MASTER ELECTRICIANS SAFETY CONNECT

R.T. Projects Electrical

Electrical Procedures

AS4801

SECTION 3

VERSION 5.1.2

Lead.Connect.

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AMMENDMENTS

Ref	Rev	Date	Details of Change /Amendment
V5.0.1	1	1 Feb 2013	Editorial amendments only
V5.1.1	2	14 Feb 2013	Procedure added for working in ceiling, crawl in spaces and on conductive roofs
V5.1.2	3	15 Jul 2013	3.2 - Clarified that Safety Observer required for high risk live testing. 3.4 – Clarified that confirmation test for testing required before and after each use. 3.14 - Include tests to confirm integrity of consumers mains connections. 3.15 – Clarified that authorisation is from person in control of pit/ pillar (eg Distributor) 3.17 Include procedure where isolation is not possible.

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3.0 ELECTRICAL PROCEDURES

3.1 LIVE WORK PROCEDURE

3.1.1 OBJECTIVE

To identify the requirements for carrying out live electrical work.

3.1.2 LEGISLATION

The requirement of electrical legislation is that live electrical work is only to be carried out when there is no other reasonable alternative. Customers have an obligation to provide a safe work place for electrical workers.

They must also comply with the requirement of the legislation that live work should not be carried out unless it is absolutely necessary.

Additional costs for the work carried out at another time or commercial inconvenience are not justifiable reasons for live work.

The requirements of this procedure apply to all The Business operations. Where a The Business customer prescribes alternative requirements that are of a higher standard, the customer's requirements shall be applied.

3.1.3 METHOD

The following circumstances are required for the performance of live work:

- It is necessary in the interests of safety, whether or not electrically safe, for the work to be performed while the electrical equipment, the subject of the electrical work is energised
- If a customer requests that live work be carried out because it is in the interests of safety or there is no other reasonable alternative, the customer will be required to complete the Live Work Application and Checklist. If both the customer and the Worker in charge do not properly complete this form, live work cannot continue

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The requirement for the Live Work Application and Checklist to be completed does not include live testing and fault finding activities.

The conditions under which live work can be carried out are:

- A written risk assessment for the performance of the live work has been properly completed - Use SWMS Working on or near exposed energised electrical equipment as a template;
- The QTP authorises the performance of the live work after consultation with the Person-in-Control of the electrical equipment, the subject of the electrical work. The QTP is the only person permitted to authorise Live Work on behalf of The Business;
- The Electrical Worker who performs the live work has appropriate qualifications and training for the performance of the live work acceptable to the QTP for The Business and has been deemed competent;
- Testing equipment appropriate for the performance of the live work, available for use by the Electrical Worker performing the electrical work, has been properly maintained and the Electrical Worker performing the electrical work makes proper use of the testing equipment;
- Clothing and personal protective equipment appropriate to the performance of the live work is being used/worn by the Electrical Worker performing the electrical work and the Electrical Worker performing the electrical work makes proper use of the clothing and equipment;
- The appropriate clothing and PPE for live work is:
    - long sleeve shirt, fire retardant fabric with a minimum weight of 190gsm (Reference ENA NENS 09-2006, Appendix A)
    - long trousers, fire retardant fabric
    - insulated safety boots
    - insulated mats
    - type LV insulated gloves as per AS2225 insulated gloves
    - safety glasses

JEWELLERY AND CONDUCTIVE CLOTHING ACCESSORIES ARE NOT PERMITTED

- The isolation point of the electricity supply for the electrical equipment, the subject of the electrical work, has been clearly identified and, except for electric line work, is able to be reached quickly without the need to climb over or shift obstructions;

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- The area where the electrical work is performed is clear of obstructions to the extent necessary for easy access to and from the area;
- There is a Safety Observer observing the performance of the electrical work, unless:- the work involves testing electrical equipment; and the employer's risk assessment does not show there is a high risk to electrical safety in performing the testing of the electrical equipment; and
- The performance of the electrical work is in accordance with a safe system of work.

3.1.4 SAFETY OBSERVER

A "safety observer", in relation to observing the performance of electrical work, means a person:

- Who is competent to help with the electrical work;
- Who is competent to rescue the person performing the electrical work and to provide resuscitation; and
- Whose competence in rescue and resuscitation has been assessed in the last 6 months.
- The extent of the rescue training will depend on the work activity and the possible hazard i.e. switchboard, pole top, etc.

3.1.5 RELATED POLICIES & PROCEDURES

Working Live Policy

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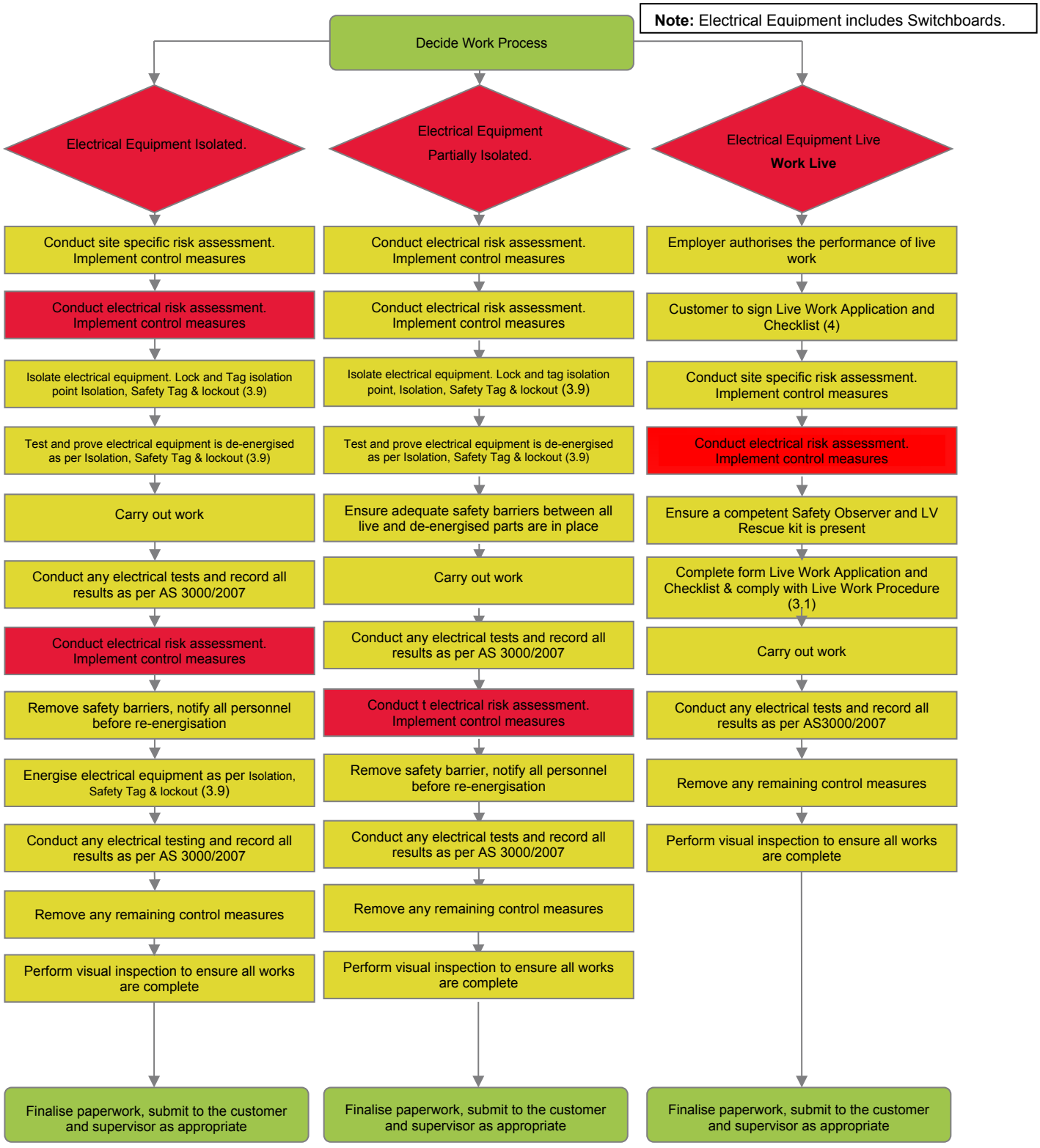
Figure 3: Work Process Flowchart



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3.2 LIVE TESTING

3.2.1 OBJECTIVE

To identify control measures that will need to be implemented when testing or fault finding on electrical equipment.

3.2.2 METHOD

Use Safe Work Method Statements Working on or near exposed energised electrical equipment as a template of generic controls when preparing a Job Specific Work Method Statement.

The generic Safe Work Method Statements noted above provide guidance on the inherent & residual risk ratings; the Worker in charge must include additional controls and/or calibrate the final risk ratings as required to reflect the job at hand before proceeding.

Ensure that the Person in Control of the electrical equipment is given the opportunity to review the Safe Work Method Statement BEFORE PROCEEDING.

Note: There needs to be a Safety Observer for live testing in cases where the employer's risk assessment shows there is a high risk to electrical safety in performing the testing of the electrical equipment.

3.2.3 INSTALLATION CATEGORY DEFINITIONS

Installation Category (instruments) means the fault level and voltage impulse level that instrument is designed to withstand. The applicable Installation Categories are outlined below:

- Installation Category I relates to signal level, special equipment or parts of equipment, telecommunications, electronic and similar equipment. Impulse withstand voltage: 1500V
- Installation Category II relates to the local level, appliances, equipment sub circuits, portable equipment etc. Impulse withstand voltage: 2500V
- Installation Category III relates to the distribution level, main switchboards etc. Impulse withstand voltage: 4000V
- Installation Category IV relates to the primary supply level, overhead lines, cable systems etc fixed installation

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Refer to Figure 4, for guidance on the appropriate Installation Category of Test Equipment.

