BASIC 240V WIRING STANDARDS AND POWER TOOLS

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Revision 2

Introduction

The purpose of this article is to provide an introduction to Australia's 240V domestic power connections, power outlets, power tool cable wiring and important safety issues.

240V Supply

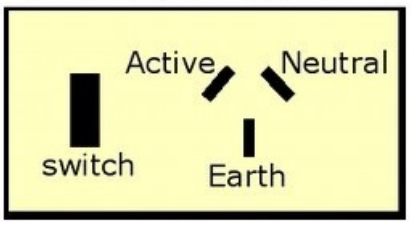
Under AS/NZS3000, Australia's electrical wiring standards, the street-supplied 240V single phase electrical power to our homes is usually distributed by two wires. One wire is the Active wire and the other is the Neutral wire. Refer to the Domestic Power Installation diagram on the last page.

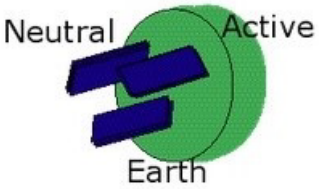
The incoming Active and Neutral wires terminate at the switchboard. The Active wire connects to the electricity meter and then to the master isolator switch which enables/disables the power to the premises. The isolator is wired to the circuit breakers and residual current devices (RCD) on the switchboard to provide several electrical circuits for the lights, power points (general-purpose outlets or GPOs) and fixed appliances such as electric hot water heater, electric cook top and electric oven.

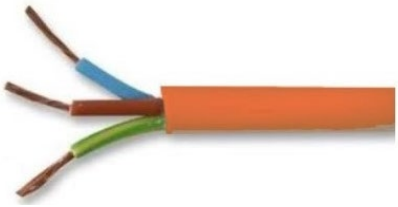
For clarity, the RCDs are not shown on the diagram on the last page but are presumed present.

240V 3-Pin Power Outlet Socket Standard

When viewing the standard Australian 240V 3-pin GPO as shown at below left, whether it be the socket in a power point, power board or extension cord, it has three wiring connections, named Active, Neutral and Earth as shown. The corresponding connection names are shown on the matching 3-pin plug.







The wiring connection named Active is the connection that kills. It's at an electrical potential of 240V above ground, and *you* are at ground potential! This connection layout is a most basic and important electrical standard and is one *you should never forget!*

240V 3-Pin Appliance Plug Standards

When wiring or replacing the 3-pin plug on a power tool or appliance cable, the plug connections to the cable have to take into account the above wiring layout of a GPO and plug, as well as the colours assigned to the cable wires per the paragraph following. Refer to the names of the plug pins in the diagram above and the colour coding of the cable wires following. Ensure the plug wiring connections are correct and proper wiring practices are used. You will either know these practices *implicitly* or you won't. *There is no half-way knowledge with 240V wiring practices in regard to electrical safety!*

Australia's 240V Appliance Cable Colour Code Standard

The standard 240V 3-core power cable fitted to many electrical tools, appliances, extension cords and power boards is comprised of three colour-coded, insulated, multi-strand copper conductors. The Active wire is coloured brown (or red), the Neutral wire is coloured blue (or black) and the Earth wire is coloured yellow-green (or green). The colours in brackets are for Australia's previous cable colour code standard, which is still in use in many older, but legal, devices. Refer to the 3-core cable image above right.

Electrical Appliances and Tools

Grounded appliances. We have many 240V appliances in our homes today such as electric toasters, frypans, washing machines and clothes dryers. Most of these appliances have exposed metal surfaces and therefore will use a three-core power cable with a 3-pin plug. These are *grounded* appliances. The earth wire is used as a safety ground to provide protection in the event of a fault condition occurring within the appliance. Generally speaking, appliances used inside the home are reasonably well cared for.

