

# Electrical Testing and Fault Finding

## Learner Workbook

Version 1

Training and Education Support  
Industry Skills Unit  
Meadowbank



PRODUCT CODE: 5682

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## Section 1: Regulations, Documentation and Test Equipment

### Acts and Regulations

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Requirements relating to testing and inspections of electrical work carried out in installations are covered in the various state and territory acts and regulations. Such as:

Electricity Safety (Electrical Installations) Regulation, 2005 (NSW).

Electricity Safety Act. 1971 - Amended (ACT).

National Electricity (South Australia) Act, 1996.

Electricity Safety (Installations) Regulations, 1999 (Vic).

Electricity Industry Safety and Administration Regulation, 1999 (Tas).

Electricity (Licensing) Regulations, 1991 (W.A.).

Electricity Safety Act. 2002 (Qld).

The regulations may cover all or some of the following:

- definitions
- testing requirements
- commissioning of installation work
- notification of installation work
- notification of test results
- qualifications of persons to carry out testing
- different grades of electrical licensing
- penalties for non compliance to safety regulations
- inspection requirements
- responsibilities of installers and supply authorities.

The aim of all state and territory Electrical regulations is to ensure the safety of persons, livestock and property from electrical shock, fire and physical injury from hazards that may arise.

## Installation work requirements

### Compliance:

Installation work must,

- comply with the requirements of AS/NZS 3000 Wiring rules
- not be connected to the supply unless it complies with AS/NZS 3000 and any local regulations or relevant codes.

### Qualified Personnel:

The testing must be carried out by either:

- the installing contractor
- another installing contractor
- an authorised person.

### Activity: Installation Requirements



Write a response

Complete the following questions:

1. What qualifications are required by your state/territory for the issue of a license to install and test fixed electrical installations?

2. What is the penalty given to an unqualified person carrying out electrical installation and testing?

### **Installation Testing:**

The test on the installation work must include the procedures necessary to check that:

- a. there is earth continuity and that the earth resistance is safe
- b. the insulation resistance is safe
- c. polarity is correct
- d. there is no transposition of earth and neutral conductors
- e. there is no short circuit between conductors
- f. there is no intermix between conductors of different circuits
- g. switchboard equipment is correctly marked
- h. the installation will operate as intended.

### **Visual Inspection:**

A visual inspection of complete electrical installations should include:

- main earth conductor size is correct
- location and suitability of equipment and accessories in restricted zones such as laundries, bathrooms, swimming pools, etc.
- voltage drop in all circuits is not excessive
- maximum demand of circuits does not exceed the current carrying capacity of the cables
- circuit protective devices are correctly rated for current carrying capacity and fault current
- mechanical protection is adequate where required
- switchboard markings are correct including neutral conductor identification
- fixing and supports are adequate
- final sub-circuits are used for appliances
- the number of points per final sub-circuit is not excessive
- RCDs are installed on the required circuits
- equipotential bonds are installed and of correct size
- environmental considerations such as heat, chemicals, etc are taken into consideration.

### **Testing and Tagging:**

The WH&S Acts of all stages and territories place a duty of care to provide a safe work place. To meet this duty of care, testing and tagging of electrical equipment is required.

Inspection and testing needs to be in accordance with the performance specifications of:

- AS/NZS 3760:2010, In-Service Safety Inspection and Testing of Electrical Equipment
- AS/NZS 3012:2010, Electrical Installations - Construction and Demolition Sites
- AS/NZS 3002:2008, Electrical Installations - Shows and Carnivals

## Construction Site Testing

Construction site wiring must meet the same standard as wiring in a completed building. In addition the following tests are required on electrical equipment:

- all construction wiring, switchboards and wiring within relocatable structures must be tested prior to connection to the supply and re-tested every six (6) months
- portable safety switches must have a daily pushbutton test before use and then every three (3) months
- fixed safety switches must have a monthly pushbutton test and then every twelve (12) months
- all plant, electrical equipment and flexible electrical cords should be inspected for wear and mechanical damage and tested for earth continuity and insulation resistance prior to first use, and every three (3) months thereafter.

All inspections must be carried out by a competent person, all equipment must be tagged, and a record of inspection and tests kept.

The details recorded shall include:

- the date of inspection
- plant number of the item inspected
- licence number and signature of the inspecting electrician
- any repairs required as a result of the inspection.

The following tables indicate the testing and inspection intervals for various work environments.

**Table 1 Description of Classes of Work Environments**

<b>Class of Work Environments</b>	<b>Examples of Equipment / Environments</b>
1. Manufacturing, repair work	Factories, workshops, repair centres, assembly, maintenance, fabrication.
2. Construction and demolition sites	Construction and demolition sites, office refurbishment, supplying equipment services to construction sites, for example electrical or plumbing.
3. Office environment	Office environment where equipment is not subject to constant flexing of the supply cords. For example computers which are used in a fixed position.
4. Commercial environments	Laboratories, tea rooms office kitchenettes, kitchens, schools, cleaning, and where equipment is subject to constant flexing of the supply cord.
5. Hire equipment industry	Hire of equipment or similar contract (leased equipment).