Figure 4: Installation Category of Test Equipment

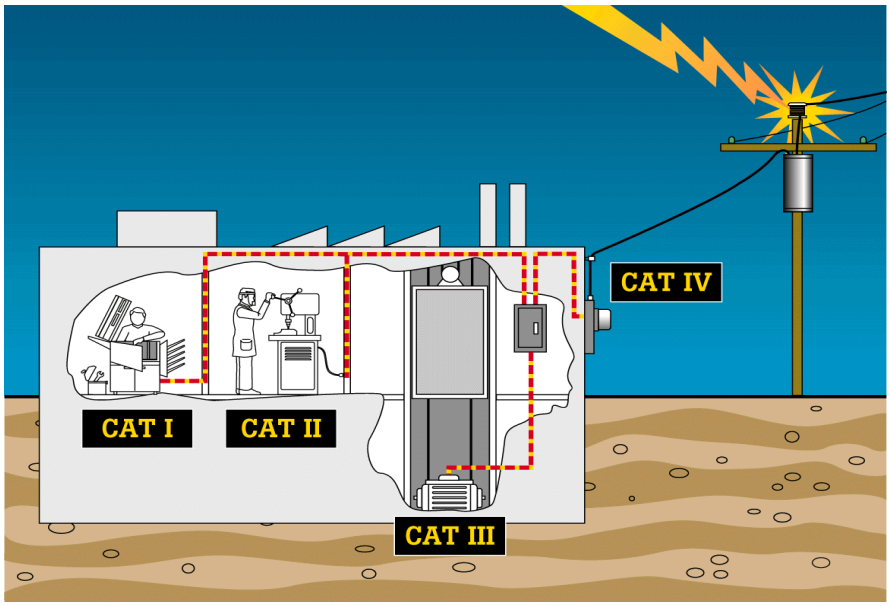

Figure 5: Identifying the Insulation Category of Test Equipment

The insulation Category will be found in the test equipment specification provided by the manufacturer. If the Insulation Category cannot be identified, it is safe to assume it does not have one or it has the wrong one.

If the Insulation Category cannot be established, DO NOT USE THE TEST EQUIPMENT on any live, low voltage works, under any circumstances.

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3.2.4 RELATED POLICY & PROCEDURES:

Working Live Policy

Before use inspection of electrical instruments

3.2.5 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer SWMS: Working on or near exposed energised electrical equipment

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3.3 WORKING ON ELECTRICAL EQUIPMENT

3.3.1 OBJECTIVE

To identify safety precautions that will need to be implemented when isolating fixed wired electrical equipment for the purpose of carrying out electrical work.

3.3.2 METHOD

Comply with Figure 3: Live work process chart, at all times.

Use Safe Work Method Statement Working on or near exposed energised electrical equipment as a template of generic controls when preparing a job specific Safe Work Method Statement .

The generic Safe Work Method Statement noted above provides guidance on the inherent & residual risk ratings; the Worker in charge must include additional controls and/or calibrate the final risk ratings as required to reflect the job at hand before proceeding.

The Safe Work Method Statement should also embrace the safety of persons carrying out non-electrical work on/near isolated electrical equipment with due consideration to the Exclusions Zones.

3.3.4 RELATED POLICY & PROCEDURES

Working Live Policy
Control measures for testing electrical equipment
Before use inspection of electrical test instruments
Isolation, safety tag and lockout
Live work process chart

3.3.5 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment

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Table 2: Exclusion Zones around Exposed Live Electrical Parts

EXCLUSION ZONES AROUND EXPOSED LIVE ELECTRICAL PARTS			
Nominal phase to phase voltage of exposed part	**Untrained Persons (inc the Public)** **(mm)**	**Operating plant operated by an Untrained Person or the Public** **(mm)**	**Electrical Workers authorised by the QTP**
Low voltage (with consultation with the Person In Control of the exposed part)	1000	3000	Insulated contact allowable under cover of a properly prepared risk assessment
Low voltage (without consultation with Person In Control of exposed part)	3000	3000	
Above low voltage, up to 33kV (with consultation with Person in Control of exposed part)	2000	3000	700
Above low voltage, up to 33kV (without consultation with Person in Control of exposed part)	3000	3000	700
Meaning of Person in Control of electrical equipment ***The Person in Control of electrical equipment is the person who controls the electrical equipment. It could be the Worker in charge (in a domestic situation) the Principal Contractor (Builder) and/or the Plant Engineer. It is never the owner of a domestic dwelling.***			

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3.4 ROUTINE TESTING OF ELECTRICAL TEST INSTRUMENTS

3.4.1 OBJECTIVE

To identify the requirements for the routine testing of electrical test instruments to ensure they are in proper working order. Types of instruments are:

- Test lamps
- Voltmeters
- Portable RCD used for fault finding
- Insulation Resistance tester
- Ohmmeters
- Fault loop impedance tester
- Resistance test block
- Multimeters

3.4.2 METHOD

All The Business workers' performing these tests must be deemed competent to do so.
Every testing instrument shall be tested on a regular basis in accordance with the listed procedure. Items that pass the test are to be tagged with the next test date and returned to service. Any item that does not pass the test is not to be used. Following repair, the instrument must be tested and tagged before being returned to service. Test records shall be retained for five (5) years.

Whenever any tests are conducted by an external organisation, a written test report will be required after the testing of each item. The testing organisation will be required to provide written details of test methods.

If an instrument is used for indication purposes only and is tested before use, the instrument shall be tested in accordance with Procedure - *Before use inspection of electrical instruments*, it is not necessary to test the instrument every six months. Any test instrument must be confirmed to be in working order before and after each use (eg confirm voltmeter is working prior to testing supply has been isolated and as soon as practicable after test to confirm test was valid).

3.4.2.1 TEST LAMPS

Test lamps will be tested to prove they are in proper working order before and after each use. They will not be tested on a six-month period and will not be tagged.

3.4.2.2 VOLTMETER

Voltmeters used to identify that voltage is present will be tested to prove they are in proper working order before and after each use. They will be tested every six months to ensure they are in proper working condition and tagged with the next test due date before returning to service.

Voltmeters used to measure voltage (against identifying whether voltage is present) will be checked for accuracy against a known and tested source. The item will be tagged with the next test date. Items will be tested every six months.

3.4.2.3 PORTABLE RCD'S USED FOR FAULT FINDING

Each instrument will be tested for current and time accuracy every six months and tagged with the next test due date before returning to service.

The recognised values are:

Class 1 RCD	10 mA	40 milliseconds
Class 2 RCD	30 mA	300 milliseconds

3.4.2.4 INSULATION RESISTANCE TESTER

An insulation resistance tester shall be able to maintain its nominal open circuit terminal voltage within +20% and –10%, when measuring a resistance of 1.0 MΩ on the 500V or 10MΩ on the 1000V range. The accuracy of the instrument will be checked against Mil-spec resistors with a tolerance of 1%. Instruments shall be tested every six months against a known resistance or resistance test block (see clause 3.4.2.7) with values 10000Ω, 1.0MΩ and 10.0MΩ.

The output voltage of an insulation resistance tester must be confirmed by a competent person under load and records retained.

(Mil-spec resistors are designed to meet the exacting requirements of military specification MIL-R-93. These resistors can offer tolerances as accurate as ±0.005% and with Thermal Coefficient of Resistance as low as ±2ppm/°C)

3.4.2.5 OHMMETER

An ohmmeter shall be capable of accurately reading in the range between 0.5Ω and 5.0Ω. The accuracy of each ohmmeter will be checked against the following resistors with a tolerance of 1%. Instruments shall be tested every six months with values 0.5Ω, 1.0Ω, 2.0Ω and tagged with the next test due date before returning to service.

3.4.2.6 FAULT LOOP IMPEDANCE TESTER

A fault loop impedance tester is to be tested in accordance with manufacturers recommendations, Readings shall be within the tolerance indicated by the manufacturer.

3.4.2.7 RESISTANCE TEST BLOCK

The resistance test block will be tested against a known source at least every two years. The resistance values will be within +1% to –1%. The test block should contain resistors as shown in the clauses above.

3.4.2.8 MULTIMETERS

Instruments that have multi function capabilities shall have each of the individual functions tested as in accordance with the above procedures. Each function shall be tested every six months and tagged with the next test due date before returning to service.

3.4.2.9 RECORDS

Records of all testing shall be maintained for at least five years.

Ensure that the Electrical & Safety Equipment Test Record has been filled out.

3.4.3 RELATED POLICY & PROCEDURES

- Working Live Policy
- Before use inspection of electrical instruments
- Electrical & Safety Equipment Test Record

3.4.4 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment

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3.5 BEFORE USE INSPECTION OF TEST INSTRUMENTS

3.5.1 OBJECTIVE

To identify the checks that must be carried out before a test instrument can be used. The types of instruments covered by this procedure are:

- Test lamp
- Voltmeter
- Portable RCD used for fault finding
- Insulation Resistance tester
- Ohmmeter
- Fault loop impedance tester
- Multimeters

3.5.2 METHOD

Any item that is not in-test or does not indicate in an acceptable manner will not be used, all leads and connections checked to ensure they are in good condition.

3.5.2.1 TEST LAMP

Test lamps will be tested to prove they are in proper working order before and after each use. Test lamps are only to be used to identify voltage when a circuit protective device of 100 amps or less protects the electrical equipment being tested.

3.5.2.2 VOLTMETER

Voltmeters used to identify whether voltage is present shall be tested to prove they are in proper working order before and after each use.

When a voltmeter is used to measure voltage (against identifying whether voltage is present), the test tag on the instrument shall be checked to ensure the instrument is in-test.

Voltmeters are divided into a number of categories depending on the situation and the possible fault current that could occur at the test point. Test leads that are supplied with a particular type of

instrument are not to be used on an instrument with a different category. Where to use the appropriate Installation Category of voltmeter is as depicted in figure 5:

3.5.2.3 PORTABLE RCD USED FOR FAULT FINDING

Before being used the test button shall be pressed to ensure the instrument is working and the test tag will be checked to ensure the instrument is in-test.

3.5.2.4 INSULATION RESISTANCE TESTER

Before use, the test tag will be checked to ensure the instrument is in-test and the battery condition is to be checked prior to use.

3.5.2.5 OHMETER

Before use, the test tag will be checked to ensure the instrument is in-test

3.5.2.6 FAULT LOOP IMPEDANCE TESTER

Before use, the test tag will be checked to ensure the instrument is in-test

3.5.2.7 MULTIMETER

Before use, the test tag will be checked to ensure the instrument is in-test and the battery condition is to be checked prior to use.

3.5.3 RELATED POLICY & PROCEDURES

Working Live Policy

Testing of electrical instruments

For potential hazards and control measures:

Refer: SWMS Working on or near exposed energised electrical equipment

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3.6 ROUTINE INSPECTION OF SAFETY EQUIPMENT

3.6.1 OBJECTIVE

To detail the requirements for the routine inspections of safety equipment, for the following items:

- safety harness
- ladders
- insulating mats and covers
- insulating gloves
- low voltage rescue kit

3.6.2 METHOD

Each item of equipment shall be tested and or inspected every six months. Items that pass inspection are to be tagged with the next test date and returned to service. Any item that does not pass inspection is to be removed from service. After repair, an item must be tested before being returned to service. Test/inspection records shall be retained for five (5) years.

Whenever an item of equipment is tested by an external organisation, a written test report will be required. The testing organisation will be required to provide written details of test methods.

