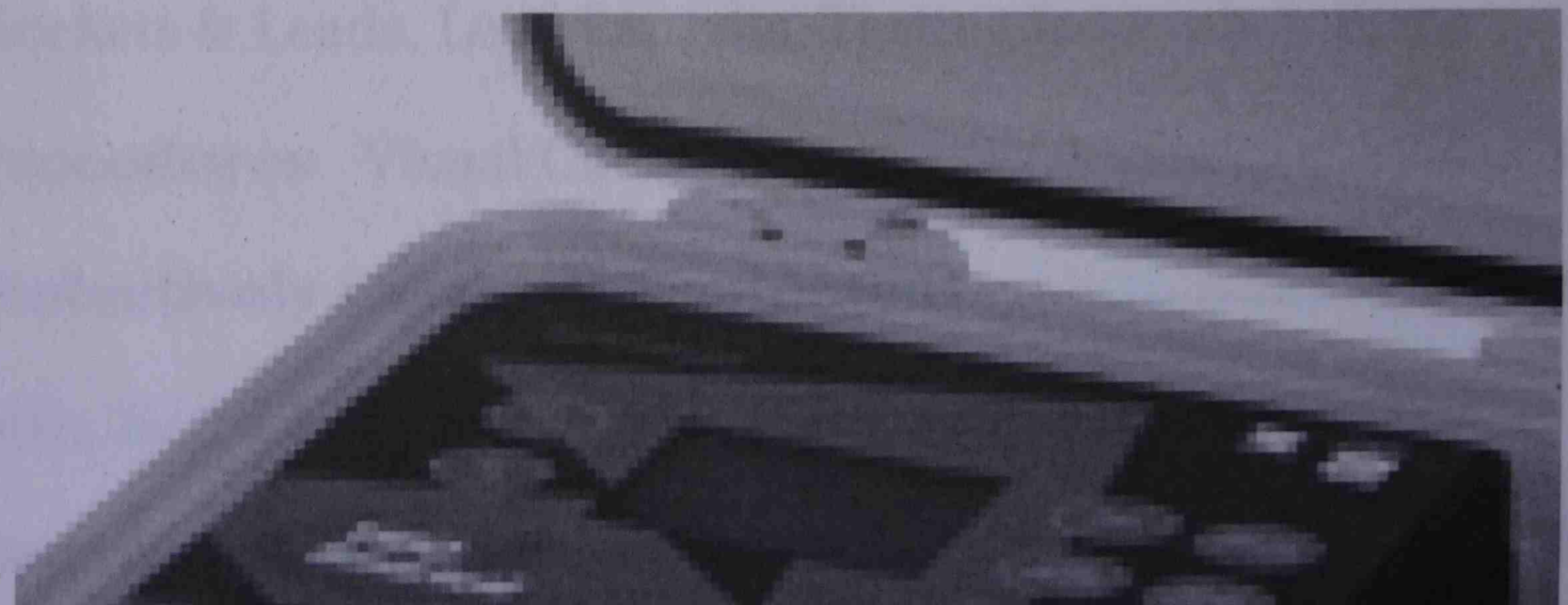
Course No.19341

In-Service Testing of Electrical Equipment

Participant's Manual



Contents

1.0 Introduction ..... **Page 5**

2.0 The Electrical System ..... **Page 6**

3.0 Electric Shock ..... **Page 8**

Electrocution, Sources of Voltage, Voltage levels & the Effects of Electric Current

4.0 Protection Against Electric Shock ..... **Page 12**

Protectively Earthed System (single insulation) & Double insulation (reinforced insulation)

5.0 Standards and Codes ..... **Page 19**

AS/NZS 3760 Electrical Practices for Construction Work

6.0 Persons Qualified to Test Equipment ..... **Page 21**

7.0 Testing Isolating Transformers and Residual Current Devices **Page 21**

8.0 3 Pin Plugs and Sockets Connections and wire colouring .... **Page 22**

9.0 Construction Site Electrical Equipment ..... **Page 23**

Plugs, Sockets & Leads, Lead Lengths, Testing Intervals & Fines

10.0 Testing Procedures Visual Checking ..... **Page 25**

11.0 Class I (Protectively Earthed) Equipment ..... **Page 26**

Visual checks, Earth Resistance Check & Insulation Resistance Test

12.0 Class II Double Insulated Equipment ..... **Page 28**

Earth Insulation Test & Insulation Resistance Test

13.0 Using the SAFE*T*CHECK Pro Logger II ..... **Page 29**

Class I Protectively Earthed Equipment

Class II Double-Insulated Equipment

Checking Extension Leads

14.0 What To Do After Testing is Completed ..... **Page 30**

15.0 Tagging Equipment Tag Colours & Fitting a Tag ..... **Page 31**

16.0 Computer Testing ..... **Page 35**

Equipment check list

Item	Number Of Items	In	Out
Box 1			
Toaster	4		
Nibbler	1		
Portable Mixer	1		
Electric Jugs with bases	2		
Soldering Transformer	1		
Box 2			
Toasted Sandwich Maker	1		
Handheld Blender	1		
Electric Drill	3		
Heat Gun	1		
Soldering Iron	1		
Heaters	2		
Extension Leads	2		
Box 3 assessment items (all marked A, B, C, D, E etc)			
Toasted Sandwich Maker	1		
Toaster	1		
Heater	1		
Extension Lead	1		
Bag Sealer	1		
Electric Drill	1		
Electric Iron	1		
Electric jug (assessment only)	1		

Item	Number Of Items	In	Out
Box 4			
SAFETCHECK ProLogger II tester	8		
ProLogger II Power lead	8		
ProLogger Earth test lead	8		
Steel mesh cover	8		
SEW insulation tester	4		
Multimeter	4		
Other			
Black pens	8		
Laptop	1		
Data Projector	1		
White Board Markers	6		
Portable RCD device (broken)	1		
Fixed RCD	1		
Power board (assessment only)	1		
Power board	1		

Page 2 of 2 parts list

Note: Equipment in the boxes is for practice testing and is in various states of repair.

1.0 Introduction

Module Purpose

To provide instruction in the skills and knowledge needed to identify problems and test the electrical safety of portable equipment in accordance with statutory requirements.

References

AS/NZS 3000:2007 Wiring Rules

AS/NZS 3760-2003 In-Service Safety Inspection & Testing of Electrical Equipment

AS/NZS 3012-2003 Electrical Practices for Construction & Demolition Sites

AS/NZS 3199:2007 "Approval and test specification – Cord extension sets".

