



THE AUSTRALIAN NATIONAL UNIVERSITY

OCCUPATIONAL HEALTH AND SAFETY UNIT

**Safety Performance Requirements  
for  
240 V Electrical Appliances**

## Topic 1

### SCOPE

This course introduces participants to the principles of electrical safety in regard to the use of electrical appliances, and includes:

- The hazard of electric shock and the appropriate resuscitation response,
- The fundamentals of visual inspection and the safety performance requirements of single phase electrical appliances,
- The testing of an electrical appliance for these safety performance requirements using the Trio Electrix Safe T Check, MkD.

The target audience is ANU staff and post-graduate students wishing to be approved by Budget Unit management to inspect and test electrical appliances. Additionally, the course provides essential background information for persons wishing to be approved by Budget Unit management for other work associated with electrical appliances (see [Electrical Safety](#), Section 2.4 and Appendix C).

This course does **NOT** cover the vast technical practice governing the design, manufacture and installation of the electrical installation or the design and construction of electrical appliances.

**Only licensed electricians** are permitted to work on the electrical installation. The electrical installation is the fixed wiring and equipment connected to it, other than electrical appliances connected by flexible leads.

## Topic 2

### ELECTRIC SHOCK and RESUSCITATION TECHNIQUES

Electric Shock is when electricity is conducted through any part of the body at a sufficient current to cause uncontrolled reactions such as muscle contraction, cardiac problems, inadequate breathing, shaking, sweating, etc. Even very low voltages (<40 volts) under the right conditions can cause electric shock and may even lead to electrocution (death resulting from an electric shock)

Electricity, sometimes referred to as an 'unseen killer' has unpredictable effects on a victim. The current involved, the contact time, the current path through the body all impact on the outcome. Muscles initially contract. Avoid touching with front of your hand first. Muscle contraction may propel you away from or into more danger. Work should be carried out in an open environment. Obviously the shorter the contact the better. Prolonged electric shock can cause internal and/or external burning especially at high currents. Current passing near or through the heart can upset or stop its rhythm. Avoid working with two hands where the current path may be directly across your chest.

If you come across a trauma casualty, one reason for which is a possible electric shock, always use **the DRABCD technique**.

#### **2.1 Danger (Safety), Response, Airway, Breathing, Compression, Defibrillation.**

##### **DANGER (Safety).**

The danger is to you, bystanders or the casualty. The first task in electric shock cases is to **isolate** the electricity. For low voltage (240/415), if switching off is not practical, 'pull or push the casualty clear of the electrical contact using dry non-conducting material (wood, rope, clothing, plastic, or rubber). Do not use metal or anything moist.

For high voltages, **wait** until the electricity is turned OFF (avoid approaching the casualty, you may become part of the circuit). Once you and the casualty are clear of danger send for help.

##### **RESPONSE.**

Check for response, gently shake and loudly shout at the casualty.

Is the casualty:

1. Alert
2. Drowsy or confused
3. Unconscious, but reacting
4. Unconscious with no reaction

If unconscious, place the casualty in the stable side position.

## **AIRWAY.**

Check for the following:

1. Is the airway open and clear?
2. Is there noisy breathing?
3. Are there potential obstructions, if so open and clear the airway.

If the casualty has false teeth and they remain in place then leave them in place, as they will help in giving mouth-to-mouth resuscitation if necessary.

## **BREATHING.**

**Look** to see if the chest rises.

**Listen** for the sound of breathing.

**Feel**, by putting your hand on the lower part of the chest.

If casualty is not breathing, give 2 effective breaths and commence CPR  
**(Cardiopulmonary Resuscitation):**

### **A. Mouth to Mouth Resuscitation**

- Tilt the head back and raise the chin forward
- Pinch the casualty's nose
- Place your mouth over the casualty's mouth
- Blow into the casualty's mouth and observe chest inflate

### **B. Mouth to Nose Resuscitation**

- Close the casualty's mouth
- Lift and tilt chin
- Blow into casualty's nose and observe chest inflate.

### **C. Mouth to Mask Resuscitation**

This is the most desirable method for rescue breaths as it lessens the risk of cross-infection and is more acceptable to many people than mouth-to-mouth. Masks are available in a various forms but are used in a similar way.