Conversely, the 240V power tools used in workshops can experience a very different life! That's because power tools can be dropped and damaged. They can be carried by the power cable. The power cables can be repeatedly trampled on, run over, crushed, items dropped onto them, harmed by sharp objects or even severed. The cables and plugs can be damaged by pulling on the cable instead of the plug or by pulling the plug sideways. The cable can get caught around an object and be freed by pulling the cable a little harder! The plugs can become damaged or crushed. In summary, the plug and cable on a power tool may suffer a very hard life and may need to be replaced during the life of the tool.

Ungrounded Appliances. There are appliances and tools which are certified as "*double-insulated*" and will carry the approved "double-insulated" logo shown above. *These devices are ungrounded and do not use an earth wire*, so the power cable is a two-wire cable which connects (usually) to a two-pin plug. Sometimes you may see double-insulated appliances and tools with a three-pin plug fitted, but in such cases, the earth pin is not wired.

Note: Double-insulated appliances and tools should never be fitted with an earth wire! It will bypass the double-insulation safety protections and safety certifications, *which are there for your protection!!*

Australia's MEN System

As shown on the diagram on the last page, all house Neutral wiring connects to the Neutral bar in the switchboard, and all house Earth wiring connects to the Earth bar. The Neutral bar is linked to the Earth bar. Finally, the Earth bar connects to a metal Earth stake which has been driven 1.5m into moist ground outside the premises. That's the way Australia's domestic electrical supply is set up at the premises. It's known as a M*ultiple Earthed Neutral* (MEN) system and is designed to minimise the risk of electrocution in the presence of a fault condition by providing *multiple* low-resistance paths to neutral/ground for redundancy. The MEN system was assigned as the standard for Australia in 1980. Australian homes built before 1980 will have been wired in accordance with one of the previous electrical standards, of which there were several across the country.

Electrical Shock

It's not the voltage that produces electrical shocks. It's the *current* which flows *through* the body as a result of the voltage. That's why RCDs are designed to trip at a specified *current*.

Residual Current Devices (RCD)

RCDs are included in the switchboard circuits to help protect us should we come into contact with an active wire which results in current passing through the body, causing an electrical shock. The RCD is designed to trip (turn off) at a specified current, usually 30mA. Yes, only a *very small* current is required to produce an electrical shock. Keep in mind that although it may not result in death, you can receive a *severe* electrical shock at a current *below* the tripping current of an RCD! Further, an electrical shock can produce strong involuntary muscle reactions in the body which can result in *consequential* injuries to the body. You really do not want to experience that! In fact, you do not want to experience *any* electrical shock!

Earth Stake Safety Warnings
As already noted, the Earth bar at the switchboard is connected to an outside earth stake at the premises. This earth connection is a critically important component of the electrical safety provided by the MEN system and should never be tampered with in any shape or form. An electrician is the only person who should work with earth stakes.

Thus, there are two fundamental safety rules regarding earth stakes:

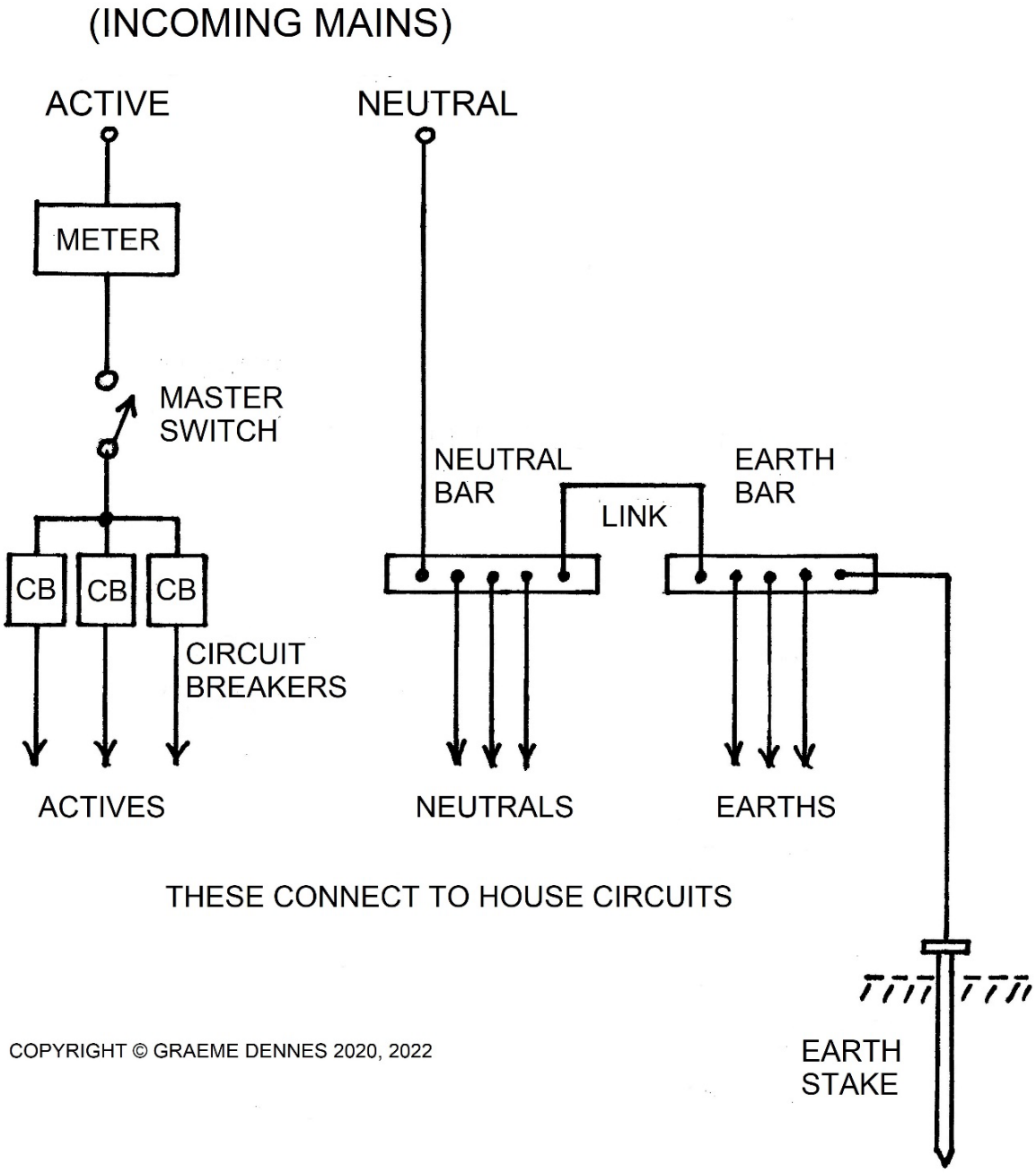
1. **NEVER** disconnect the wire which connects to the Earth stake for any reason whatsoever, whether it be for a microsecond or a millennium! *An electrician is the only person who should do that.*

2. Should you find the wire that connects to the Earth stake has been disconnected, **NEVER** touch the wire or attempt to reconnect it to the Earth stake. **IMMEDIATELY** turn off the power at the master isolator switch and call an electrician.

Unknown Device
Before plugging in an appliance whose electrical condition is unknown, check and then recheck that the tool or appliance and its power cable and plug appear sound and physically undamaged. If in any doubt, test the device with an appliance tester to confirm its electrical safety before using it.

Summary
Incorrect wiring or poor wiring practices can result in your death or the death of someone else. Check and then recheck!! If you have any doubts whatsoever about the electrical safety of your 240V wiring practices or the safety of a tool or appliance, seek expert advice before connecting it to 240V power. Don’t just play it safe, play it VERY safe. If in any doubt, **don’t plug it in!**

DOMESTIC POWER INSTALLATION



My grateful appreciation and acknowledgement is given to the web sites from which the coloured images have been drawn.

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The writer would appreciate your advice of errors or suggestions for improvements.

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