Duration of Course

10 hours total

Contacts

WorkCover NSW

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Standards Australia

www.standards.com.au

phone: 1300 65 46 46

fax: 1300 65 49 49

documentation on-line

http://www.saiglobal.com

Assessment

Theory assessment = 30% of the total mark

Practical assessment = 70% of the total mark

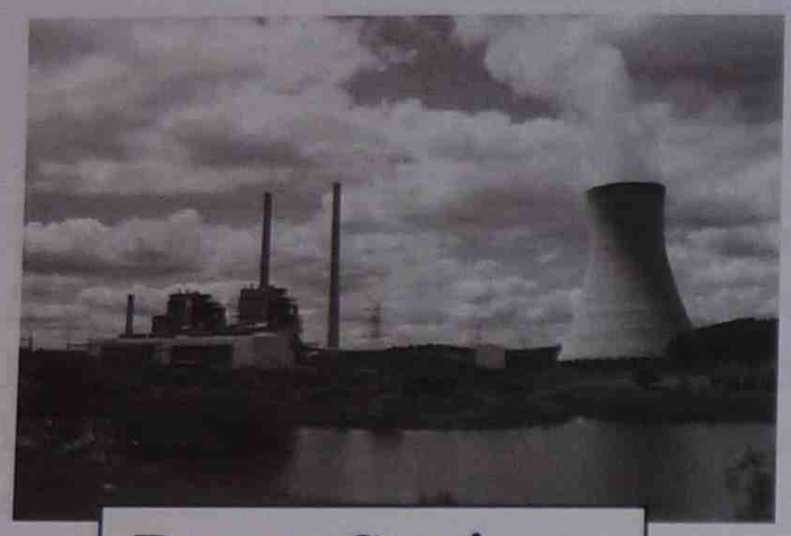
Full competency must be gained in the practical and at least half in the theory. This means a total of 85% must be gained overall.

Assessment

Competency	Assessment Criteria/Learning Outcomes
1.0 Describing basic electrical concepts	• Explain the terms voltage, current, resistance and power. Use correct measurement units • Identify sources of low voltage AC electrical supply • State four effects of current flow • Identify and describe conductors and insulators in terms of their properties and function.
2.0 Demonstrating safety awareness & describing electrical equipment protection	• Describe basic circuit terms and the use of circuit protection devices • Describe the basic plan of a single phase and three phase low voltage supply system • Define the effects of electric shock • List and explain four methods of preventing electric shock • State the properties of extension leads • Identify the correct polarity of cords and sockets.
3.0 Testing electrical equipment for safe use	• List the categories of portable electrical equipment • Demonstrate the correct use of test equipment • Use an approved appliance safety tester • Use a check list to determine the safety of an appliance
4.0 Attaching the correct and completed safety tag	• State the approved inspection and testing intervals for environments where portable appliances are used • List the limitations of this course in respect to inspection and testing of electrical equipment • Make an informed decision if a piece of equipment is suitable for use • State the recommended methods of tagging equipment.
5.0 Completing the correct documentation	Design and implement a suitable recording system for safety inspections and tests.

2.0 The Electrical System

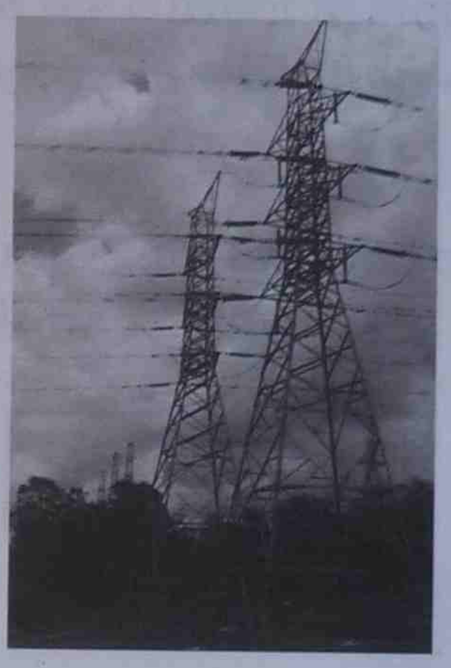
The electrical system currently used in Australia follows the European model of 230volts phase to earth/neutral and 400volts between phases. The following is a description of how this electricity is made and distributed o the customer.