- Fit mask firmly over the casualty's nose and mouth; deliver rescue breaths via valve or tube.
- Rescue breaths must be effective, and considered effective if the chest rises and falls with each breath delivered.

## COMPRESSION

If breathing absent start CPR (**Cardiopulmonary Resuscitation**) as per the following table.

Age range	Adult 9 years or older	Child 1 – 8 years	Infant Newborn to 12 months
Compress with	2 Hands	2 Hands	2 Fingers
Rate, Depth, And point of compression	100 per minute 1/3 depth of chest Middle of the chest	100 per minute 1/3 depth of chest Middle of the chest	100 per minute 1/3 depth of chest Middle of the chest
Initial breaths and duration	2 initial breaths 1 second	2 initial breaths 1 second	2 initial breaths 1 second
Compression: Breaths	30:2	30:2	30:2



When the casualty's normal breathing returns, cease resuscitation and move the casualty into the coma position. Keep a constant watch on the casualty to ensure they do not cease breathing again, until trained assistance takes over.

## DEFIBRILLATION

Defibrillation is an emergency procedure involving an Automated External Defibrillator (AED). The device delivers a controlled electric shock to the casualty's heart through adhesive pads that are placed onto the chest of a cardiac arrest casualty.

## Topic 3

### VISUAL INSPECTION and SAFETY PERFORMANCE REQUIREMENTS for ELECTRICAL APPLIANCES

Electrical appliances are generally “safe” because a number of safety performance requirements have been included in their construction (and use). These safety performance requirements include:

- sound physical construction,
- insulation,
- earthing,
- continuity.

This topic provides details of these safety performance requirements, and commences with details of the visual inspection that should be undertaken (before testing) on each appliance to confirm it is of sound physical construction.

#### 3.1 General Visual Inspection

- Disconnect the appliance from the power point.
- Visibly check the power plug looking for:
  - Bent or broken pins
  - Exposed wiring at either end on appliance cord.
- Are all plugs and sockets appropriate for Australian usage?
- Run hand along the cable checking for nicks, cuts, joins/insulation tape, frayed wiring etc.
- Check if shroud/cord protector is still correctly fitted, and capable of stress
- Is the housing serviceable, all fixing screws and covers secure?
- Inspect switches/speed controls for mechanical operation. Ensure that they are clear of obstruction from grease, metal particles, dirt and dust, etc.
- Is all appropriate guarding fitted and secure?
- Look for name/compliance plate, checking for double insulated symbol; this will indicate if the unit has undergone the Australian Standards testing for certification of safety.
- Is a legible power consumption plate affixed?
- Ensure that the appliance has been through testing laboratories.
- An electrical smell can be a sign of fusing from loose wiring.
- Unroll extension leads fully and subject them to check as above.

**Note:** Any equipment failing a General Visual Inspection should not be further tested with the Safe T Check. The equipment **MUST** be removed from service and referred to a qualified electrician or electronics technician for further assessment.

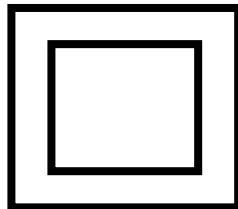
### 3.2 Insulation

The insulation keeps electricity IN and constrains it to “safe” locations within the appliance.

Visual inspection and safety performance testing verifies the insulation meets performance requirements.

Insulation has specifications for electrical resistance, mechanical strength, and temperature.

Appliances are generally constructed as single-insulated appliances (additionally protected by earthing) or as double-insulated appliances (without earthing). A double insulated appliance is identified by the words ‘DOUBLE INSULATED’ or by the international symbol of a small square overlaid by a larger square:



#### Electrical Resistance.

- Minimum insulation resistance between mains conductors and earth 1 Mohm. (Exception, heating elements may be considered in specification down to 10 kohm)  
[240 V equipment is to be tested at 500 V<sub>dc</sub> ; higher voltage equipment to be tested at 1000 V<sub>dc</sub>]
- Double insulated appliances do not have an earth pin. They are tested by wrapping a conducting ‘bandage’ around the appliance (at parts normally handled) to provide the ‘earth’ connection for the test instrument.

#### Temperature.

Insulations of different composition can maintain their performance at different temperatures. Typical temperature ratings for common insulation materials are:

- PVC: 0 - 75 °C
- silicone rubber: 20 - 90(or 150 or 200) °C
- mineral insulation: 0 - 90 °C

Note: Mains-rated cables normally have their maximum temperature coded and printed on the cable.