If an item of electrical safety equipment is tested before use in accordance with Procedure *Before use inspection of electrical safety equipment*, it is not necessary to test the item every six months.

3.6.2.1 SAFETY HARNESS

General requirements

The following items shall be subjected to inspection by the operator of each item before and after each use to ensure that it is in a serviceable condition:

a. Personal equipment - harnesses, lanyard assemblies, connectors, fall-arrest devices
b. Common use equipment - ropes, slings, fall-arrest devices, mobile attachment devices together with any other items in Item (a) above that are provided for common use

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Inspection shall be by sight and touch. It shall include the opening of any equipment where access for daily inspection is provided, to ensure that internal components are in satisfactory condition. This requirement includes the opening or removal of temporary rope or line protectors, to enable rope to be properly inspected. Operation of the locking mechanism on fall-arrest devices shall also be checked.

Snap hooks

An overall check for wear, distortion, corrosion and damage and a specific check of the latch and its pivot for distortion and/or breakage.

A specific check of the latch return spring for breakage distortion or loss of tension. The check of the latch and its spring shall include a slow closing of the latch from the fully open position. The latch shall close fully in a smooth and positive manner.

Rings

For damage, distortion or cracked welds.

Pole straps

For any damage or signs of wear, excess distortion, broken, cut or worn threads.

Webbing

For cuts, cracks, tears, or abrasions undue stretching and damage due to deterioration, heat, acids or other corrosives.

Stitching

For broken, cut or worn threads.

3.6.2.2 LADDERS

Stiles and rungs	Not cracked, splintered or loose
Metal parts	Not cracked or bent
Moving parts	No signs of excessive wear
Bolts and pins	Satisfactory security
Ropes	Fitted and in good order

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Bucket or chain	Secure and undamaged especially at fastenings to stiles
Feet	Not worn or split. If movable must be able to move freely
Timber ladder	No sign of decay, borers or termites
Fibreglass ladders	Surface smooth, clean and polished, of uniform colour and without any pits chips voids or longitudinal grooves along the stiles

3.6.2.3 INSULATING MATS AND COVERS

Insulating mats used on a regular basis shall be tested in accordance with applicable standards.

Insulating mats not used on a regular basis shall be washed with water, soap/detergent and stretched as required; and as a minimum examined for the following at least once every month:

- Blisters, cracks, cuts or holes
- Embedded foreign matter
- Defective fastenings

3.6.2.4 INSULATING GLOVES

Insulated gloves will be tested in accordance with applicable standards and relevant state and federal legislation.

Insulating gloves shall always be:

- Suitable for purpose and application
- Maintained so that they remain suitable for use
- Visually confirmed as being correctly functioning before use and safe-tested every 6 months to ensure that they provide the protection that they were intended to provide
- Remain in good repair and condition

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Table 3: Insulating Gloves

Insulating gloves can be identified in the following manner.

Working Voltage	Manufactured to AS2225	Manufactured to IEC 903
500 volts	White colour code	00
1000 volts	Red colour code	0

3.6.2.5 LOW VOLTAGE RESCUE KIT

A rescue kit shall contain the following equipment and be inspected every six months to ensure all items are present, in good condition and gloves are in-test:

- Insulated crook:
- Insulating gloves in protective cover
- “Isolate Here In Emergency” sign
- Burn dressings and fire blanket
- Torch

NOTE: ENSURE THAT LOW VOLTAGE RESCUE KIT INSULATING GLOVES ARE TESTED AND WITHIN TEST DATE.

3.6.3 RECORDS

Records of all testing/inspections shall be maintained for at least five years.

Ensure that the Electrical & Safety Equipment Test Record has been filled out.

3.6.4 RELATED POLICY & PROCEDURES

Working Live Policy

Before use inspection of electrical safety equipment

Electrical & Safety Equipment Test Record

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3.7 BEFORE USE INSPECTION OF ELECTRICAL SAFETY EQUIPMENT

3.7.1 OBJECTIVE

To identify the requirements for an examination of electrical safety equipment before on-site use. Items include:

- Safety harness
- Ladders
- Insulating mats and covers
- Insulating gloves
- Low voltage insulated tools
- Low voltage rescue kit
- Safety helmets
- Temporary anchor points
- Travel restraint equipment

3.7.2 METHOD

Each item of equipment shall be tested and or inspected every six months. Items that pass the inspection are to be tagged with the next test date and returned to service. Any item that does not pass the test is to be removed from service. After repair, an item must be tested and/or inspected before being returned to service. Test records shall be retained for five (5) years.

Whenever an item of equipment is tested by an external organisation, a written test report will be required. The testing organisation will be required to provide written details of test methods.

3.7.2.1 SAFETY HARNESS

The following items shall be subjected to inspection by the operator of each item before and after each use to ensure that it is in a serviceable condition:

a. Personal equipment - harnesses, lanyard assemblies, connectors, fall-arrest devices
b. Common use equipment - ropes, slings, fall-arrest devices, mobile attachment devices together with any other items in Item (a) above that are provided for common use

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Inspection shall be by sight and touch. It shall include the opening of any equipment where access for daily inspection is provided, to ensure that internal components are in a satisfactory condition.

This requirement includes the opening or removal of temporary rope or line protectors, to enable rope to be properly inspected. Operation of the locking mechanism on fall-arrest devices shall also be checked.

3.7.2.2 LADDERS

Each time before use, a ladder shall be examined for any signs of damage, splitting or major defects.

3.7.2.3 INSULATING MATS AND COVERS

The item shall be stretched and examined for the following:

- Blisters, cracks, cuts or holes
- Embedded foreign matter
- Defective fastenings

3.7.2.4 INSULATING GLOVES

Immediately prior to use, all insulating gloves shall be visually inspected for cuts, tears, perishing and distortion.

Gloves shall be pressure tested for pinholes by sealing the entry to the glove and compressing air trapped within by rolling the glove on itself.

Loss of air indicates that the glove is defective. Defective gloves shall not be used.
Soiled gloves will be cleaned in accordance with the manufacturer's instructions.

3.7.2.5 LOW VOLTAGE INSULATED TOOLS

Each time before a low voltage insulated tool is used it shall be inspected for any signs of damage and/or deterioration of the insulation.

3.7.2.6 LOW VOLTAGE RESCUE KIT

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On each occasion before placement ready for use, the rescue kit shall be inspected to ensure that all items are present and in good order. Each item is to be visually inspected for any damage or defect. Gloves shall be tested as above.

- Insulated crook
- Insulating gloves in protective cover
- "Isolate Here In Emergency" sign
- Burn dressings and fire blanket
- Torch

3.7.2.7 SAFETY HELMET

Each time before use, helmets shall be inspected as follows:

- No dents, cracks or other damage
- Not discoloured or weathered or showing loss of glaze
- Harness adjustable to secure a good fit
- Not embrittle - this can be checked by gently squeezing the helmet sideways
- Not modified in any way e.g. paint or fittings attached by drilling or cutting the helmet. Approved stickers or labels designed for the purpose are acceptable

Helmets shall be cleaned regularly using warm water with soap or mild household detergent. Solvents, very hot water or abrasives shall not be used.

Safety helmets should be replaced every three (3) years and the harness replaced every two years. A harness from one design or make of helmet should not be interchanged with any other design or make of helmet.

3.7.3 RELATED POLICY & PROCEDURES

Working Live Policy

Routine Inspection of safety equipment

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3.8 TESTING OF ELECTRICAL EQUIPMENT

3.8.1 OBJECTIVE

To outline the requirements for inspection and testing of electrical equipment either as part of a normal safety inspection or following electrical repairs to the item of equipment.

3.8.2 LEGISLATION

A person who installs electrical equipment or an electrical installation has an obligation to ensure that:

- The way the electrical equipment or installation is installed is electrically safe
- The processes followed for installing the electrical equipment or installation will be electrically safe when installed
- After the electrical equipment or installation is installed, the person tests and examines it to ensure it is electrically safe

Obligation of repairer of electrical equipment or electrical installation

A person who repairs electrical equipment or an electrical installation has an obligation to ensure that:

- The way the electrical equipment or installation is repaired is electrically safe
- The processes followed for repairing the electrical equipment or installation will be electrically safe when repaired
- The electrical equipment or installation, when repaired, is electrically safe

Without limiting subsection (1), the obligation includes ensuring that the electrical equipment or installation, when repaired, is tested and examined to ensure it is electrically safe.

3.8.3 METHOD

CAUTION: The QTP for The Business and/or the ECA must confirm the competency of any Electrical Worker to test, before they are permitted to conduct any testing included within this procedure. If an Electrical Worker is deemed competent to test, the appropriate entry shall be included on the Application for employment form.

Electrical tests may be required as part of regular testing in a workplace or following electrical repairs to an item of equipment. The actual test will vary depending on the item of equipment and whether the supply is permanently wired or connected by plug and socket. Further information can be obtained from AS/NZS 3760.

3.8.4 DEFINITIONS

Class I equipment (basic insulated, protectively earthed equipment)
Accessible unearthed parts shall be all external parts that are not connected to the protective earthing conductor and are separated from live parts by double insulation or reinforced insulation, and includes parts used to support the equipment in operation.

NOTE 1: Class I equipment may have parts with double insulation or parts operating at extra-low voltage.

NOTE 2: This provision includes a protective earthing conductor as part of the flexible cord or cable for equipment intended for use with a flexible cord or cable

3.8.5 CLASS II EQUIPMENT (DOUBLE INSULATED EQUIPMENT)

Equipment in which protection against electric shock does not rely on basic insulation only, but in which an extra layer of insulation (called supplementary insulation) is provided to give double insulation, there being no provision for protective earthing or reliance upon installation conditions. This equipment is generally manufactured with a non-conductive (insulated) enclosure and is marked either with the words DOUBLE INSULATED or with the symbol to allow easy identification.

NOTE: CLASS II EQUIPMENT MAY ALSO BE MANUFACTURED WITH METAL ENCLOSURES WHICH ARE DOUBLE INSULATED FROM LIVE PARTS.

3.8.6 TEST EQUIPMENT

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All test equipment used for testing under the scope of this procedure shall be in accordance with Procedure -Testing of electrical instruments & Procedure - Before use inspection of test instruments.

3.8.7 TESTS REQUIRED

- An external inspection of the equipment and the connecting facilities.
- Protective earth continuity test for Class I (single insulated) equipment, power boards and cord sets.
- Insulation testing, which may be achieved by measuring insulation resistance or leakage current.
- Confirmation of the correct polarity of live connections in cord sets with rewireable plugs and cord extensions sets.