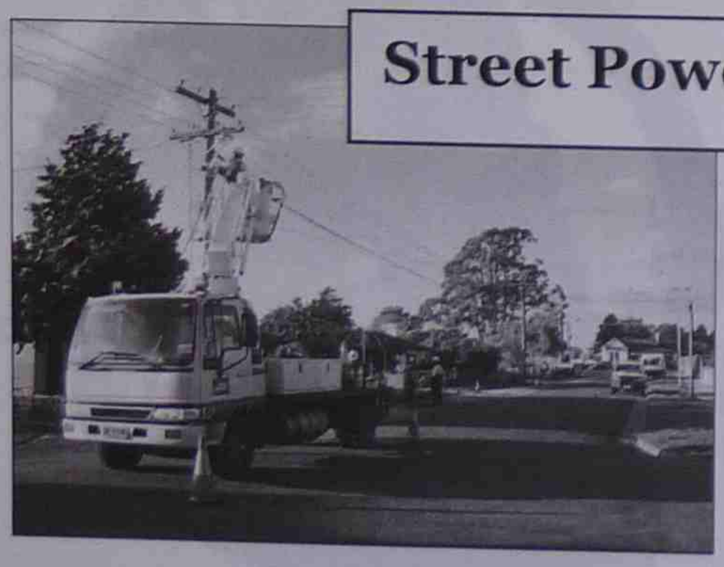
Power Station

Transformer

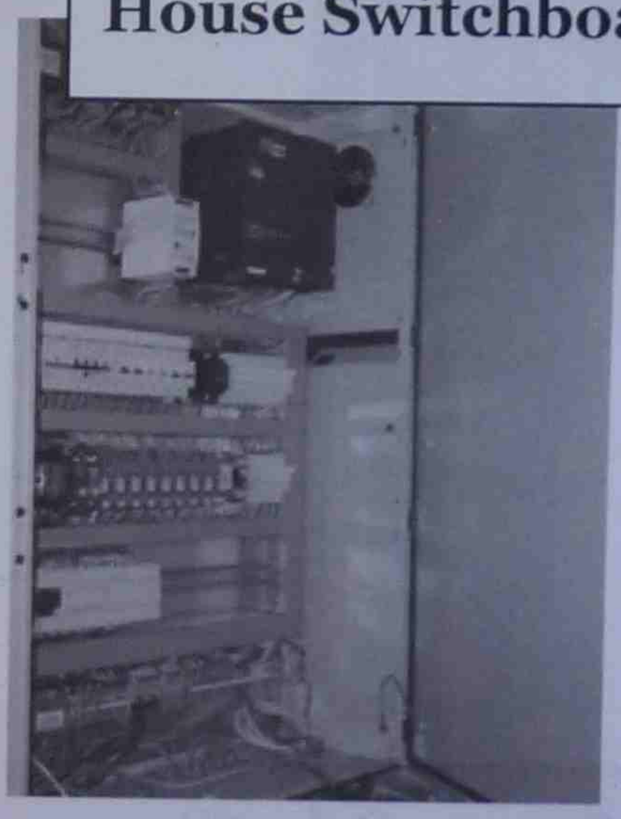
Transformer



Power Lines



Street Power Lines



House Switchboard

3.0 Electric Shock

The human body is controlled by very **small electric currents**. If an electric current from another source such as a power point or generator is allowed to pass through the human body it can interfere with the normal body functions such as breathing or heart beat. If the current goes through certain parts of the body **it can cause the person to die**.

If a person is said to have an **"electric shock"** it does not mean that they have died however if they have been **"electrocuted"** then they have died.

3.1 Electrocution

The most common way to die from electrocution is for the current to stop the chest muscles from working which stops you from breathing. **This will then cause death by suffocation.**

Often the current stops the operation of the heart muscles and so blood circulation will also stop. **This will also cause death by suffocation.**

Shock Current Paths

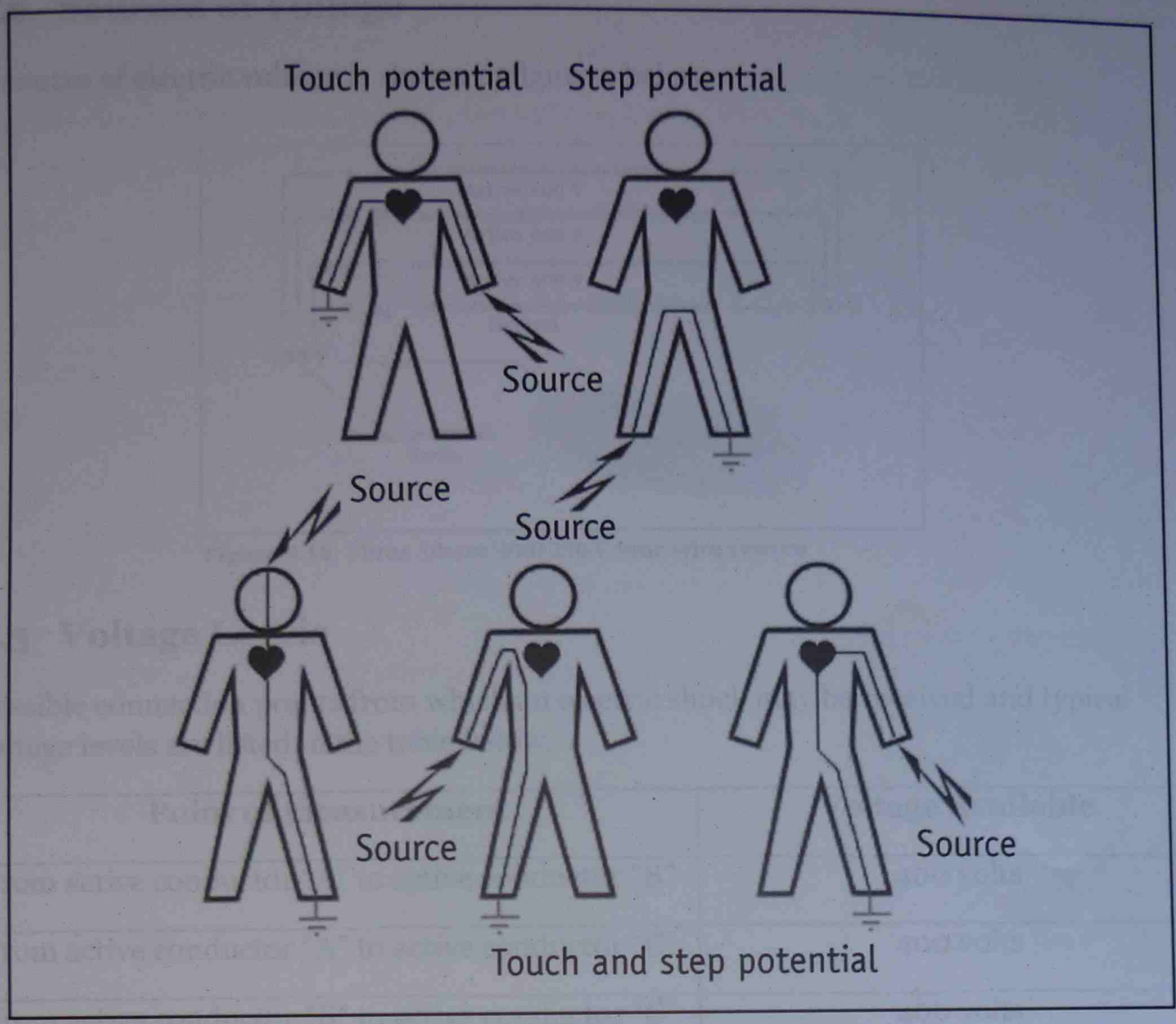


Figure 6.1 Possible current paths through a person

Remember that all electric shocks that are suspected of passing through the heart may prove fatal and should be monitored by medical staff.

3.2 Sources of Voltage

A source of electric voltage is shown in figure 2 below.