### 3.3 Earthing

Earthing is the dedicated wiring within a single-insulated appliance designed solely to carry any fault current from failed insulation. All *exposed metal* on the appliance must be earthed, if not double-insulated. Earth connections should be by purpose specific screw or bolt.

*Exposed metal* is any conductor, which after breakdown of internal insulation, may become live, and be touchable by the *standard test finger*. The *standard test finger* is an electromechanical device of similar dimension (80 mm long × 12 mm diameter) and jointing as an adult male finger.

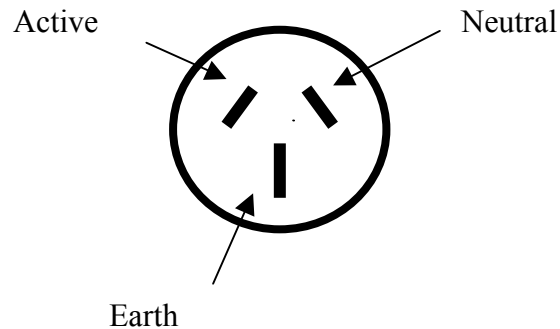
Extension leads **MUST** have an earth wire and connection no matter what their intended use may be at the time of construction.

#### Earthing.

- Resistance of appliance earth between exposed metal and the plug earth connection should not exceed 0.5 ohm.  
(Exception, for rotating or oscillating exposed metal the resistance should not exceed 1.5 ohm)
- Resistance between exposed metal to main earth connection at the switchboard must be low enough to operate the switchboard's protective device(s), or 2.0 ohms whichever is lesser.
- Earth conductors must have the capacity to carry the fault current. Their cross sectional area must be 0.5 sq mm or equal to the cross sectional area of the active, whichever is the greater. Note that the fault current could be as high as 25 A.

### 3.4 Electrical Continuity

The electrical installation provides supply via an active wire (as the current supplier), a neutral wire (for the current return) and an earth wire. The position of active, neutral and earth on a general power outlet (i.e. wall outlet socket and switch) from the electrical installation is as shown below:



When the plug from an appliance is fitted to this outlet socket, it is essential for electrical safety that the active, neutral and earth pins of the appliance match those of the socket outlet.

The *electrical continuity* test for an appliance confirms the correctness of these connections. The *electrical continuity* test for an extension lead confirms the correctness of the connections at both ends of the lead.

### 3.5 Insulation Colour

The recommended colours for flexible wiring used for supply cords on appliances in Australia are:

<b>Earth:</b>	green/yellow
<b>Active:</b>	brown, black, white or orange
<b>Neutral:</b>	blue

Watch out for overseas equipment. USA, European, etc. equipment do not use the same colour codings.

## TOPIC 4

### TESTING an ELECTRICAL APPLIANCE using the Trio Electrix Safe T Check, MkD

*Be diligent in undertaking the testing of an electrical appliance. If in doubt, the electrical appliance should be removed from service and referred to a qualified electrician or electronics technician.*

*Your contribution is appreciated; it will reduce the risk from the electrical hazard to persons using the appliance.*



#### 4.1 The Safe T Check, MkD

Once the appliance has passed the initial General Visual Inspection, you should now be able to identify whether the appliance is one of the following:

- earthed appliance, or
- double insulated appliance, or
- extension cord.

The Safe T Check, MkD appliance tester will put the electrical appliance through an automated series of checks, that assess whether the appliance conforms to the safety performance requirements for:

- insulation,
- earthing,
- continuity.

Note: If any doubt exists about the appliances design, then the appliance should be checked as an EARTHED APPLIANCE.

#### 4.2 Safety Testing of an Earthed Appliance

##### Preparation of an Earthed Appliance for Testing.

- A) Confirm the appliance has passed the General Visual Inspection (Section 3.1).
- B) Disconnect the appliance to be tested from the electrical installation by removing its plug from the power point.
- C) Turn any switches on the appliance 'ON' to establish electrical continuity for the appliance.
- D) If the appliance to be tested has a variable speed control fitted, turn the control to the fully 'ON' position or on to the highest speed. This will connect active/neutral directly to the internal windings.