3.8.8 TESTING PROCEDURE

Inspection

The following checks should be made - others may be necessary depending on the equipment and its use:

- Obvious damage or defects in cord, plug and accessories and any damage that could indicate exposure to heat, chemical, water, etc.
- Flexible cords are effectively anchored and they are not damaged
- Single insulated cores of flexible cords are not damaged, twisted or exposed
- External sheaths are not damaged so that inner cores are visible
- Unprotected conductors or the use of insulating tape to repair damage
- The sign indicating the maximum load for power boards is intact
- Operating controls are in good working order
- Covers, guards and similar protection are secure
- Any ventilation is not to be covered
- Connecting devices inspected to ensure there is no damage
- When looking at the front of a normal flat pin plug that polarity is earth, neutral, active in a clockwise direction

3.8.9 EARTHING CONTINUITY

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The object of this test is to ensure that the resistance of the protective conductor is sufficiently low to ensure operation of the circuit protecting the equipment. Class I (single insulated) equipment.

- With accessible earthed parts: check the continuity of the protective earthing conductor from the plug earth pin to the accessible earthed parts.
- Without accessible earthed parts: for cord extension set, outlet devices and portable residual current devices check the continuity of the protective earth conductor from the earth pin of the connector plug to the earth socket/contact of the outlet.

Result

The measured resistance shall not exceed 1 Ω.

3.8.10 INSULATION TEST

- This test can be performed in two possible ways depending on the type of equipment.
- Insulation resistance
- Leakage current test

3.8.11 INSULATION RESISTANCE

Insulation resistance is measured with the switch on the equipment in the closed position. The test is made between live parts and accessible earthed parts. Table 4 displays the acceptable minimum results.

Before leaving the site, check that the switchboard is in the same condition as it was found. Ensure any fridges, deep freezes or hot plate elements are in the same electrical position (i.e. on or off) as when you found them.

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Table 4: Installation testing

Equipment	Insulation Test	Minimum Insulation Resistance
Class I	Measure between live parts and accessible earthed parts	1.0MΩ
Class II	With live and neutral conductors electrically connected, measure between live parts and accessible metal parts	1.0MΩ
Portable RCDs with functional earth	Measure between live parts and the functional earthing conductor	0.1MΩ
Cord sets, portable outlets and portable RCDs	Measure between live parts and the protective earthing conductor	1.0MΩ
Mineral insulated metal sheath heating elements	Measure between live parts and accessible earthed parts	0.01MΩ (10kΩ)

Testing of plug packs, power supply units, portable isolation transformers and power packs shall be performed in the following manner as appropriate:

- Live supply conductors and accessible earthed parts of a Class I transformer or enclosing case
- Live supply conductors and accessible earthed parts of a Class II transformer or enclosing case
- Live supply conductors and the connections from the transformer output (secondary) winding
- Connections from the transformer output (secondary) winding and accessible earthed parts. This test is not applicable for equipment with ELV output, which is connected to earth directly, or by a resistive component.

The insulation between components shall not be less than 1 MΩ.

3.8.12 MEASUREMENT OF LEAKAGE CURRENT

If it is necessary to have the item of equipment energised to close the control switch it is not possible to conduct insulation resistance tests on the equipment. In this case it is necessary to carry out leakage current tests. This is only necessary in Class I equipment. Tests must be

carried out to prove that the item of equipment is electrically safe i.e. a 10 amp RCD would be a satisfactory method of measuring leakage current.

The leakage test can be carried by any effective method. Possible methods are:

- A direct reading meter in the protective earth wire circuit of the test equipment
- A clamp meter in conjunction with special cord set where the protective earth conductor can be safely separated for measurement
- A portable appliance tester that will measure the leakage current

3.8.13 TESTING OF RCD

Testing of RCDs shall be as detailed in procedure Testing and Tagging.

3.8.14 INSTRUMENTS

The following test instruments should be available. Depending on the electrical work being undertaken, the full list of instruments may not be needed. Tests to prove instruments are in proper working order must be conducted every 6 months.

- An ohmmeter capable of accurately measuring low resistance readings between 0.01Ω and 10.0Ω.
- An insulation resistance tester that is able to maintain its terminal voltage within +20% and –10% of the nominal open circuited terminal voltage when measuring a resistance of 1MΩ on the 500v range or 10 MΩ on the 1000v range.
- A voltage indicator to suit the work activity. The electrical condition of the work site will determine the installation category of the instrument that must be used for testing. There are four separate installation categories. These are;
    - Installation Category i relates to signal level, special equipment or parts of equipment, telecommunications, electronic and similar equipment. Impulse withstand voltage: 1500V
    - Installation Category ii relates to the local level, appliances, equipment sub circuits, portable equipment etc. Impulse withstand voltage: 2500V
    - Installation Category iii relates to the distribution level, main switchboards etc. Impulse withstand voltage: 4000V

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  - Installation Category iv relates to the primary supply level, overhead lines, cable systems etc fixed installation
- A trailing lead of known resistance.
- A range of resistors with a tolerance of 1% (to calibrate ohmmeter and insulation resistor tester) with the following ohm ratings: 0.1, 0.5, 5.0, 10.0, 1,000, 10,000, 1 MΩ.

The following are recommended but their use will depend on the work activity:-

- Clamp-on ammeter for measuring load
- Suitable instrument for measuring fault loop impedance
- Suitable instrument or equipment for checking the operation of RCDs
- Suitable instrument for measuring leakage current
- Phase rotation meter

3.8.15 RELATED POLICY & PROCEDURES

- Working Live Policy
- Work process flowchart
- Testing of electrical instruments
- Before use inspection of test instruments
- Isolation, safety tag and lock-out
- Visual safety examination / inspection

3.8.16 FOR POTENTIAL HAZARDS AND CONTROL MEASURES:

Refer: SWMS Asbestos
SWMS Working on or near exposed energised electrical equipment

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3.9 ISOLATION, SAFETY TAG AND LOCKOUT

3.9.1 OBJECTIVE

To identify the safety precautions to be implemented when hard wired electrical equipment is isolated prior to electrical work being carried out.

3.9.2 LEGISLATION

Legislation stipulates that if an Electrical Worker has isolated an item of equipment (by switch or fuse) and while the worker is performing the work, the worker does not have the isolation point under the worker's sole effective control. The Electrical Worker must ensure:

- That there is attached to the device, in a prominent position, a warning sign (see examples) and
- The isolation point, when in the open position, is locked; or other precautions are taken to stop the device being accidentally closed

3.9.3 METHOD

3.9.3.1 ISOLATING

All electrical equipment and conductors shall be regarded as energised until isolated and proved de-energized. Work shall not be carried out on or near de-energized exposed conductors until an electrical worker has:

a) Positively identified the electrical equipment, all of its energy sources and their isolation points
b) Isolated and discharged where necessary the electrical equipment from all sources of supply
c) Secured the isolation
d) Proved de-energisation of all electrical equipment and conductors
e) Identified the safe area of work

The electrical equipment to be worked on and the appropriate points of isolation and all of its energy sources shall be positively identified.

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The electrical equipment to be worked on shall be isolated from all sources of supply either by opening switches, removing fuses or links, opening circuit breakers or removal of circuit connections. Control circuits or control systems (PLCs, emergency stops, etc.) shall not be used as a means of isolation, e.g. by operation of a stop button.

All other non-electrical sources of energy shall be made safe in accordance with AS 4024.1 – Safety of machinery.

3.9.3.2 SECURING THE ISOLATION

Positive Isolation must be achieved at the circuit source by appropriate methods such as locks on circuit breakers, removing a cable from a MCB or device and placing in a connector or removing the fuse links etc. In situations where other people can access isolation points, it is important that the isolation method or system cannot be inadvertently or easily compromised.

The securing device need not be an integral part of the switch and may be either:

a. An additional component, such as a clip, screw, bolt or padlock that will prevent the switch from being operated
b. A personal danger tag, lock-out system
c. Another approved system

Local Isolation of circuits by locking out/tagging control isolators or light switches etc. is not permitted as a sole source of isolation under any circumstances.

3.9.3.3 PROVING DE-ENERGIZED

All electrical equipment and conductors, unless proven to be de-energized, shall be treated as energized. Any voltage tests used to prove de-energization shall be conducted between all conductors and a proven earth or shall be conducted to another approved procedure. Voltage detectors used to prove de-energisation, shall be tested for correct operation immediately before use and again immediately after use to confirm that the detector is still working.

Should the worker be unable to verify that the isolation device contacts have opened by visual or testing line and load sides of the isolation point, an additional upstream isolation must be made or the work treated as live work.

A Worker of The Business required to work in association with electrical equipment shall be competent in procedures proving de-energization and in the use of any equipment utilised to do so.

WARNING: THE USE OF TESTERS THAT DETECT AN ELECTRIC FIELD SURROUNDING AN ENERGISED CONDUCTOR MAY NOT BE SUITABLE FOR CABLES THAT ARE SURROUNDED BY A METALLC SCREEN, CABLES CARRYING DIRECT CURRENT AND IN SOME OTHER CIRCUMSTANCES.

Before any electrical work is performed on isolated equipment, a test-for-dead must be performed by the Worker in charge, to ensure that the equipment has been Positively Isolated.

3.9.3.4 IDENTIFY THE SAFE AREA OF WORK

The safe area of work should be identified by erecting obstacles or warning signs or another approved method. All personnel who are to work in the safe area shall be advised of its limits.

3.9.3.5 RESTORING POWER

Ensure all electrical tests are completed and results recorded;
Visually check that all equipment is safe to be energised;
Notify all persons involved in the work activity that the equipment will be energised;
A Danger Tag and/or Safety Lock can only be removed by the person that placed them - unless the original person is absent from the worksite and/or is unable to remove the tag and/or lock because of unforeseen circumstances and then only by Worker in charge of the worksite.

3.9.3.6 OUT-OF-SERVICE TAG

An Out of Service Tag shall be fixed to any item of equipment that is not electrically safe. The tag shall not be removed until the item of equipment has been repaired and tested to prove that it is electrically safe.

3.9.4 RELATED POLICY & PROCEDURES

Working Live Policy

3.9.5 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

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Refer: SWMS Working on or near exposed energised electrical equipment

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Figure 6: Typical Danger Tag

Figure 7: Typical Out of Service Tag

Figure 8: Typical Safety Lock

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3.10 WORKING IN VICINITY OF EXPOSED LIVE PARTS

3.10.1 OBJECTIVE

To specify the prescribed clearances and conditions that must be complied with when working in the vicinity of exposed live electrical parts.

3.10.2 METHOD

There are specific clearances that must be maintained when working in the vicinity of exposed live electrical parts. This includes switchboards, equipment owned by an electricity supplier and electrical equipment owned by a customer.