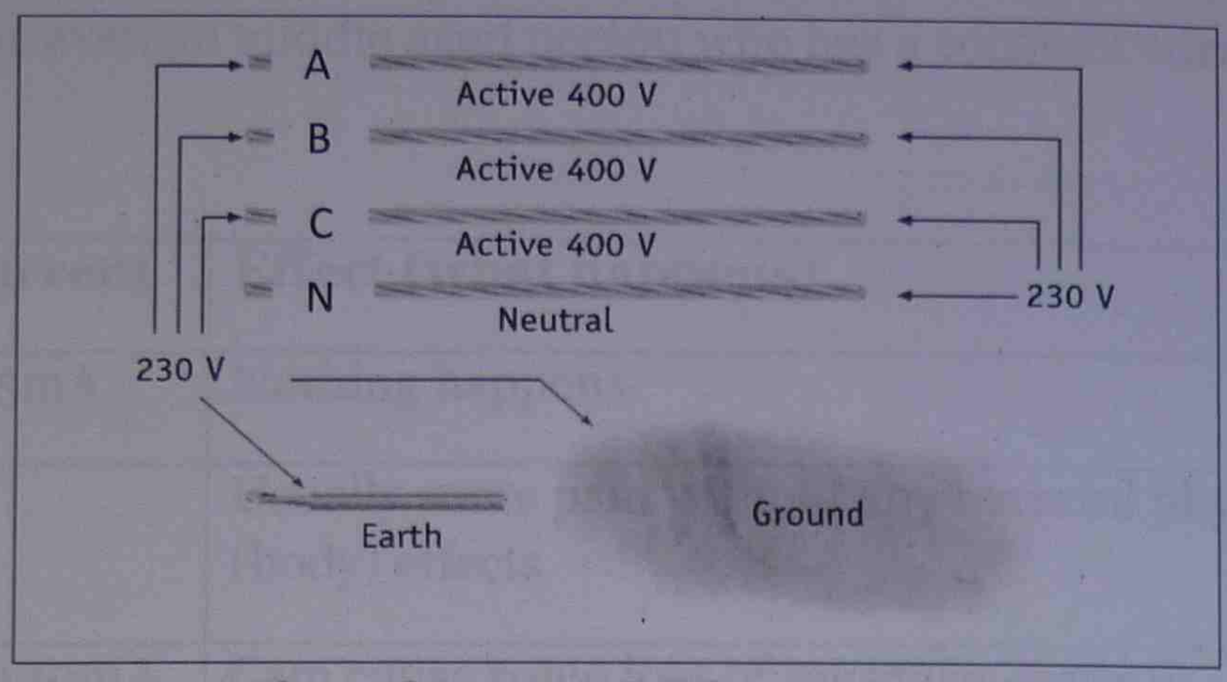


Figure 5.16 Three-phase 400/230 V four-wire system

3.3 Voltage Levels

Possible connection points from which an electric shock may be received and typical voltage levels are listed in the table below.

Point of measurement	Voltage Available
From active conductor "A" to active conductor "B"	400 volts
From active conductor "A" to active conductor "C"	400 volts
From active conductor "B" to active conductor "C"	400 volts
From active conductor "A" to active conductor "B"	400 volts
From active conductor "A" to active conductor "N"	230 volts
From active conductor "B" to active conductor "N"	230 volts
From active conductor "C" to active conductor "N"	230 volts
From active conductor "A" to earth or ground	230 volts
From active conductor "B" to earth or ground	230 volts
From active conductor "C" to earth or ground	230 volts
From active conductor "N" to active conductor "E"	Unknown voltage (it should be 0 volts but it can be enough to be lethal)

3.4 Effects of Electric Current

The effects on a human body caused by passing an electric current through it vary slightly depending on the age and physical condition of the body. The figures in table 2 below are for the average middle aged person who has a constant current applied.

Table 2

Amount of Current	Effect (what happens)
Greater than 0.5mA	Nothing happens
0.5 to 10mA	Usually some pain without any harmful physiological (body) effects
Little more than 10mA	Cam cause some loss of muscular control

Higher values of current than those mentioned in table 2 can cause (depending on the path and duration):

- Problems breathing
- Dangerously high blood pressure
- Heart problems such as Atrial Fibrillation and Transient Cardiac Arrest

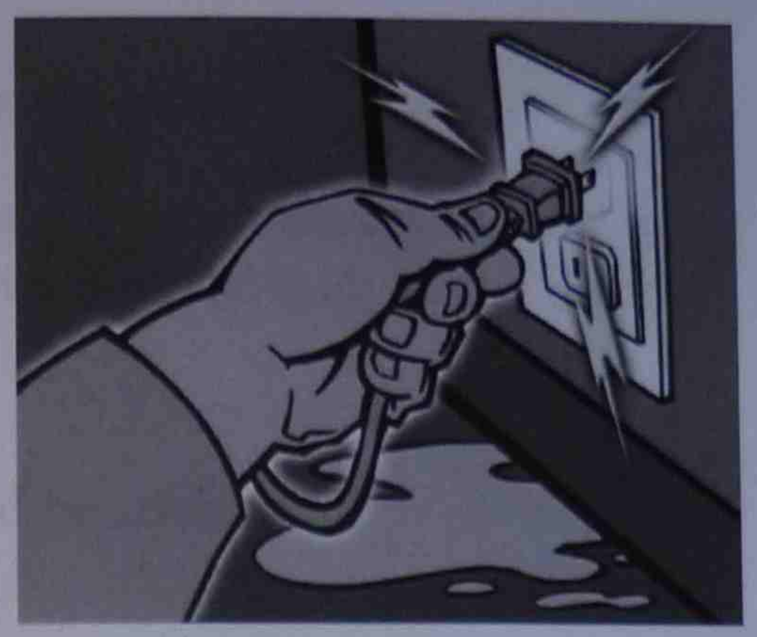
As long as the time is shorter than one second these effects usually disappear and everything returns to normal when the current flow stops.

If the period of current flow is longer than one second, often Ventricular Fibrillation can lead to death (electrocution).

4.0 Protection Against Electric Shock

There are three methods used to stop people and animals (as per AS/NZS 3000:2007) from accidentally getting an electric shock:

1. Double insulation
2. Protective earthing
3. Isolating transformers



4.1 Protectively Earthed Systems (single insulation)

In this method the aim is to ensure that a fuse or circuit breaker will immediately disconnect any device in which the conductive material that is in contact with single insulated wiring may be touched by a person using it.

This method is referred to in the Australian Standard AS/NZS 3000, as protection method Class I. It gives the user two levels of protection: ***(1) the single insulation used on the live equipment inside the device; and (2) the earthed conductive container.***