##### Safety Testing of an Earthed Appliance with the Safe T Check, MkD

- A) Plug the Safe T Check into a power point and turn it on.
- B) Make sure the Safe T Check is in the 'self-test' mode i.e. the meter reads 'CHECK'.
- C) Plug the appliance to be tested into the socket labelled TEST USE ONLY provided on the front panel of the Safe T Check.

Note: The appliance to be tested must be connected directly into the Safe T Check and not via an extension lead.

Note: If an earthed appliance is fitted with a very long lead it may fail the earth continuity test because of excessive earth-lead resistance.

- D) Connect the GREEN earthing lead to the Safe T Check via the green terminal.

- E) Connect the opposite GREEN end to a convenient metal (conductive) portion of the appliance being checked.

Note: If an earthed appliance has a number of metal surfaces, which are possibly not connected together, then the each metal surface must be tested in turn with the EARTH clamp connected to each metal surface.

- F) Select the **EARTHED APPLIANCE** testing parameters by pressing the keypad marked 'earthed appliance' in the green/yellow section of the panel. Upon this selection the Safe T Check will automatically set-up test parameter thresholds to test earth appliances. The previously flashing LED will extinguish. The 'CONFIRM' LED will commence flashing.
- G) Confirm the connection of the green earth lead to the tester and the appliance under test by pressing the confirm button. Previously flashing 'CONFIRM' LED will extinguish. The 'TEST' LED will commence flashing.
- H) Start the tests by pressing the 'START' pad. The 'TEST' LED will stop flashing and will illuminate continuously during the testing cycle. During the testing cycle the operator may apply stress to the appliance supply lead and plug in order to detect any intermittent faults.
- I) Test results be indicated via:
- ◆ Meter indication 'PASS or 'FAIL'
  - ◆ Fault indication, red LEDs:
    - electrical continuity
    - earth continuity
    - extension lead
    - insulation
  - ◆ Audible enunciator.

**WARNING:** Upon completion of a successful safety test and removal of test lead, please ENSURE ALL SWITCHES / SPEED CONTROLS on the appliance are returned to the OFF position.



### 4.3 Safety Testing of a Double-Insulated Appliance

#### Preparation of the Double-Insulated Appliance for Testing.

- A) Confirm the appliance has passed the General Visual Inspection.
- B) Disconnect the appliance to be tested from the electrical installation by removing its plug from the power point.
- C) Turn any switches on the appliance 'ON' to establish electrical continuity for the appliance.
- D) If the appliance to be tested has a variable speed control fitted, turn the control to the fully 'ON' position or on to the highest speed. This will connect active/neutral directly to the internal windings.
- E) Wrap the appliance with the conductive bandage supplied, taking care that the bandage makes contact with all exterior metal fittings and the exterior of the appliance where hand contact routinely occurs.

Note: The conductive bandage maybe woven metal cloth mesh, conductive braid, aluminium foil, or other suitable flexible conductor with low resistance (less than 100 ohms).

Note: The wrapped appliance should be on an insulated bench to avoid earthing the measurement circuit in the Safe T Check.

#### Safety Testing of a Double-Insulated Appliance with the Safe T Check, MkD

- A) Plug the Safe T Check into a power point and turn it on.
- B) Make sure the Safe T Check is in the 'self-test' mode i.e. the meter reads 'CHECK'.
- C) Plug the appliance to be tested into the socket labelled 'TEST USE ONLY' provided on the front panel of the Safe T Check.

Note: The appliance to be tested must be connected directly into the Safe T Check and not via an extension lead.

- D) Connect the conductive bandage to the blue socket for DOUBLE INSULATED APPLIANCES on the Safe T Check.
- E) Select DOUBLE INSULATED test by pressing the membrane pad marked 'double insulated' in the blue section of the 'Select Option' panel. Upon this selection command the Safe T Check will automatically set up test parameters to test double insulated appliances. Previously flashing select LEDs will extinguish. The 'CONFIRM' LED will commence flashing.
- F) Confirm the connection of the conductive bandage wrapped around the appliance under test to the Safe T Check by pressing the 'CONFIRM' membrane pad. The Safe T Check will check that the conductive bandage and connecting lead are correctly applied, since the correct establishment of an earthed test environment is vital to the correct verification of insulation resistance in a double insulated appliance. The verification of a correctly wrapped and connected conductive bandage is made by the Safe T Check by

measuring the capacitance between the electrical circuit in the double insulation and the conductive bandage. If the verification test passes, the LED indicator will show steady illumination and the 'START TEST' LED will flash prompting the next sequence of the test.