**Table 2 Frequency of Inspection and Tests of all Electrical Equipment Other Than Fixed Equipment**

Class of Work	Class of Equipment		Additional Testing for RCDs		Cord Extension Sets & Electrical Portable Outlet Devices (EPODs)
	Class 1 (protectively earthed)	Class 2 (double insulated)	Push-button test (by user)	Test for operation	
<b>1. Manufacturing</b>	6 months	12 months	Daily, or before every use, whichever is the longer	12 months	6 months
<b>2. Construction &amp; Demol'n (see AS/NZS 3012)</b>	3 months	3 months	Immediately after connection to a socket outlet and every day in use	Each day	3 months
<b>3. Office</b>	5 years	5 years	3 months	2 years	5 years
<b>4. Commercial</b>	12 months	12 months	3 months or before every use, whichever is the longer	2 years	3 months
<b>5. Hire Equip.</b>	Before each hire	Before each hire	Before each hire	Before each hire	Before each hire
<b>6. Shows/Carnivals</b>	6 months	12 months	Daily, or before every use, whichever is the longer	12 months	6 months



## **Types of Test Equipment**

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### **General Information**

When testing any electrical installation, it is important to:

- identify suitable test equipment which can be used to confirm that an installation meets prescribed requirements
- check essential test equipment to determine instrument accuracy on known loads
- maintain test equipment in a safe and operational working condition
- confirm that the readings taken using essential test equipment are within a range of expected values for typical load conditions
- list the required periodic inspection and tests that show workplace equipment is safe to use.

The essential instruments needed for testing that an electrical installation complies with the requirements of electrical safety regulations are as follows:

- insulation/continuity resistance tester
- ohmmeter - ohms range of a multimeter - capable of displaying accurate readings in the range between 0.5 and 5 ohms.
- series (400 V/230 V) test lamps
- RCD tester
- fault loop impedance tester.

Additional instruments useful in testing are:

- voltmeter - voltage range of a multimeter or clip-on ammeter
- neon tester
- phase sequence indicator
- clamp-on ammeter (tong tester).

Accessories used in testing procedures include:

- a fluorescent lamp starter, base wired and with insulated alligator clip.
- a 15 W lamp and 40 W lamp wired with insulated alligator clips. These are used as known loads.
- a trailing lead of known resistance - 100 m flexible cable fitted at one end with an insulated alligator clip and the other with a plug suitable for connecting to test instruments.
- a resistance calibration panel for checking instrument accuracy. Suggest resistance values:
  - for earth resistance testing - 0.5  $\Omega$ , 1  $\Omega$  and 2  $\Omega$  at 1% tolerance 1 W
  - for typical loads - 10  $\Omega$ , 15  $\Omega$ , 20  $\Omega$  and 50  $\Omega$  at 1% tolerance 1 W
  - for insulation resistance - 10 k $\Omega$ , 1 M $\Omega$  and 10 M $\Omega$  at 1% tolerance 1 W
- temporary test bridges - short lengths, say 300 mm, of flexible cable fitted with insulated alligator clips.

## **Test Equipment Information**

### **INSULATION RESISTANCE TESTER**

#### **Description**

AS/NZS 3000:2007 Wiring Rules – Clause 8.3.6 requires insulation resistance to be measured by applying a d.c. voltage of 500 V. As an electrician you may be required to use a 500 V or 1000 V insulation resistance tester (sometimes referred to as “megger”) which can be a hand driven generator type or a pushbutton electronic type. These instruments may also include ohmmeter or continuity test functions.

The AS/NZS 3000:2007 Wiring Rules requirements for low voltage wiring systems is to have a minimum insulation resistance of 1 megaohm between all live conductors and earth, and 10,000 ohms for low voltage equipment with a sheathed heating element such as found on stoves and water heaters.

#### **Use**

Some important points to remember when using insulation resistance testers:

- although the instrument may not be able to deliver enough energy to cause a fatality it can give a nasty shock capable of causing a secondary accident such as falling from a ladder
- a 500V/1000V testing voltage can cause electrical damage if applied to solid state/electronic equipment or apparatus (e.g. electronic control panels or light dimmers)
- an insulation resistance tester must only be used on wiring disconnected from the supply, i.e. DEAD testing.

As insulation resistance testers age there may be a deterioration of components such as the strength of permanent magnet fields in a hand driven type or a change in circuit component values in the electronic type. This can result in a decrease in the nominal test voltage to well below the instruments rated value.

It is important that your insulation resistance tester measures resistance accurately if you are to ensure the installation you test complies with the requirements.

The insulation resistance tester must maintain its terminal voltage within +20% and -10% of the nominal open circuit terminal voltage, when measuring a resistance of 1 M $\Omega$  on the 500 V range.