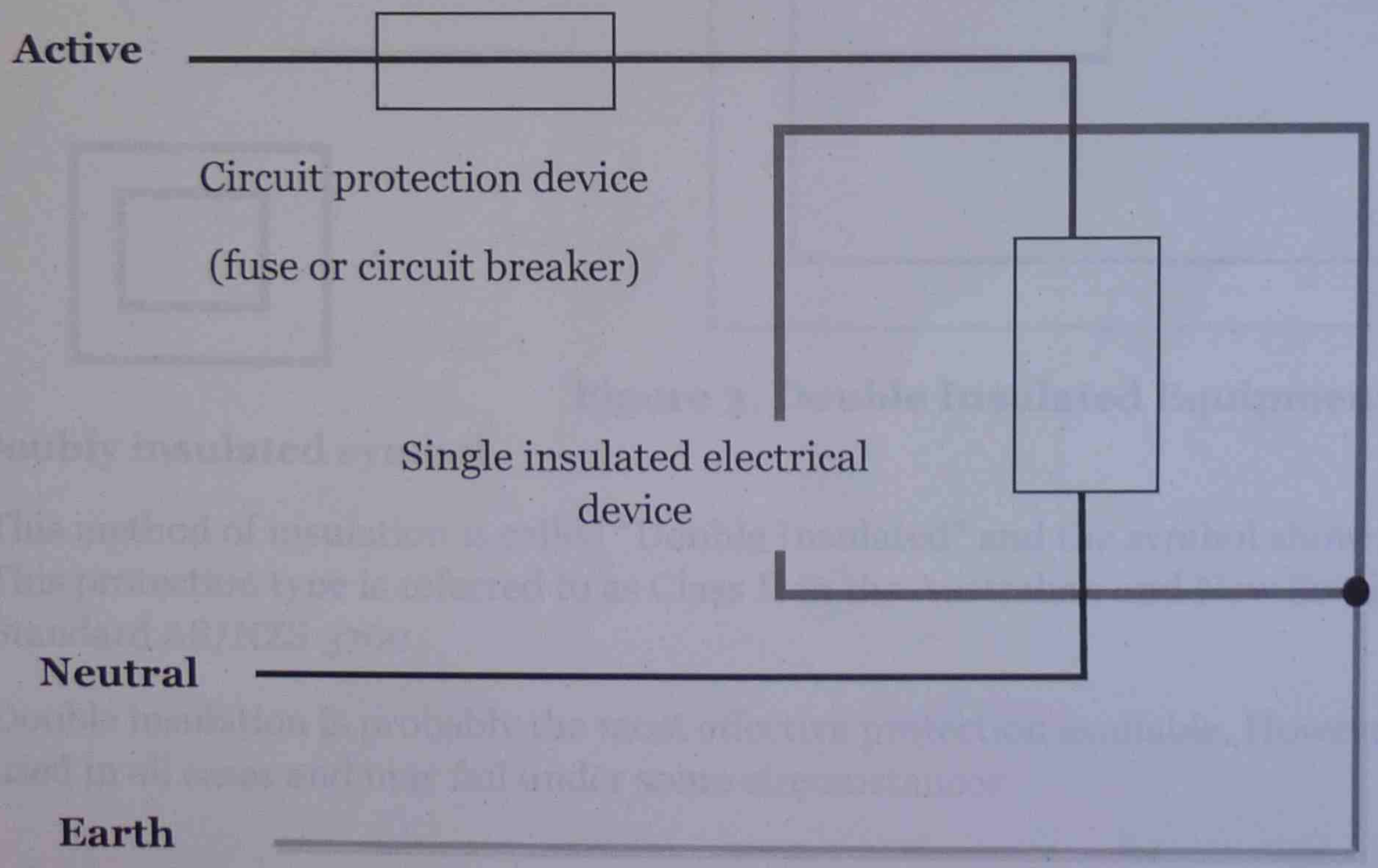


Figure 4. Protectively Earthed Appliance

If the earth connection is poor or broken, exposed conductive parts of the equipment will become alive when an insulation breakdown happens. **Failure of the earthing conductor causes up to 30% of all electrical fatalities in Australia.**

4.2 Double Insulation (reinforced insulation)

The user is protected by two layers of electrical insulation which covers the live wires and parts in the device and a non conducting plastic used as the body of the device.

No earthing of the device is required and none should be attempted.