The Worker in charge of a worksite shall ensure that any, non-authorised Electrical Workers and non-electrical persons, including members of the public do not come within the Exclusion Zones shown in table 2. Effective barricading and/or the use of a competent Safety Observer shall be used as appropriate to keep persons out of the Exclusions Zone in table 2.

This procedure only applies to routine Low Voltage installations. Please refer to relevant legislation, working near Exposed Live Parts and/or Client Procedures prior to working on Complex Installations, in Hazardous Areas and/or on High Voltage installations.

3.10.3 RELATED POLICY & PROCEDURES

Working Live Policy
Live Work Procedure
Working on electrical equipment Procedure

3.10.4 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment

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3.11 INSTALLATION OF SAFETY SWITCHES IN A DOMESTIC DWELLING

3.11.1 OBJECTIVE

To outline the requirements for the installation of safety switches on power circuits in a domestic residence. This procedure considers the installation of safety switches in:

- New installations
- Existing installations
- Rental premises

3.11.2 METHOD

3.11.2.1 NEW INSTALLATION

- One or more socket – outlets; and
- Lighting points; and
- Combination Fan, Light And Heater Units Are Regarded As A Lighting Point.
- Directly connected hand – held electrical equipment, e.g. directly connected hair dryers or tools.

Any new installation shall provide protection for the final sub circuits above, by an RCD that has a maximum rated residual current of 30mA.

3.11.2.2 EXISTING INSTALLATIONS

Socket outlets that are added to existing circuits shall be protected by a 30 mA RCD.

Exception:

- Where socket-outlets or lighting points that are not RCD-protected are replaced, including the replacement of a single socket-outlet with a multiple socket-outlet assembly
- Extensions to final sub circuits supplying lighting points only, provided that the existing final sub circuit is not RCD-protected

Some state legislation may require additional requirements for the installation of safety switches.

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3.11.2.3 RENTAL PREMISES

Some state legislation requires the owners of leased domestic residences, to have a safety switch installed for the power circuit of the residence within six months of a residential tenancy agreement being entered into.

If either of the above applies and the power circuits are not protected by an RCD, any electrical installation work must include the installation of a safety switch to protect general purpose outlets.

3.11.3 DEFINITIONS

Electrical installation work is the work of installing, altering or adding to an electrical installation and includes supervising the work.

Domestic residence means a building or structure, or part of a building or structure, that:

- Is used or designed to be used as a single dwelling e.g. dwelling house or flat
- Is not used or designed to be used for temporary accommodation e.g. boarding house or motel

Socket outlet – As per AS3000:2007 a device for fixing or suspension at a point, and having contacts intended for making a detachable connection with the contacts of a plug. The term 'Socket outlet' is deemed to include a cord-extension socket attached to a flexible cord that is permanently connected to installation wiring.

3.11.4 RELATED POLICY & PROCEDURES:

Visual safety examination / inspection procedure
Testing an electrical installation procedure

3.11.5 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment
SWMS Asbestos

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3.12 TESTING & TAGGING

3.12.1 OBJECTIVE

To establish the Testing and Inspection intervals of electrical equipment owned by The Business.

3.12.2 METHOD

A register will be maintained of all electrical equipment owned by The Business. The register will include a log of all tests/inspections carried out on each item of electrical equipment. The Business will maintain this register and retain the records for at least five (5) years.

The QTP will ensure any Electrical Worker conducting any inspection and tests of Electrical Equipment under this procedure are competent to do so in accordance with AS-3760: in-service safety inspection and testing of electrical equipment.

All electrical equipment and appliances will be connected to an appropriate Residual Current Device (RCD) and the length of any leads shall be minimised.

All portable, semi-portable and transportable electrical power tools, equipment, leads, portable RCD's etc., will be certified as safe by a licensed Electrical Worker and fitted with a current compliance tag.

All RCDs, portable tools & electrical leads in the field will be tested and tagged at 3 monthly intervals or by specific state or client requirements, providing the requirements are not greater than three months. All equipment in offices will be tested and tagged in accordance with AS 3760.

Any electrical equipment found to be defective or due for retesting will be tagged with an Out of Service tag and immediately removed from use until the fault is rectified or properly disposed of. The length of electrical extension leads used in field is generally limited to 35 metres.

Where applicable, in-service testing and inspection shall include as a minimum:

- An external inspection of the equipment and the connecting facilities (e.g. supply flexible cord)
- Protective earth continuity tests for single insulated equipment, power boards and cord sets

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- Insulation testing, which may be achieved by measuring insulation resistance, or leakage current
- Confirmation of the correct polarity of live connections in cord sets with re-wireable plugs and cord extension sockets

3.12.3 RELATED POLICY & PROCEDURES

Visual safety examination / inspection procedure

3.12.4 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment

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3.13 VISUAL SAFETY EXAMINATION / INSPECTION

3.13.1 OBJECTIVE

To identify the steps to be taken when performing a safety examination of an electrical installation.

3.13.2 METHOD

The objective of conducting a safety examination for a customer is to ensure that the installation is electrically safe and that as far as can be seen the installation complies with the intent of the current wiring rules.

A visual examination should also include a safety check of appliances and leads if requested by the customer. A safety examination does not guarantee that appliances and equipment will work correctly.

The Visual safety examination / inspection check list and report shall be used for recording results. A written report is to be provided to the customer even when no defects have been identified using the Electrical Safety Report. A copy of these documents shall be retained for at least five (5) years.

Clauses noted below are from AS/NZS 3000:2007 unless indicated otherwise.

3.13.2.1 GENERAL

- Basic protection (protection against direct contact with live parts), e.g. insulation and enclosure.
- Fault protection (protection against indirect contact with exposed conductive parts), e.g. by the use of automatic disconnection of supply, double insulation or isolating transformers.
- Protection against hazardous parts, e.g. enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.
- Protection against the spread of fire, e.g. penetration of fire barriers.
- General condition of the electrical equipment, e.g. signs of damage that could impair safe operation, disconnection of unused electrical equipment.

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3.13.2.2 CONSUMER MAINS

- Current carrying capacity.
- Voltage drop, e.g. size of conductors.
- Underground installation conditions, e.g. enclosure, depth of burial, mechanical protection
- Aerial installation conditions.
- Connection of wiring.
- Protection against external influences.

3.13.2.3 SWITCHBOARDS

- Location, e.g. access and egress.
- Protective devices, e.g. selection and setting of adjustable protective devices for compliance with overcurrent protection, arc fault protection and discrimination requirements.
- Isolating devices, e.g. main switches.
- Connecting devices, e.g. neutral bars, earth bars and active links.
- Connection and fixing of wiring and switchgear.
- Identification and labelling of electrical equipment.
- Protection against external influences.

3.13.2.4 WIRING SYSTEMS

- Conductor size, e.g. current-carrying capacity and voltage drop.
- Identification of cable cores.
- Adequate support and fixing.
- Connections and enclosures.
- Particular installation conditions, e.g. underground, aerial, safety services.
- Segregation from other services and electrical installations.
- Protection against external influences, e.g. enclosure.

3.13.2.5 ELECTRICAL EQUIPMENT

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- Isolation and switching devices for protection against injury from mechanical movement devices and motors.
- Isolation and switching devices for protection against thermal effects, e.g. motors, room heaters, water heaters.
- Switching devices for particular electrical equipment, e.g. socket outlets, water heaters, etc.
- Particular installation conditions, e.g. locations affected by water, explosive atmospheres, extra-low voltage, high voltage.
- Compliance with required Standard.
- Connection, support and fixing.
- Protection against external influences.

3.13.2.6 EARTHING

- MEN connection.
- Earth electrode.
- Earthing conductors, e.g. size, identification.
- Equipotential bonding conductors, e.g. size, identification.
- Connections, joints and terminations.
- Protection against external influences.
- Connection to earthing arrangements for other systems.
- Creation of earthed situation that may require earthing of additional electrical equipment.

If it is not possible to obtain entry to a room/area or switched socket-outlets cannot be viewed because of furniture, the details should be listed on the Visual Safety Examination/Inspection.

3.13.3 RELATED POLICY & PROCEDURES

Working Live Policy

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3.14 TESTING AN ELECTRICAL INSTALLATION

3.14.1 OBJECTIVE

. To detail the electrical tests that must be completed before and after electrical installation work is connected to supply. This procedure is based on, and is consistent with Section 8 of AS/ NZS 3000 should be referenced.

3.14.2 LEGISLATION

A person who installs electrical equipment or an electrical installation has an obligation to ensure that:

- The way the electrical equipment or installation is installed is electrically safe
- The processes followed for installing the electrical equipment or installation, when installed, will be electrically safe
- After the electrical equipment or installation is installed, the person tests and examines it to ensure it is electrically safe

3.14.3 OBLIGATION OF REPAIRER OF ELECTRICAL EQUIPMENT OR ELECTRICAL INSTALLATION

A person who repairs electrical equipment or an electrical installation has an obligation to ensure that:

- The way the electrical equipment or installation is repaired is electrically safe
- The processes followed for repairing the electrical equipment or installation, when repaired, will be electrically safe
- The electrical equipment or installation, when repaired, is electrically safe
- The obligation includes ensuring that the electrical equipment or installation, when repaired, is tested and examined to ensure it is electrically safe.

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3.14.4 METHOD

CAUTION: The Qualified Technical Person (QTP) (see definition in Overview Section CL 1.4.1) for The business must confirm the competence of any Electrical Worker before they are permitted to conduct any testing included within this procedure. If an Electrical Worker is deemed competent to test, the appropriate entry shall be included on the application for employment form. Where a worker is not confirmed competent measures must be implemented to ensure all electrical work is tested by a competent person prior to commissioning. Records shall be kept to verify that all electrical work has been tested and who undertook the testing.

Comply with the Testing Process Flow Chart before proceeding.

Conduct a visual examination of the installation using Procedure - Visual Safety Examination / Inspection of an Electrical Installation and its associated forms.

Electrical test results should be recorded on the Electrical Test Record. This will be valuable if the The Business and/or worker are required to verify mandatory testing has been carried out.

This testing procedure is derived from AS/NZS 3000:2007. It has been arranged so that testing and checking may be carried out in a logical and orderly manner. However, it is acceptable to vary the written procedure providing the same results are achieved, the intent of the procedure is satisfied and the installation is electrically safe. The inspection process should be “results orientated” and not necessarily procedural orientated.

3.14.4.1 TEST EQUIPMENT

All test equipment used for testing under this procedure shall in accordance with Procedure - Testing of electrical instruments (see 3..4) & Before use inspection of test instruments (see 3.5).