Note: Failure of this verification for double insulation appliances may be for one or more of the following reasons:

- 1) The double insulated appliance is not correctly wrapped or connected to the blue socket for double insulated appliances.
  - 2) The assumed double insulated appliance is, in fact, an earthed appliance and the incorrect identification and/or an incorrect test selection has been made.
  - 3) The double insulated appliance is connected to the Safe T Check via an extension cord.
  - 4) The appliance is earthed via another path such as metal-earthed bench.
  - 5) Both active (A) and neutral (N) leads are open circuited in the appliance. E.g. failure to turn the appliance switch(s) 'ON'.
  - 6) The resistance of the conductive bandage around the appliance is too high.
  - 7) The appliance has extremely low inherent capacitance between the external surface and the internal electrical circuit. This may apply to some very small appliances with minimum internal circuitry e.g. a plastic bed lamp.
- G) Start tests on the double insulated appliance by pressing the 'START' membrane pad. The test LED will stop flashing and will illuminate continuously during the test cycle. During the test cycle the operator may apply stress to the appliance supply lead and plug in order to detect any intermittent faults.
- H) Test results be indicated via:
- ◆ Meter indication 'PASS or 'FAIL'
  - ◆ Fault indication, red LEDs:
    - electrical continuity
    - earth continuity
    - extension lead
    - insulation
  - ◆ Audible enunciator.

#### 4.4 Safety Testing Extension Leads

- A) Confirm the extension lead has passed the General Visual Inspection.
- B) Plug the Safe T Check into a power point and turn it on.
- C) Ensure the Safe T Check is in the 'self-test' mode i.e. the meter reads 'CHECK'.
- D) Plug the ends of the extension lead into the plug and the socket labelled 'TEST USE ONLY' provided on the front panel of the Safe T Check.

**Note:** If the extension lead has a fixed socket (as in extension reels), this must be connected to the fixed test plug on the Safe T Check with a short extension lead of the same rated voltage and current, which has been previously tested and verified safe.

- E) Select 'EXTENSION LEAD' test by pressing the membrane pad in the orange section of the graphic membrane panel. Upon this selection command, the Safe T Check will automatically set up test parameters to test extension leads and change the Earth threshold set point from 0.2 to 1.0 ohm.
- F) Previously flashing select LEDs will extinguish, and the start test indicating LED will be flashing, thus prompting the operator to the next step.
- G) Start tests by pressing the 'START' membrane pad. The LED will stop flashing and will illuminate continuously during the test cycle. During the testing cycle the operator may apply stress to the lead and plug in order to detect any intermittent faults.
- H) Test results be indicated via:
  - ◆ Meter indication 'PASS or 'FAIL'
  - ◆ Fault indication, red LEDs:
    - electrical continuity
    - earth continuity
    - extension lead
    - insulation
  - ◆ Audible enunciator.



#### 4.5 Evaluation of In-Service Testing Results

Any appliances FAILING the Safe T Check test must be:

- marked FAIL and taken out of service, and
- referred to a qualified electrician or electronics technician for further assessment.

Note: If any doubt, refer the appliance to a qualified electrician or electronics technician.

#### 4.6 Some technical difficulties that have been experienced when testing double insulated appliances

Experience has highlighted difficulties with the testing of some double-insulated appliances; this is mainly due to the design and construction of the appliance.

A number of double-insulated appliances are now being constructed with their electrical circuits fully encapsulated in plastic casing to further improve electrical safety. For an appliance of this design, it makes it difficult for the Safe T Check, MkD to detect an electrical circuit necessary in commencing into its test phase.

Some examples of appliances that are consistently faulted due to their intrinsic design:

- small portable heaters,
- vacuum cleaners with large plastic body casing,
- upright oscillating fans,
- AC/DC adapters.

If difficulties are experienced the appliance must be referred to a qualified electrician or electronics technician, either within the Budget Unit, a contractor of the Budget Unit, or Facilities and Services. The *Work Request Form* for F&S is at [http://www.anu.edu.au/admin/facilities/maintenance/work\\_request\\_form.html](http://www.anu.edu.au/admin/facilities/maintenance/work_request_form.html)