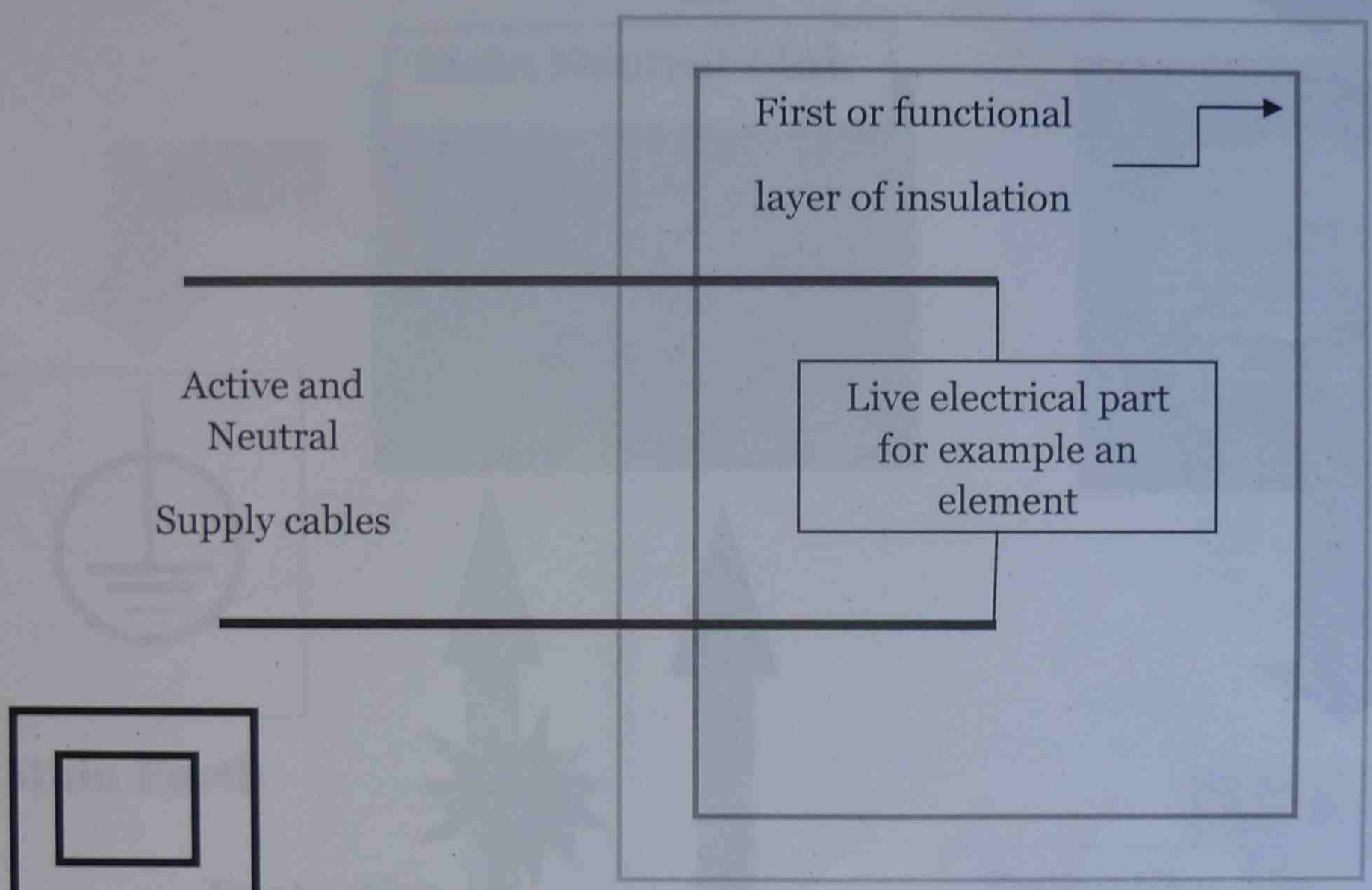


Figure 3. Double Insulated Equipment

Doubly insulated symbol

This method of insulation is called "Double Insulated" and the symbol shown above. This protection type is referred to as Class II in the Australian and New Zealand Standard AS/NZS 3760.

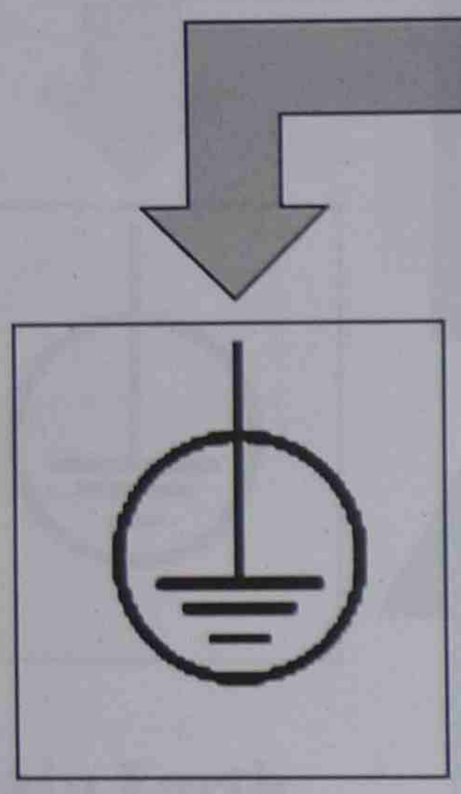
Double insulation is probably the most effective protection available. However it can't be used in all cases and may fail under some circumstances.

Supply

Transformer

Supply Authority Fuse
100Amps

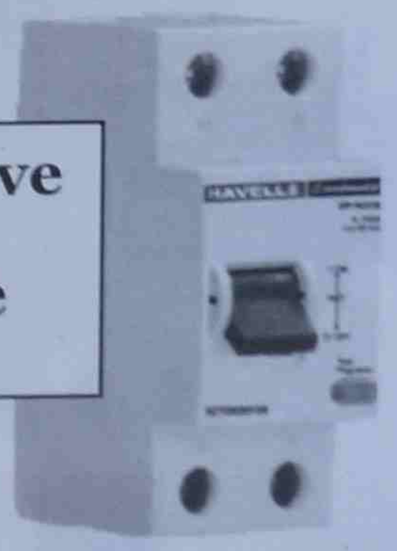
Main Neutral Link



Main Earth

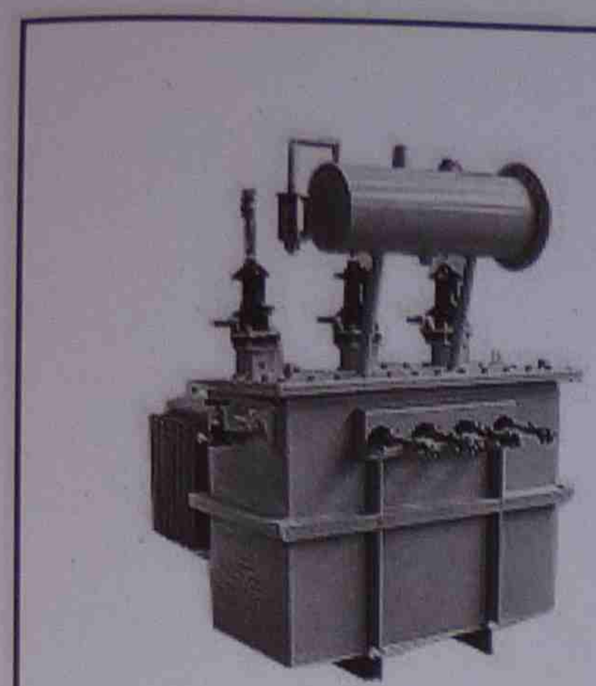
Protective
Earth

BROKEN



Protective
Device

Short circuit Active to Earth - No Earth connected

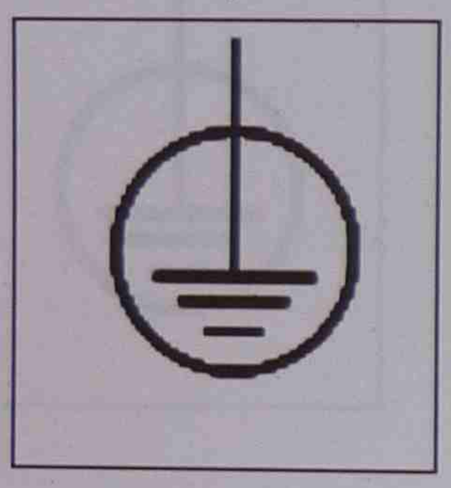


Supply

Transformer

Supply Authority Fuse
100Amps

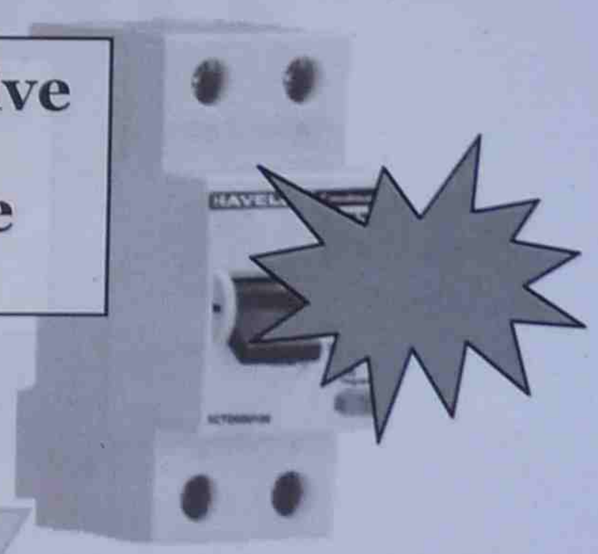
Main Neutral Link



Main Earth

Protective
Earth

Protective
Device



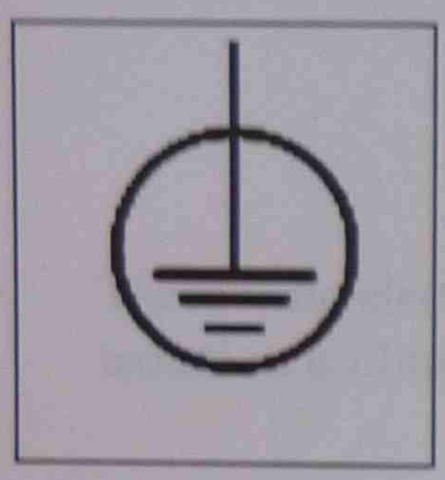
Short circuit Active to Earth – Fuse blows