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3.14.4.2 TESTS REQUIRED

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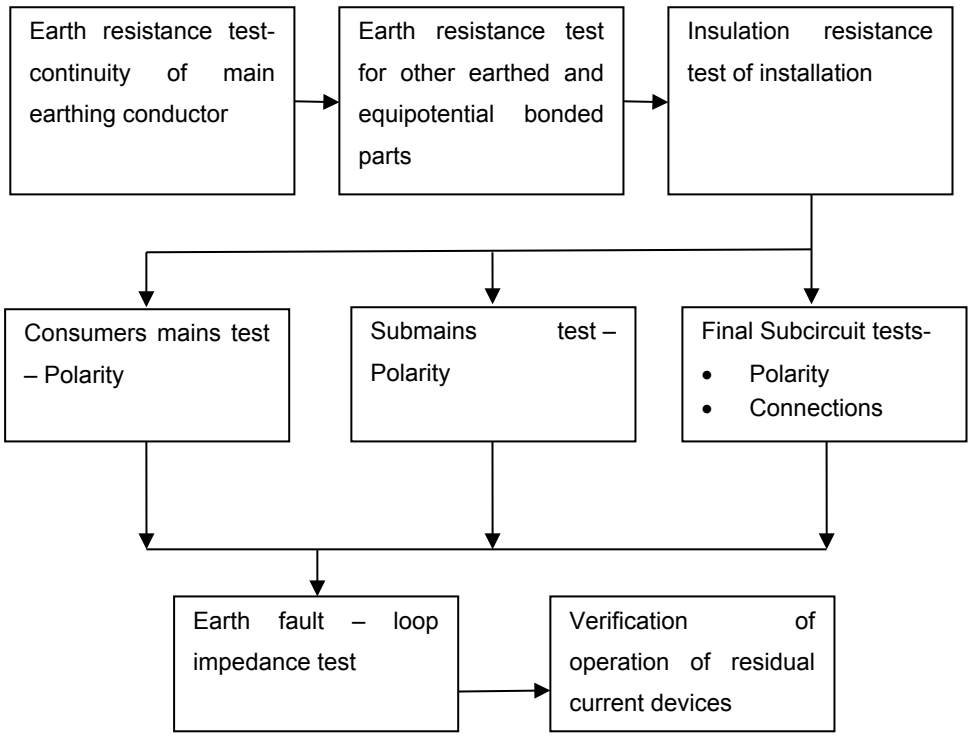
Mandatory tests:

- Visual inspection
- Continuity of earthing system
- Insulation resistance
- Polarity
- Correct circuit connections
- Fault loop impedance in accordance with CL 8.3.9 AS/ NZS 3000
- Operation of RCD in accordance with CL 8.3.10 AS/NZS 3000
- Integrity of consumers mains neutral in accordance with AS/NZS 4741 (Appendix B)



3.14.4.3 TESTING PROCEDURE

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This testing procedure can be used for the testing of new installations or a full electrical test on an existing installation.

If appropriate, advise the customer that it is necessary to disconnect all supply for a short period of time. Ensure that others are not at risk while testing is being carried out (eg access to switchboard or parts under test.

Carry out site specific risk assessment and implement control measures including PPE. Ensure testing instruments are suitable for the required tests, are in-test and that tools are in good condition.

Note the position of protective devices as to whether any are isolated. Leave installation in condition as it was found.

If supply is connected, isolate supply at the service fuse and implement measures to guard against accidental re-energisation. Disconnect any earth bond to the neutral at the service attachment point when there is an overhead service from the network to the installation

If an electrical installation fails a test at any stage, that test and any proceeding tests that may have been affected shall be retested to ensure accuracy of results.

3.14.4.4 VISUAL

A visual examination of the electrical work must be conducted to ensure that the electrical work is complete and that all cables are properly terminated. It is also important to verify that the work complies with the requirements in AS/NZS 3000 and any other relevant standard. This should be completed in accordance with Visual Safety Examination/Inspection procedure in Section 8 of AS/NZS3000.

3.14.4.5 PROTECTIVE EARTHING CONTINUITY

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Tests to prove the continuity of the earthing system are necessary to ensure the earthing system has been installed in a manner that will cause circuit protective devices to operate if there is a fault between live parts, other than the neutral, and the mass of earth.

An effective earthing system will ensure that exposed conductive parts of electrical equipment do not reach dangerous voltages when such faults occur.

- Remove the MEN connection and the main neutral from the main neutral link and secure. Where practicable, disconnect any earth conductor where there is likely to be an alternate earth path (e.g. water heater earth).
- The resistance of any equipotential bonding conductor or resistance of main earthing conductor shall be less than 0.5Ω.
- Test continuity of the main earthing conductor between the electrode, adjacent to the main earth connection and the main switchboard.
- Test continuity between the main earthing conductor at the switchboard and any portion of metallic water piping required to be bonded, i.e. any copper water pipe leaving the ground and entering the building.
- Test continuity between the main earthing conductor at the switchboard, all accessories and permanently connected appliances that are required to be earthed e.g. HWS, socket outlets, lights, motors, range, etc. Maximum resistance shall be low enough to allow the passage of current necessary to operate the circuit protective device.
- Results shall be consistent with the length, cross-sectional area and type of conductor material.

3.14.4.6 EARTH FAULT LOOP IMPEDANCE

Earth fault loop impedance maximum allowable resistance of a protective earthing conductor depends on the type and rating of the protective device and the impedance of the live conductors. Reconnect any earth bonds that were disconnected.

NOTE: If insulation resistance tests are carried out before continuity tests a defective continuity test may require a further insulation resistance test of the circuit affected.

3.14.4.7 INSULATION RESISTANCE

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- Test insulation resistance between the main earthing conductor at the switchboard and each conductor of the consumer's mains. Minimum Insulation Resistance 1 MΩ.
- Test insulation resistance between the main earthing conductor at the switchboard and the neutral link and terminals of the main switch/s.
- Minimum Insulation Resistance for the general installation is 1 MΩ and for appliances incorporating heating elements, it is 0.01 MΩ or a value permitted in the applicable appliance standard.
- Where circuits with low insulation resistance incorporate appliances, the appliances are to be disconnected where practical and the test repeated on the circuit to establish whether the equipment or the circuit has low insulation resistance.
- Test insulation resistance between active and neutral conductors of consumers mains (between phases if three phase), sub-mains and final sub circuits. Minimum Insulation Resistance 1 MΩ.
- Where building design results in structural metal work including conductive building materials that are not required to be earthed are in close proximity to wiring (eg conductive roof with no ceiling space) carry out an insulation test between the conductive part and associated circuits. Test insulation resistance between any conductive parts of low pitched roofs or roofs associated with cathedral ceilings, the main neutral link, and the terminals of the main switch/s. Minimum Insulation Resistance 1 MΩ.

3.14.4.8 POLARITY TESTING OF MAINS

An approved voltmeter and loop impedance tester are used to carry our these tests, Electrical Safety Legislation allows a variation of plus or minus 6% of the statutory voltage at the point of supply. **If the voltages recorded at the switchboard are outside these limits, the installation needs to be left disconnected until rectified.** The Supply Entity contacted for assistance if connections to the service attachment point are in good order.

Allowable Margins

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Phase to Neutral – 240 V	226 – 254V
Phase to Phase – 415 V	391 – 439 V
Phase to Phase – 480 V	450 – 510 V
Neutral to Independent Earth	0 – 6 V
Independent Earth – Installation Earth	0 – 6 V

- Turn OFF the main switch/s and any circuit breakers or remove all fuse carriers noting position of switches prior to test. Confirm that bonding conductor to a service support is not connected, and that main neutral and MEN connection are still disconnected from the neutral link.
- Reconnect supply (refer to Live Testing Procedure 3.2).
- Prove correct connections. Test between:
    - Independent earth and customer's earth (0v);
    - Independent earth and line terminal of the main switch (240v). For multiphase supply test between each pair of line terminals at the main switch ((415v);
- Perform neutral integrity test using loop impedance tester.

  Note: This test has been introduced within AS/ NZS 4741 to address the challenges of confirming Insulation Piercing Connections associated with connections to the network are effective.:
    - Connect loop impedance test neutral and earth leads to the main neutral conductor andthe active lead to an incoming active on the line side of the main switch. Conduct test to confirm impedance is equal to or less than 1 ohm.
    - Reconnect the main neutral and MEN connection to the main neutral link.
    - For 3 phase installation – confirm phase rotation is correct.
    - Return switches to the position they were in prior to the testing.
    - Where a neutral bonding conductor was disconnected previously - test to ensure the bonding conductor is not connected to the service active:
    - Test neutral bond tail (0v);
    - Connect bond to attachment point
    - Confirm bonded metalwork is not energised (0v)
    - Verify that the MEN connection and main neutral are connected to the main neutral link;

- Using an approved tester confirm there is no dangerous voltage at the neutral link (no indication)
- Carry out other installation tests as applicable
- If this completes the testing required for the work undertaken, advise the customer that supply has been restored.

NOTE: A similar polarity test sequence is required for sub-mains to all other switchboards .

NOTE: Replacement of the main earth and neutral into the neutral link at this time is to minimise the possibility of a potential rise on the earthing system during tests and causing others on site to receive a shock.

- Test between the main neutral conductor and the line side of all circuit protective devices (CPDs) – proves supply at CPDs.
- Test between the phases of circuit protective devices on a multiphase installation.
- Test between the main neutral conductor and the load side of any circuit breakers. Test lamps should not light proving the CBs turn off.

3.14.4.9 TESTING AND CHECKING OF CIRCUITS

Note: if complete installation test is not being carried out, contunity testing, insulation testing and loop impedance as per 3.14.4.5, 3.14.7 &3.14.4.5 are required to be undertaken prior to these tests.

Water heater:

- Energise circuit
- Check that the control switch, over temperature cut-out and thermostat are connected in the active conductor
- Check that the neutral conductor corresponds with the active conductor and that there is no interconnection with other circuits
- Check access is available for component replacement and maintenance
- Check circuit loading and that the current carrying capacity of the cable, control switch and protection device has not been exceeded and the switchboard is correctly marked. For water

heaters with off peak and booster elements that have a common neutral, a double pole control switch or double pole circuit breaker is required

Range/ cooking appliance:

- Ensure that any isolating switch and all range element control switches are in the "OFF" position

NOTE: kW rating of range and check the current carrying capacity of all cables and equipment forming part of the final sub-circuit for the range has not been exceeded.

