

## **1.2 Hazards are identified, risks assessed, and control measures identified and applied**

### **2.1 Hazard control measures are monitored in accordance with workplace requirements**

You need to be familiar with AS4741:2010 as well as other hazards associated with carrying out tests such as working on or near live equipment need to be considered in safe systems of work.

The following is a list of items that must, where applicable, be included as part of the pre-test visual inspection:

- The location is correct
- Isolation is correct
- Labels are installed
- No visible damage to equipment
- Equipment is ready for testing
- Wiring is complete with no visible damage
- Connections are correct, complete and mechanically sound
- Alternative supplies are identified and managed
- Persons and animals are clear of any object that may become energised during testing
- Workers notified of testing in progress

### **1.3 Tools, equipment and personal protective equipment (PPE) required for testing are determined, obtained and confirmed in working order**

#### **2.2 Use of tools, equipment and PPE for testing are carried out in accordance with workplace requirements**

#### **2.3 Testing of connections to electricity networks are conducted in accordance with workplace requirements and AS4741**

Before the use of any test equipment, the requirements in section 3 of AS4741:2010 must be followed.


Notes:

1. All test instruments used on the low voltage electricity network must be appropriately rated.

2. Users must ensure that good electrical contact by test probes is always achieved considering mains and apparatus that are exposed to weather may be covered with non-conductive coverings such as dust, oxide etc.

3. Users must be assessed as competent in the instruments use.

The table below lists examples of instruments used to complete testing described within this guide.

<b>Test Type</b>	<b>Instrument</b>
<b>Safe to Approach</b>	<p data-bbox="491 636 890 674"><b>Non-contact proximity tester</b></p>  <p data-bbox="491 1263 1358 1404">Proximity type non-contact voltage detectors are used for checking the absence of hazardous LV a.c voltage on poles and exposed metalwork such as meter boxes etc. They should be capable of detecting voltages as low as 50V.</p>

<b>Polarity</b>	<b>Test Lamps</b>
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Test lamps are used on low voltage mains and apparatus to test for the presence or absence of supply. They are also used to distinguish between phase to neutral or phase to earth voltages (230 V) and phase to phase voltages (400 V).

Note: Test lamps may not give a visible glow for voltages less than 90V.

As test lamps are low impedance (approx.  $2000\Omega$ ) work procedures must consider the potential low impedance safety risks.

### **Multimeter**

Multimeters can be used to confirm polarity.

Work procedures must address risks such as incorrect operation (i.e. measuring of voltage when meter has been configured for current measurement) and incorrect readings due to high impedance, incorrect scale setting etc.

**Neutral Integrity**

**Loop Impedance Meter**




A loop impedance meter is used to provide the impedance of an active and neutral circuit back to the supplying transformer. The incoming service neutral must be disconnected from the installation earthing conductors to prevent a parallel return path through the earth resulting in an incorrect loop impedance reading.

### Test Load



	A test load is used to provide a load between an active and neutral to allow measurements of voltage or current to be taken. The load should be 9 amps or greater.
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<b>Independent Earth</b>	<b>Independent Earth</b>  <p>An independent earth is used to establish an effective electrical connection to earth. It must be installed no closer than 2m from other conductive structures. No uninsulated contact with the independent earth stake or lead should be made when undertaking measurements.</p>
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On arrival at the work location, a visual inspection must be carried out as per AS4741:2010 section 2.

### 5.1 Pre-test visual inspection

A visual inspection must be carried out before, or in association with, testing in order to prevent electrical shock or damage to property.

The following is a list of items that must, where applicable, be included as part of the pre-test visual inspection:

- The location is correct
- Isolation is correct
- Labels are installed

- No visible damage to equipment
- Equipment is ready for testing
- Wiring is complete with no visible damage
- Connections are correct, complete and mechanically sound
- Alternative supplies are identified and managed
- Persons and animals are clear of any object that may become energised during testing
- Workers notified of testing in progress

#### Test Procedure

The following tests must be carried out when required as per AS4741:2010 clause 4.1. Contact the DNSP if test results are outside of the expected range

#### 1.1 Polarity Test

Where required as per section 4.1 of AS4741:2010, before the connection of a conductor to an energised active or distribution neutral it must be proven correct by electrical testing. The requirements in section 4.3 of AS4741:2010 must be followed.

Note:

- One method to disconnect active supplies to the installation is the removal of service protective devices.

- The incoming neutral must be disconnected from the earthing conductors of the installation and connected to an effective earth as this will prevent a hazardous voltage rise on the service neutral conductor during a polarity test.

It is recommended to carry out a safe to approach test on metal surrounds and structures as part of the final confirmation step before leaving the location.

#### 1.2 Neutral Integrity Test

As per section 4.4 of AS4741:2010 this test is to prove the neutral connections of the supply to electrical installations, within the limits of the test.

AS4741:2010 provides 3 examples of tests which could meet this requirement however other tests may be used which achieve the same requirements as per section 4.4 of AS4741:2010. A

combination of tests should also be considered to minimise the possible disadvantages (such as requirement to remove the neutral when undertaking the impedance method) of individual tests. The 3 examples from AS4741 include:

- a) Voltage
- b) Impedance
- c) Current

### 1.2.1 Voltage Method

Appendix B of AS4741 specifies the method to be followed.

