Newcomers' Notebook

Power mains safety and electrical hazards in communications equipment

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During the 1970s, an article was regularly published in Amateur Radio magazine called *Newcomers' Notebook* authored by Rodney Champness, VK3UG. The articles were directed at people starting out in amateur radio and answered questions on subjects related to electronics and communications.

I recently contacted Rodney and he endorses the resurrection of Newcomers' Notebook.

Accordingly, this space is available for us to answer your questions, no matter how big or small, simple or complex. Google is often the 'go-to' source of answers for people today, but Google isn't focused directly on the question you have asked, its answers may not be in the correct context of your question, and the answer it provides may not be locally focused. Send your questions to AR via email through *simon@wia.org.au* and please use *Newcomers Notebook* in the subject line.

This first article is aimed to assist Foundation licensees, and those studying for same, to understand the correct wiring of 240 VAC power mains and the potential electrical hazards in maintaining their own equipment. This topic is a recent change to the licence conditions and may not yet be addressed in training material currently available. Check – If it is covered, all well and good; if not, follow up about updated material.

Electric shock

The human body can conduct electricity and is susceptible to electrical shock. Electrical shock can range from mild tingling to severe burns and even death. The high voltage is not normally fatal as demonstrated by coming into accidental contact with the spark plug lead of a motor car. If the accompanying current is sufficiently high enough, the heart is affected, and this may lead to death. With higher current values and the body is burnt internally and externally.

Safe Work Australia states that between 2003–15, one hundred and forty-two (142) workers died due to contact with electricity (an average of 11 workers each year). It also identifies the types of equipment that poses greater risk than others.

- Portable electrical equipment including plugs and sockets; electrical connections; the cable itself. All are especially vulnerable to damage.
- Extension leads, particularly those connected to equipment that is frequently moved, can suffer similar problems.

Mains breakers and fuses

Older style houses may still be fitted with wire fuses. A licenced electrician should be engaged to replace the fuses with Circuit Breakers (CB) and install a Residual Current Circuit Breaker (RCCB), also known as a Residual Current Device (RCD) or safety switch. Fuses require an excess of the rated current to flow through the fuse wire before the fuse blows and are generally slower to react to excess current than a CB.

An RCCB/RCD will save your life by ensuring that the current is cut off in the event of a current leakage or an imbalance in current that could result in electrocution. A CB will save your home from electrical fires by ensuring that the wires are not overheated and that there is no overload on the electric circuit. You need to ensure that you have both in your house. A 30 mA current through your body is enough to cause cardiac arrest or irreversible damage to your body.

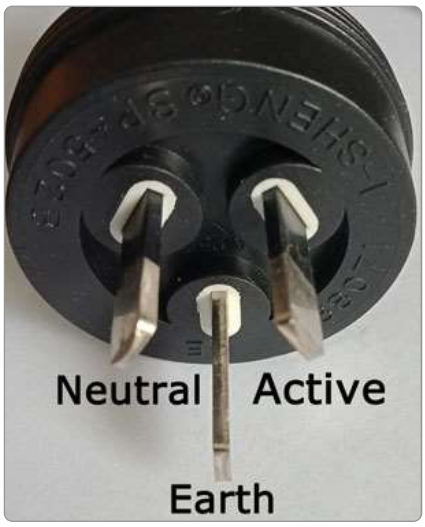


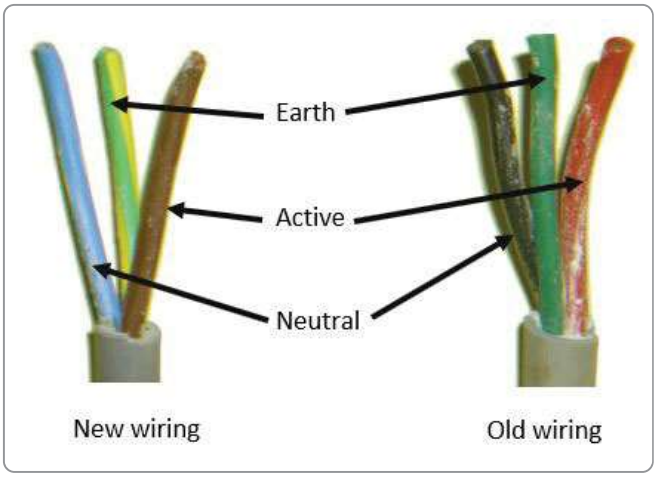
Figure 1: The common three pin power plug and its connections.

The RCCB/RCD is a safer device as they immediately cut off the power source when electricity leaking to earth is detected at a level that is harmful to humans. I know they work well from personal experience.

Mains wiring

As experimenters, homebrewers and repairers of our equipment plugged into the 240 VAC (50 Hz) mains, we need to be mindful of electric shock-hazards. The socket outlet (General Power Outlet - GPO) on the wall is the source of electricity and is usually rated at 10 Amps. Any hard-wired equipment (eg, Ovens, cook tops) or anything *behind* that GPO, can only be altered or repaired by a licenced electrician. The work must comply with the Australian/New Zealand Wiring Rules AS/NZS 3000:2018.

Our area of focus extends from the three-pin plug that plugs into the GPO, and any lead that supplies power to our communications equipment.



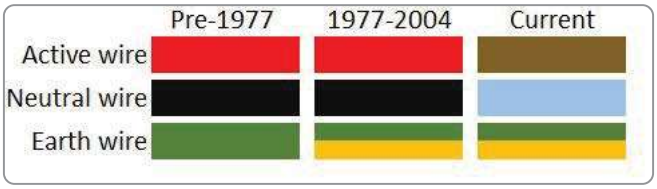


Figure 2: Wiring colour schemes you will find.

The three pin plug

The standard three pin power plug used in Australia is also utilized in New Zealand, Fiji, Tonga, Solomon Islands, Cook Islands, Papua New Guinea, and several other Pacific Island countries.[1]

Wire colours

In power cables, the neutral conductor is normally coloured blue and is the return path for the circuit. The Earth conductor is coloured green with a yellow tracer. This wire must be connected to the metal case of any equipment. The Earth wire provides protection if the equipment fails. The Earth pin is electrically connected to an Earth stake near your house power box.

Deliberately disconnecting the Earth wire and operating any equipment in that state is an extremely dangerous practice.

Older equipment may have the older coloured wiring fitted:

- Active – Red
- Neutral – Black
- Earth - Green

Testing

Using a multimeter set correctly to test the voltage on the wires will produce the following results:

- between Active and Neutral, the reading should be around 240 V
- between Active and Earth, the reading should be around 240 V
- between Neutral and Earth, the reading should be 0 V.

A worthy practice is to perform a continuity check between the metal chassis of the equipment and the Earth pin, with the power lead not plugged into the GPO. If there is no continuity, repair the Earth lead before proceeding.

Other hazards

Before opening any communications equipment for service or repair, unplug the device from the mains. Inspect the cable for any breaks or bare wires.

Once the case is open, some capacitors may still be holding their full charge. Caution is especially required if the equipment is valve operated as there may be many hundreds of volts in circuits around the valve.

Some hazardous substances were used in older communications equipment that are dangerous or even toxic to humans. Caution should be exercised when repairing or rebuilding older equipment.

Have fun and stay safe.

1 Wikipedia.