- Connect supply and prove that any isolating switch is connected in the active conductor and effectively isolates supply.
- Check that the neutral conductor corresponds with the active and that there is no interconnection with other circuits

Power Circuits:

- Energise and test one circuit at a time, checking each outlet individually to confirm that the active, neutral and protective earthing conductors are correctly connected so that there is no short circuit between conductors, switching of the outlet is effective, there is no transposition of conductors or interconnecton to other circuits.
- Energise the RCD/s and test for accuracy with an RCD test instrument. The RCD/s should trip between 50% and 100% of rated value. (300ms for 30mA RCD, 40ms for 10mA RCD)
- Energise all applicable circuits and press any RCD test button to ensure it is operational
- Check cable rating, RCD current and trip rating, fuse element or circuit breaker size and switchboard marking
- Confirm loop impedance is within limits in accordance with Clause 8.3.9.3 of AS/NZS 3000 for any outlets that are not protected by an RCD as outlined in AS/NZS 3000 8.3.9.

Lighting Circuits:

- Energise each lighting circuit separately. Check that each light works
- Test light switches for correct polarity

- Energise any RCD/s and test for accuracy with an RCD test instrument. The RCD/s should trip between 50% and 100% of rated value
- Check cable rating, fuse element or circuit breaker size and switchboard marking

Permanently Connected Appliances or Equipment:

- Energise each circuit separately
- Check the circuit protection device does not exceed the current carrying capacity of the conductor
- Energise any RCD/s that may be associated with permanently connected appliances (e.g. pool equipment) and test for accuracy with an RCD test instrument
- 3.14.4.6 EARTH FAULT LOOP IMPEDANCE

- The fault loop impedance of all circuits must be verified to meet (Cl 1. 5.5.3 (c) and Cl 5.7 of AS/ NZS 3000

3.14.5 GENERAL

Maximum Demand

Using total loading obtained from previous tests, calculate the maximum demand and check that the rating of the consumer's mains and main switch are suitable.

Check marking and rating of main switch/s is correct and refit neutral link cover where required. Test with the whole of the installation energised, including lighting points switched ON, that any exposed conductive parts are not live. Ensure any fridge, freezer or hot water system is energised and stove elements and oven are off.

Before leaving the site check that the switchboard is in the same condition as it was found. Ensure any fridges, deep freezes or hot plate elements are in the same electrical position (i.e. on or off) as when you found them.

RECHECK THE MEN CONNECTION

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3.14.6 RELATED POLICY & PROCEDURES

Working Live Policy

Electrical safety obligations

Work process flowchart

Testing of electrical instruments

Before use inspection of test instruments

Isolation, Safety tag and lock-out

Visual Safety Examination/Inspection

Accessing a pit or pillar

3.14.7 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Asbestos

SWMS Working on or near exposed energised electrical equipment

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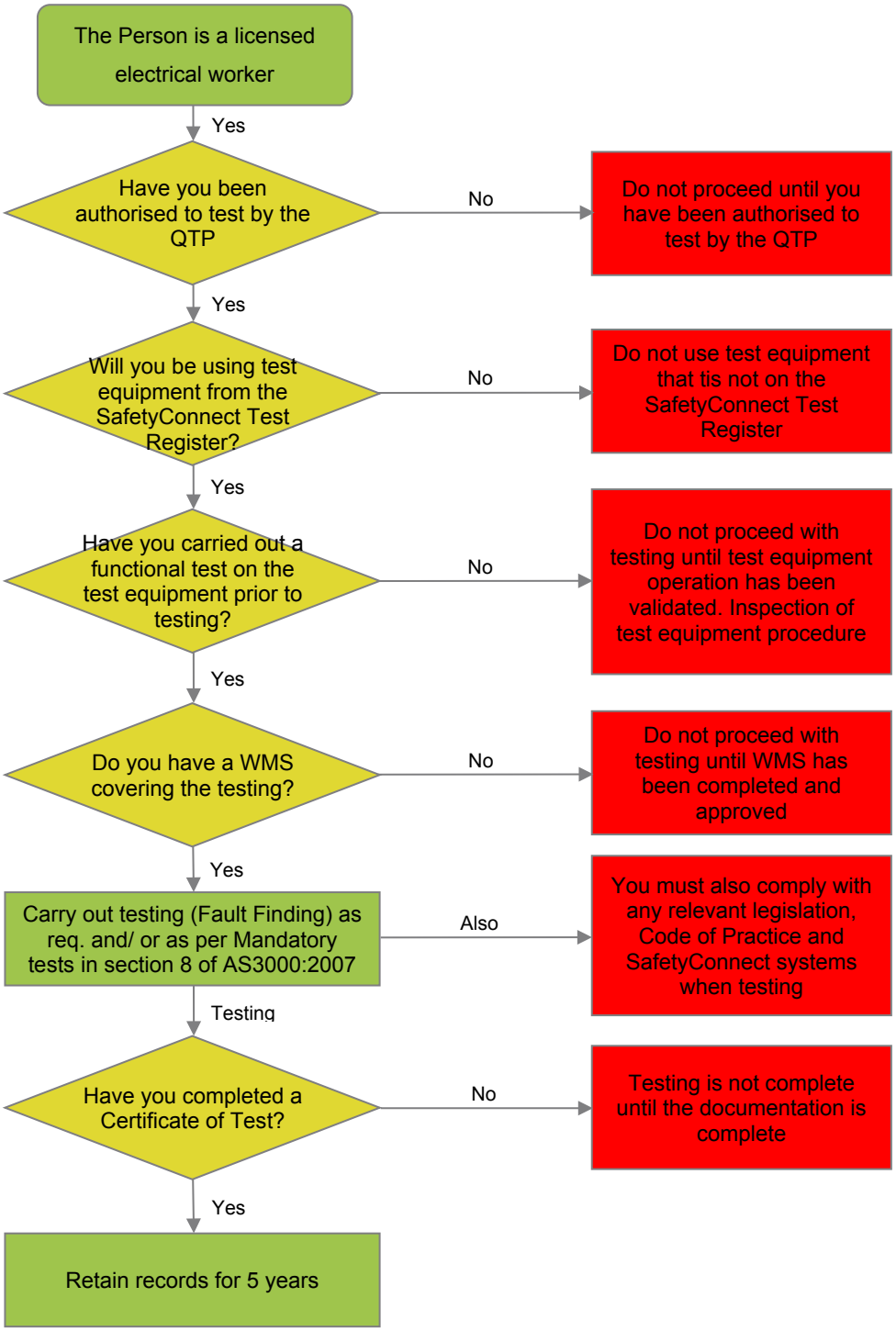
Figure 9: Testing Process Chart



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3.15 ACCESSING A PIT OR PILLAR

3.15.1 OBJECTIVE

To identify the safe procedures that may be required when accessing a pit, pole or pillar.

3.15.2 LEGISLATION

Authorised Person, for an electrical part, means a person who:

- Has enough technical knowledge and experience to do work that involves contact with, or being near to, the electrical part
- Has been approved by the person in control of the electrical part to do work that involves contact with, or being near to, the electrical part, or is authorised to act for the person in control of the electrical part

Any Electrical Worker who is required to access a pit, pole or pillar or work in the vicinity of an open pit or pillar must be an Authorised Person.

3.15.3 METHOD

The QTP for The Business and/or the ECA shall establish if an Electrical Worker has the appropriate competencies to safely access a Distributors pit, pole or pillar prior before allowing them to become an Authorised Person for The Business.

The QTP for The Business and/or the ECA will confirm in writing to the Electrical Worker that they are an Authorised Person for The Business upon gaining authorisation from the person in control of the electrical equipment (eg Distributor).

NOTE: The status of Authorised Person given by The Business is not transferable and ceases when/if the worker leaves The Business.

3.15.4 RISK ASSESSMENT

A risk assessment will be conducted at every job. Identified control measures will be implemented. Depending on the type size and complexity of the work activity, the risk assessment may be written. This will be the decision of the person carrying out the work.

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3.15.5 RELATED POLICY & PROCEDURES

Working Live Policy

3.15.6 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Excavation and trenching

SWMS Confined space

SWMS Working on or near exposed energised electrical equipment

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3.16 PORTABLE ELECTRICAL TOOLS

3.16.1 PORTABLE ELECTRIC TOOLS

Portable electrical tools will:

- Be given a visual safety check before each use
- Be protected by either a portable or fixed 30 mA RCD
- Be tested (as a minimum) every 3 months as per Procedure – Testing and Tagging or by State or client requirements
- Be checked at the beginning of each week to ensure the item is in-test and the tag in place

3.16.2 RCD

Will be tested (as a minimum) every 3 months as per Procedure – Testing and Tagging or by State or client requirements.

3.16.3 EXTENSION LEADS

Extension leads will:

- Be heavy duty
- Be fitted with a shrouded socket and have insulated pins
- Be given a visual safety check before each use
- Be tested (as a minimum) every 3 months as per Procedure – Testing and Tagging or by State or client requirements
- Be checked at the beginning of each week to ensure the item is in-test and the tag in place
- Not be placed through doors and windows where there is a possibility of damage if the door or window is closed
- Not be placed in a position to cause a person to trip or covered to prevent tripping;
- Not be used when tightly coiled
- Be kept clear of walkways and driveways as much as possible
- Not be placed in a position where the lead is subject to mechanical or environmental damage
- Not be connected to a double adaptor

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3.16.4 WORKPLACE SAFETY INSTRUCTIONS

Workers of The Business will conform to any written safety instruction being used by the owner/manager of the workplace.

3.16.5 RELATED POLICY & PROCEDURES

Working Live Policy

Safety tag and lock-out

Testing and Tagging

3.16.6 FOR POTENTIAL HAZARDS AND CONTROL MEASURES

Refer: SWMS Working on or near exposed energised electrical equipment

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3.17 WORKING IN CEILING, CRAWL IN SPACES AND ON CONDUCTIVE ROOFS

3.17.1 OBJECTIVE

To identify the requirements for carrying out work in ceilings, crawl in spaces and on conductive roofs (CCICR Work).

3.17.2 LEGISLATION

The requirement of the OHS/Electrical legislation is that safety risks be identified and mitigated to As Low as Reasonably Practicable (ALARP).

Additional costs for the work carried out at another time or commercial inconvenience are not, in themselves, justifiable reasons for defending ALARP. Regulators have issued guidelines that are reflected in the procedure. The Guidelines indicate that the first and most effective approach for this work is to isolate supply at the switchboard feeding the area being worked on.
The requirements of this procedure apply to all the business operations. Where the customer or other Person in Control of the installation prescribes alternative requirements that are of a higher standard, these shall be applied.