This method uses a test load and voltage measurements between the incoming neutral and independent earth to confirm if the neutral connections are effective.

#### Test Setup

The following process is used to obtain the required conditions to perform the test.

1. Supply to the installation to be disconnected. A common but not only available method to achieve this is by operating the service protective device.
2. Incoming neutral to be separated from the installation neutral link preventing any connection with the installation earth(s).
3. Connect a test load between an active phase and the incoming neutral.
4. Install an independent earth stake no closer than 2m from any other conductive structure. The installation earth may be used in place of the temporary earth stake if it has been confirmed as an effective earth.

#### Test

Voltage measurements are to be taken as follows:

V<sub>a</sub> – measure voltage from active phase to incoming neutral,

V<sub>b</sub> – measure voltage from active phase to independent earth stake, V<sub>c</sub> – measure voltage from incoming neutral and independent earth.

#### Results

The following results should be obtained to confirm suitable neutral integrity:

V<sub>a</sub> – This voltage should be approximately equal to the nominal supply voltage obtained from DNSP.

Vb – This voltage should be approximately equal to the nominal supply voltage obtained from DNSP.

Vc – Contact the DNSP to confirm an acceptable voltage value.

### Considerations

When developing a procedure for carrying out the voltage method test as per above, all considerations within section B2 of AS4741 must be considered.

## 1.2.2 Impedance

This method uses a loop impedance meter to measure the supply circuit impedance (also known as the external loop impedance).

DNSP

Transformer

Figure 2: Loop Impedance Method

### Test Setup

The following process is used to obtain the required conditions to perform the test.

1. Supply to the installation to be disconnected. A common but not only available method to achieve this is by operating the service protective device.
2. Incoming neutral to be separated from the installation neutral link preventing any connection with the installation earth(s). If the neutral is not separated, more than one return path will be included in the measurement giving a false indication of the service neutral impedance.

### Test

Connect a loop impedance meter (L) between an active phase and the incoming neutral. A loop impedance measurement is then taken.

### Results

Contact the DNSP to confirm an acceptable loop impedance value.

Note: For a 2 or 3 phase installation with a loop impedance value greater than the acceptable value, undertake the loop impedance test using other active phases to identify if the high impedance is within the neutral conductor.

### Considerations



When developing a procedure for carrying out the Loop Impedance method test as per above, all considerations within section B3 of AS4741 must be considered.

### 1.2.3 Current Method

This method compares the ratio of the current in the active phase compared to the current in the neutral by applying an appropriate test load.



Figure 3: Current Method

#### Test Setup

The following process is used to obtain the required conditions to perform the test.

1. Supply to the installation to be disconnected. A common but not only available method to achieve this is by operating the service protective device. Do not disconnect the incoming neutral.
2. Connect a test load between the active phase and the incoming neutral.

#### Test

Measure the ratio of current returning through the neutral conductor. This is generally achieved using a tong clip on ammeter. For example:

- As per diagram above measure CA using ammeter to confirm current through test load. Then measure CN to determine the ratio of current returning via the neutral conductor. The remaining current will be returning via earth connection(s) within the installation.

#### Results

Contact the DNSP to confirm an acceptable ratio value of current returning through the neutral conductor.

#### Considerations

When developing a procedure for carrying out the Current method test as per above, all considerations within section B4 of AS4741 must be considered.

### 1.3 Phase Rotation Test

As per section 4.5 of AS4741, where connections have been carried out on the active conductors supplying an installation with more than one phase, correct phase rotation shall be verified. Carry out the process as described in section 4.5 of AS4741.

It should be noted that a phase rotation instrument may give an incorrect result on a 3-phase supply where only 2 phases are available (i.e. one phase not electrically connected).

#### 1.4 Phase Confirmation

Workers need to perform a test to confirm the correct phasing prior to interconnection of conductors within a low voltage electricity network.

#### 1.5 Final Checks Before Leaving Work Location

Where connections have been removed to carry out testing, ensure all connections are reinstated and supply is reconnected (where required). The installation is to be left in a safe manner.

In addition, it is recommended before leaving the work location a safe to approach test (refer to section 7) is carried out on the switchboard and metal structures (such as raiser brackets, service poles, downpipes etc) to provide an indication that no hazardous voltage is present.

#### 1.6 Records

Records should be maintained by the company carrying out testing to confirm compliance to this guideline. Contact the DNSP (refer to section 9) to confirm any records to be supplied to the DNSP.

### **2.4 Corrective actions are undertaken in accordance with workplace requirements**

#### Post Test Inspection

The following is a list of items that must be included as part of the post-test inspection:

- Neutral identification tags have been installed on overhead neutral conductors identified as part of testing
- Ensure all test equipment has been removed
- Danger tags are applied if required and removed if redundant
- Ensure the neutral is connected prior to installation energisation
- All temporary markings have been removed
- All required test results recorded on testing form
- All covers removed for testing are undamaged, in place, and secured (sealed) if required

- Check all connections and terminations related to the work are correctly mechanically tightened. All connections must be secondary validated by a

combination of visual inspection and tug or pull tests

- All enclosures are secured and locked if required

- Danger and out of service tags are fully filled out and applied where required

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