 'box within a box' symbol ⧈, no earth connection is needed.
  As a general guide, if the flexible cable fitted to the equipment has three conductors then the equipment needs to be earthed. If the lid of the equipment can be removed easily, the earth wire is connected to the case. In many places, a good earth/ground is not available and equipment which does not need an earth is preferable.

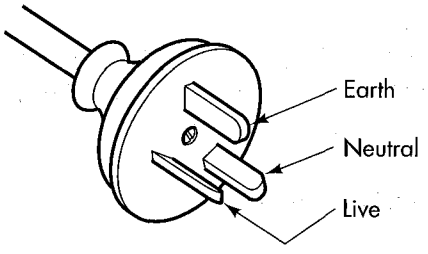
- Does the plug match the socket outlet?

United Kingdom



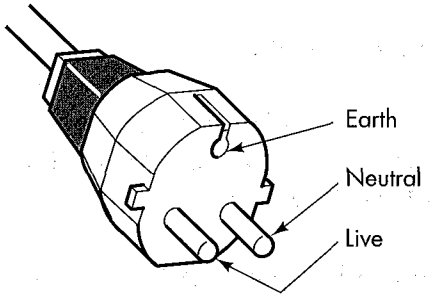
Earth	Green/Yellow	13 Amp/250 V ac
Neutral	Light Blue	
Live	Brown	

Australia/New Zealand



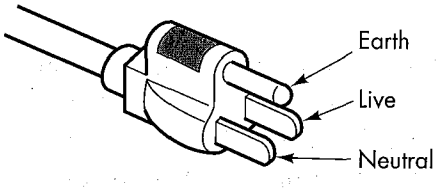
Earth	Green/Yellow	15 Amp/250 V ac
Neutral	Light Blue or Black	
Live	Light Brown or Red	

Europe/Saudi Arabia



Earth	Green/Yellow	16 Amp/250 V ac
Neutral	Light Blue	
Live	Brown	

USA/Canada



Earth	Green/Yellow or Green	15 Amp/125 V ac
Live	Brown or Black	
Neutral	Light Blue or White	

Figure 4: Examples of plugs and associated cable colour codes

Always ensure that the correct plug has been fitted to match the socket outlet. Makeshift arrangements are dangerous.

Flexible cables and extension cords

Different colours identify conductors. These may vary by country.

For example a machine from the USA will have:

- a brown or black cable which is the live conductor
- a green/yellow cable which is the earth conductor, and
- a light blue or white cable which is the neutral conductor

And a machine from the UK will have:

- a brown cable which is the live conductor
- a green/yellow cable which is the earth conductor
- a blue cable which is the neutral conductor

It is essential that the correct cable colours are identified and correctly connected to the plug (Figure 5).

2. Location of Equipment

Careful consideration should always be given to the placing of equipment. Damp conditions should be avoided if possible, and, as a general rule, equipment should be positioned in a dry, clean, well ventilated area. It should stand on a solid, level base.

Equipment should always be as near as possible to the electrical supply: extension leads should be discouraged.

Working instructions and safety instructions should be clearly displayed on or near the equipment.

Maintenance and repair instructions should be kept by an assigned person in a designated place.

3. Training

Staff expected to use the equipment either on a regular basis or occasionally should be given training on:

- how to use the equipment. They should also understand what is expected of the machine
- basic information on how the equipment works
- safety practices
- what action to take in the case of an emergency or if the machine does not function correctly
- how to take care of the equipment on a day-to-day basis