3.17.3 METHOD

ISOLATE SUPPLY

As it is extremely difficult to implement controls equivalent to positive isolation of the supply which is the preferred method for all CCICR Work. Where positive isolation is not achievable then the procedure for CCICR work in or adjacent to the area not isolated (refer 3.17.7) is to be followed. If this method is not achievable then an electrical risk assessment is to be conducted and express approval from the *worker in charge* is required to conduct work with potentially live parts in or adjacent to CCICR. (refer 3.17.7.1).
Where this procedure is not followed The *worker in charge*, in permitting a worker to work in these high risk areas without isolating supply, must confirm that the reason for not isolating supply is defendable on safety grounds and that the risk of electric shock from exposed conductive parts is mitigated to As Low As Reasonably Practicable. The effectiveness of the controls should be discussed and agreed with by workers and the Customer/ Person in control of the site if applicable.

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3.17.4 RISKS

The major risks associated with this work are electric shock, confined spaces and fall from height. This procedure addresses the risk of electric shock; also refer to Confined Spaces and Heights safe work method statement.

3.17.5 MANAGING THE RISK OF ELECTRIC SHOCK WHEN PERFORMING CCICR WORK.

Preferred option:

- Before starting any CCICR Work turn off all electricity at the switchboard supplying the area;
- Take steps to prevent the supply from being accidently re-energised (refer isolate & lock out procedure 3.9);
- There may still be a risk from any Alternate Supply, Sub Mains and Consumers Mains as these will not be isolated. For this reason the written on-site risk assessment will need to consider this and ensure any alternate supply, sub mains or consumers mains that are installed in or adjacent to the area are isolated and steps taken to guard against accidental re-energisation.
- Where solar photo voltaic (PV) systems are installed, DC supply cables from the solar cells on the roof to the inverter unit will be live when the solar cells are generating electricity. For this reason the written on-site risk assessment will need to consider this.
- When undertaking CCICR Work the worker must ensure that cables are not damaged creating a risk for others.

Option where isolation is not possible:

- **Where all electrical circuits in or adjacent to the area are not isolated the requirements in 3.17.7 must be followed.**

3.17.6 CCICR WORK CHECKLIST

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Prior to carrying out any CCICR Work:

- Turn off all electricity in or adjacent to the area the CCICR Work is to be undertaken;
- Take steps to prevent supply being accidently re-energised (refer isolate & lock out procedure 3.9);

Complete pre-work risk assessment by:

- Identifying hazards that may pose risks. These may include high temperatures, lack of ventilation, evidence of vermin, sharp objects, asbestos, lack of lighting, type of lighting, type of insulation material, accessibility to the work are (e.g. cramped and awkward positions), working at height and location of electrical wiring, piping and conductive parts.

Carrying out CCICR Work:

- Ensure someone is aware of where you are and contact with them is maintained until the work is completed;
- Be aware that heat and humidity may cause heat stress, so make sure fluid intake is sufficient to ensure you do not become dehydrated;
- Take additional lighting (e.g. torch) with you as the lighting is generally poor in ceiling spaces;
- Take care accessing and traversing the work area, avoiding tripping over debris, material and the ceiling trusses;
- Step carefully on ceiling joists or other beams – not the ceiling material;
- Use appropriate tools – preferably manual or battery operated tools;
- Be aware of the location of electrical cables, fittings and equipment and avoiding contact with them;
- Carry out and test all electrical work in accordance with AS/NZS:3000 with particular focus on positioning cables and equipment correctly in relation to potential mechanical damage, electric shock and fire (particularly light fittings and transformers);
- Ensure that, if fixing points are required (e.g. saddling cables in place), fixings are well clear of all electrical cables and equipment;
- Make sure you do not damage any cables or electrical equipment; and

- Use appropriate, well maintained and correctly-fitted personal protective equipment;

Completion of CCICR Work:

- Replace any insulation material that may have been disturbed or moved for access, ensuring that it is not covering any electrical fittings or equipment, especially downlights;
- Dispose of debris and waste appropriately; and
- Wash your hands, face, neck and hair with soap and water.

3.17.7 Approved procedure when all circuits are not isolated.

This procedure must be followed where circuits in or adjacent to the area where the CCICR Work is to be carried out are not able to be de-energised. The worker in charge is the management representative delegated responsibility for supervision of the CCICR Work by the Business;

- There shall be a designated worker in charge for all work carried out by the Business;
- The *worker in charge*, in permitting a worker to work in these high risk areas without isolating supply must confirm that the reason for not isolating supply is defendable on safety grounds and that the risk of electric shock from exposed conductive parts is mitigated to As Low As Reasonably Practicable.

Control measures may include but are not limited to:

- Isolating the worker from any conductive parts using insulating barriers, PPE or by maintaining safe distance from the Parts;
- testing all conductive parts with an approved test method; and
- Verifying that all circuits in the area are protected by a functioning safety switch

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3.17.7.1 METHOD

The primary risk in this work that is addressed in this procedure is a worker receiving electric shock through mechanical damage to cables energizing conductive parts, exposed live parts associated with wiring or electrical equipment energizing conductive parts. An example would be conductive insulation or a metal ceiling batten being energized and the worker creating a path to earth.

To ensure this risk is controlled the following circumstances need to be considered in relation to circuits or electrical equipment in or near the area to be worked on:

- Are the reasons for not isolating justified (eg risk associated with isolating is higher such as disconnecting connections from network for consumers mains where there is no primary fuse)
- Are there likely to be any conductive parts in contact with energized wiring or equipment in close proximity to the worker during any of the work (including entry and egress)? and
- Is the energized wiring or equipment likely to be disturbed in a way that could create a shock path during the work?

The same controls are required as for live work including

- PPE, safety observer and treating all conductive parts as energized until testing proves otherwise.
- An approved voltmeter/ trailing leads with probe on insulated material at least 1 metre in length (to keep away from potential energized parts) is used to test that any conductive material or parts in proximity to the worker are not energized.
- The work procedure needs to ensure no cables or conductive parts are disturbed during the work.

Where the risk assessment confirms there is minimal risk associated with the above issues the work is authorized by the worker in charge under the CCICR policy.

Where the risk assessment is unable to confirm this risk is not minimal the work must not proceed unless there is express permission from the worker in charge.

This process is depicted in the following flow chart on the following page.

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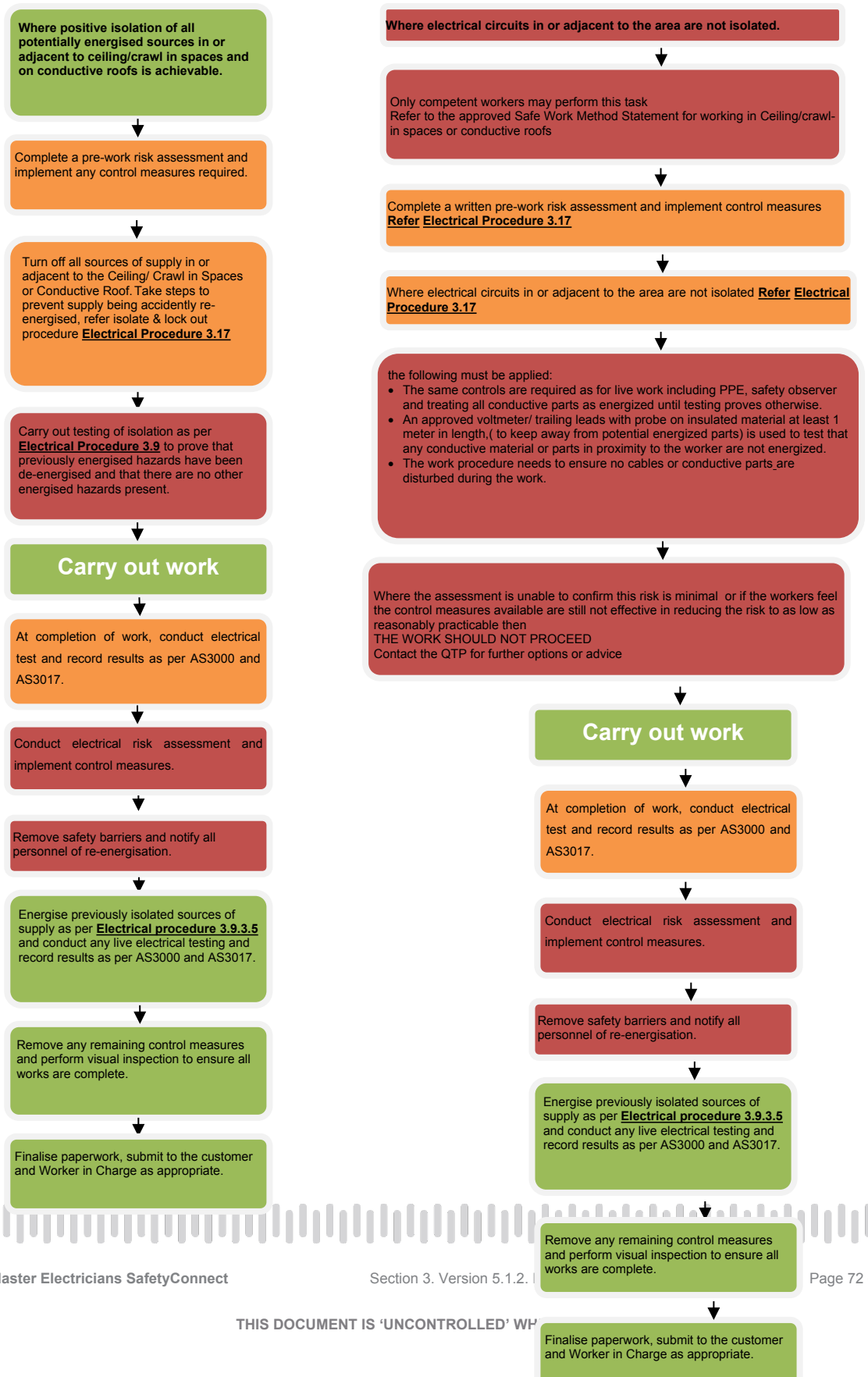
Fig 10

Ceiling, Crawl- in Spaces and on Conductive Roofs Flow Chart



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3.17.7.2 RESPONSIBILITIES

- **Worker in charge** – is responsible for making sure that this Policy and associated Procedures are implemented as appropriate by those listed below and that an effectiveness review of this Policy is untaken regularly (at least every 12 months). Ensure that workers are complying with the company policies and procedures. Worker in Charge- is responsible to undertake an on-site risk assessment and ensuring proposed controls are adequate and effective
- **Workers** – are responsible for complying with company policies and procedures, and implementing risk controls detailed on the on-site risk assessment or APPROVED Safe Work Method Statement prior to commencing CCICR Work.

3.17.7.3 RELATED POLICIES & PROCEDURES

Working Live Policy, Working at Heights Policy, Asbestos Policy, Isolate & Lock Out Procedure.

This document is based on Working on roofs and in ceiling spaces published by Workplace Health and Safety Queensland and Department of Commerce Western Australia.