Supply

Transformer

Supply Authority Fuse
100Amps

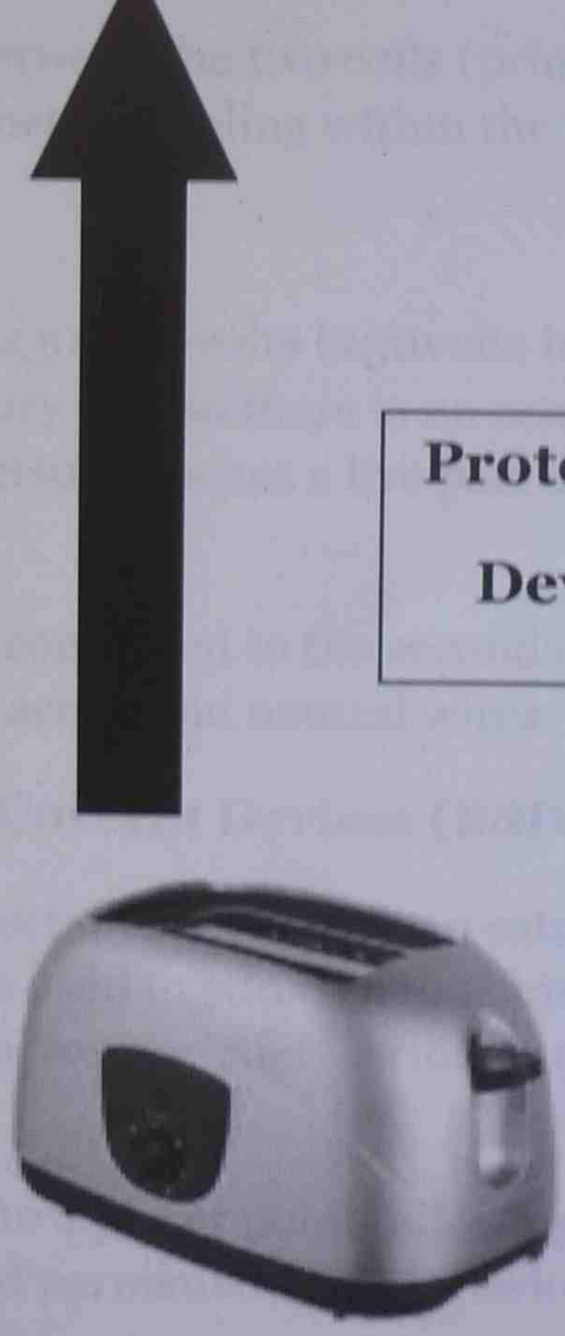
Main Neutral Link



Main Earth

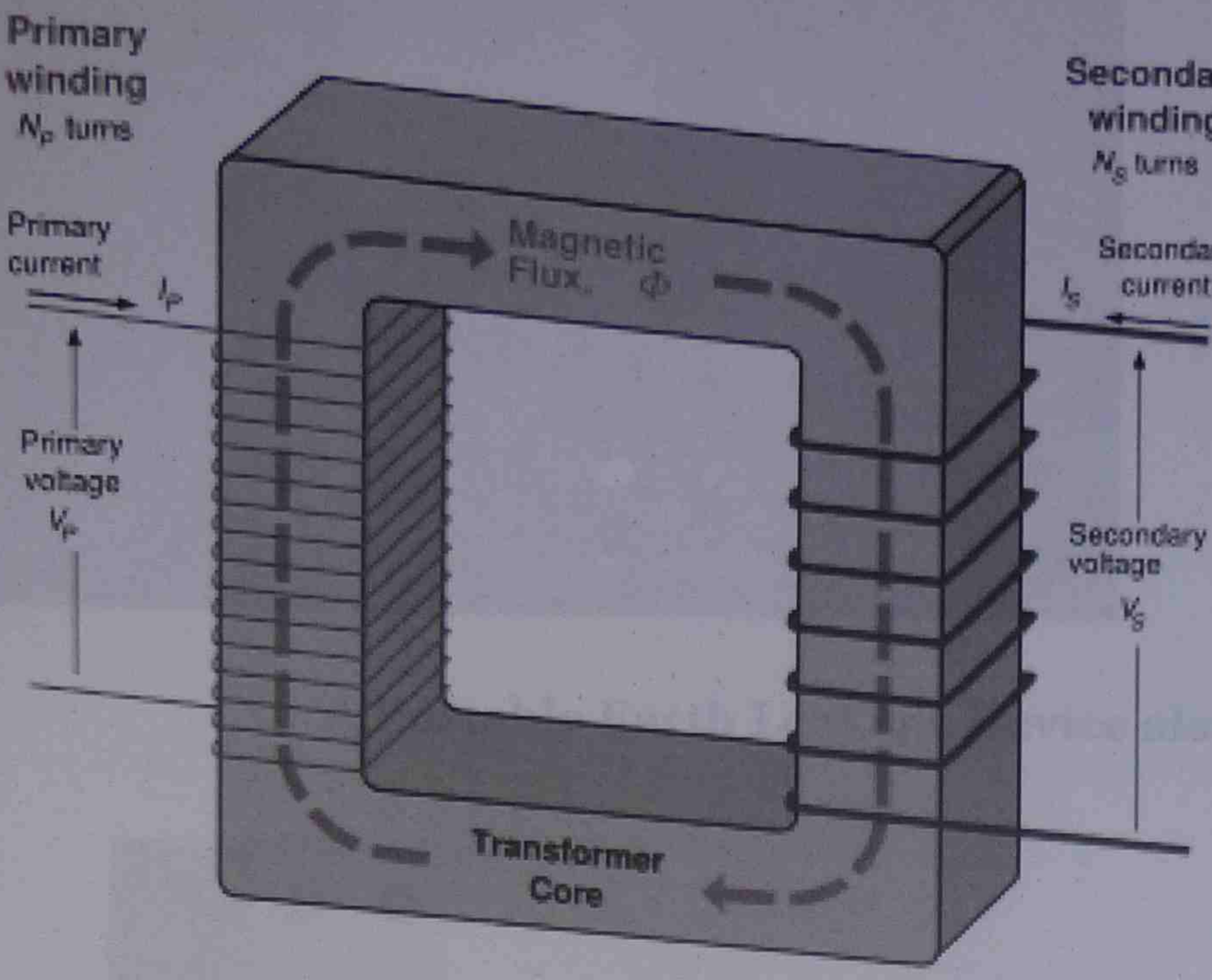
Protective
Earth

Protective
Device



Circuit Normal – No Faults

4.3 Isolation of Supply Using an Isolation Transformer



There is no electrical connection between the two coils (primary & secondary) and isolation is obtained from the magnetic coupling within the transformer iron core.

Isolation transformers are usually 230/230volts (230volts in and 230volts out). There is no earth connection on the secondary side so there is no return path to the main earthing system. This means if a person touches a live part of the secondary side then the electricity has nowhere to go.

Note that there should be no earth connected to the secondary coil. An electric shock can still be obtained from touching the active and neutral wires.

4.4 Supplementary Residual Current Devices (RSD)

To make sure that maximum protection is available, an extra device called a "safety switch" is used. The switch may be used in addition to a protective earth or double insulated protection methods. The use of a safety switch is now mandatory in most places, especially building sites.