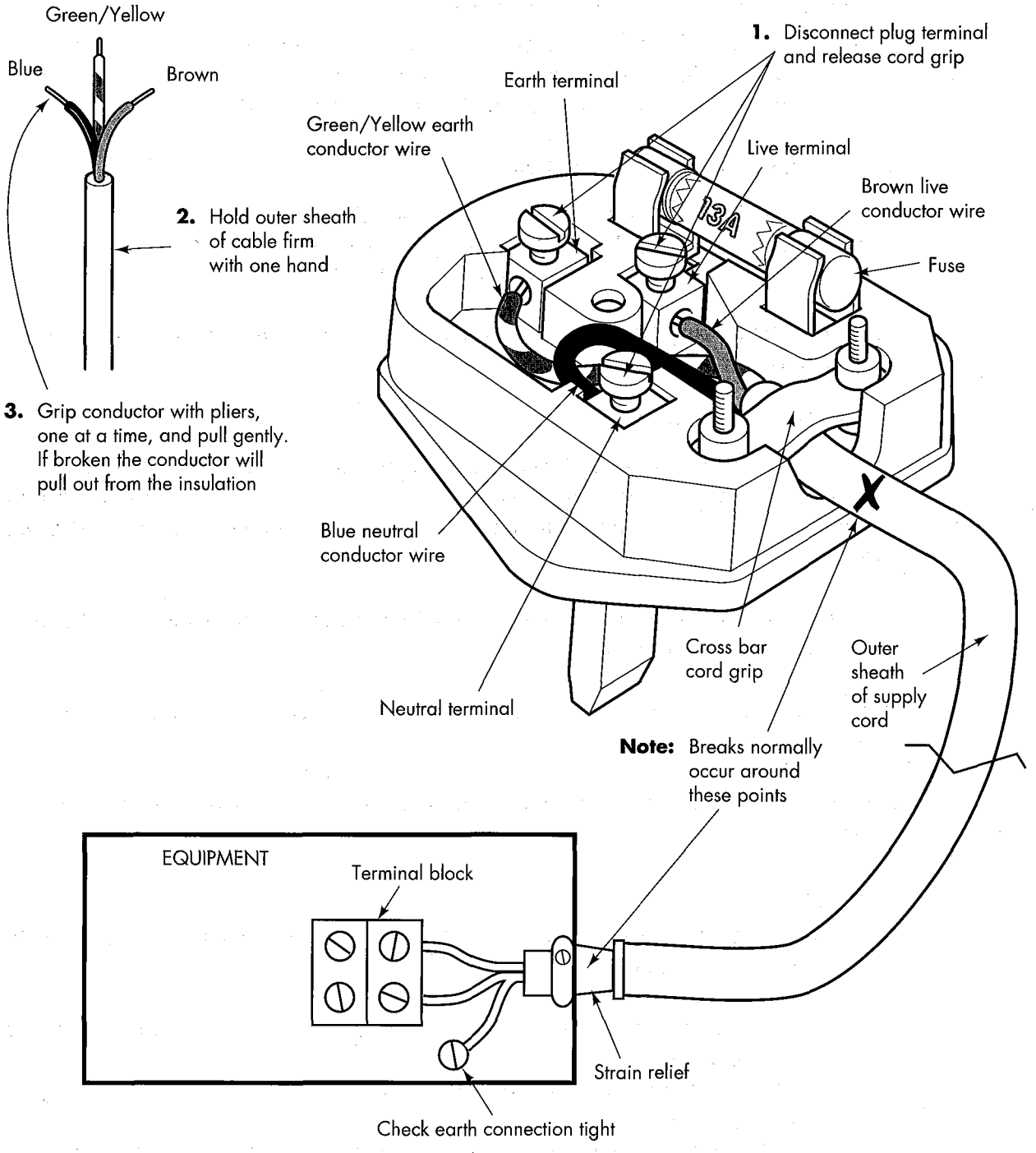


Figure 5: Checking mains lead for conductor break

Refresher training sessions should be carried out at regular intervals to ensure that the machine is being used correctly and good practices are maintained. Sufficient 'back up' staff should also be trained to cover illness, holidays and unforeseen staff shortages. It may be best for nurses to be 'back up' staff because they are more static than doctors.

Spares

For a machine to fulfil its task, adequate spare parts should be held in store. Alternatively, a local supplier should be identified so that spares can be acquired quickly.

To help decide which is right for your hospital, answer the question: 'If a machine breaks down, how long will the machine be out of service if the spare parts are not held in store?'

The type and number of spares will depend on:

- the level of technical maintenance expertise available to carry out repairs
- how often particular items are required
- cost of particular items
- whether spares are in the country or whether they have to be imported
- whether spares can be improvised or bought from a local generic source

It is important to keep a list of spare parts held in store. Adopt a re-ordering procedure as the spares are used, paying particular attention to the source of spares.

Voltage regulators

Much modern electrical equipment is voltage sensitive and fluctuations in the electrical supply present a problem in many developing countries.

However, there are many voltage regulators and stabilisers on the market and although in some cases these are expensive, the cost should be judged against the cost of repair or replacement of parts or even the cost of a new machine.

Seek advice from the manufacturer or local experts if available.

IF THERE IS ANY DOUBT REGARDING SAFETY A QUALIFIED ELECTRICAL ENGINEER SHOULD BE CONSULTED BEFORE ALLOWING EQUIPMENT TO BE MADE OPERATIONAL.