A safety switch may be plugged into a power point (allowing other devices to be plugged into it) or may be installed permanently at the switchboard.

A Portable Earth Leakage Device also known as an RCD.

A Fixed RCD

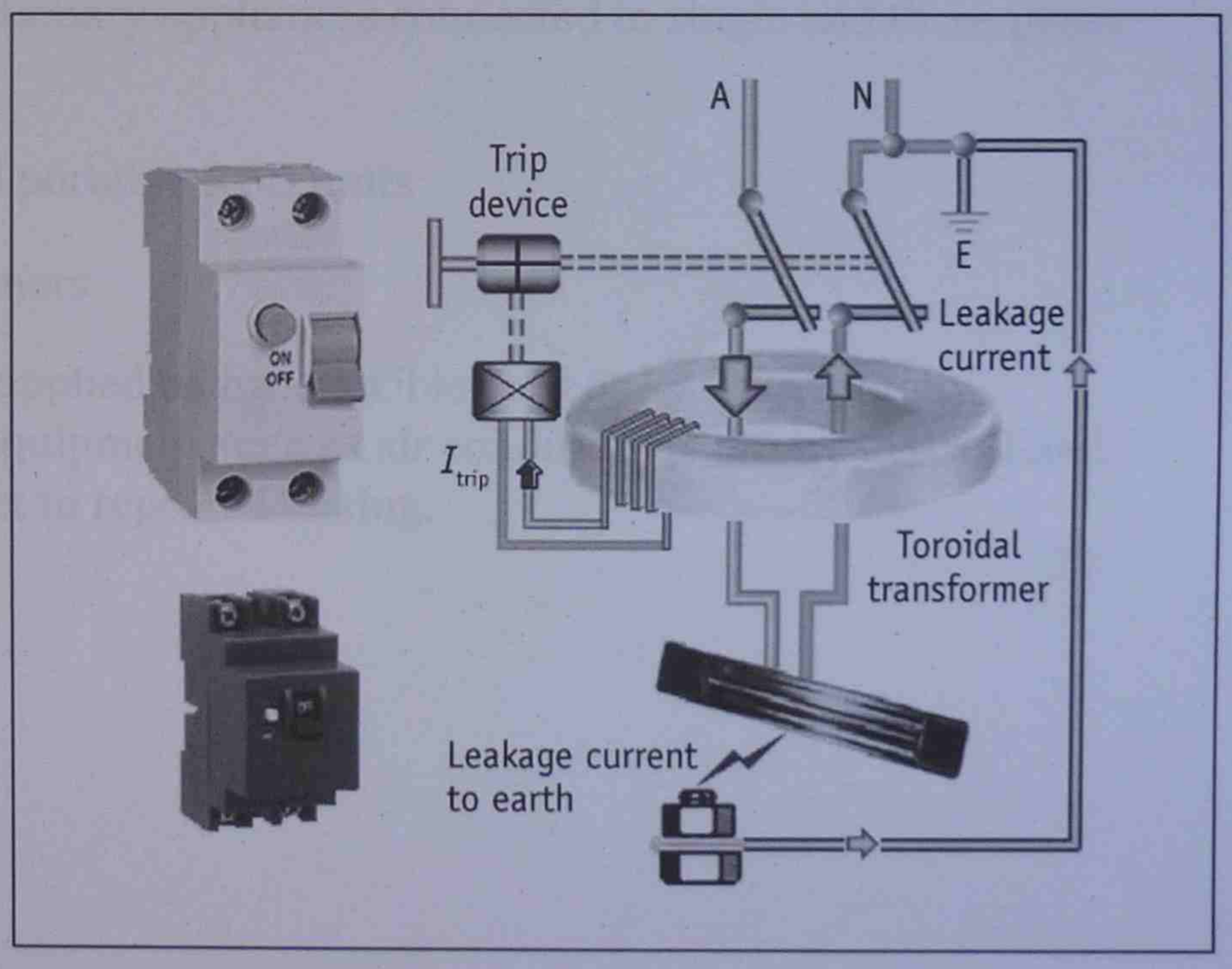


Figure 4.11 RCD showing leakage current to earth

5.0 Standards and Codes

5.1 AS/NZS 3760 Electrical Practices for Construction Work

AS/NZS 3760:2003
(Incorporating Amendment No. 1)

Australian/New Zealand Standard™

In-service safety inspection and testing of electrical equipment

(accessed 13/08/2010: http://www.saiglobal.com/PDFTemp/Previews/OSH/as/as3000/3700/3760-2003(+A1).pdf)

This is the standard that covers the testing of:

- Flexible cords
- Flexible extension sets and portable outlet devices
- Portable hand held and stationary appliances connected to single and three phase low voltage supplies
- Equipment that is supplied portable RCD units
- Portable isolation transformers.

Any electrical equipment that is supplied using a flexible cord or lead is generally considered to be portable. Some equipment such as air conditioners are treated as fixed equipment if the lead is not subject to repeated flexing.