7

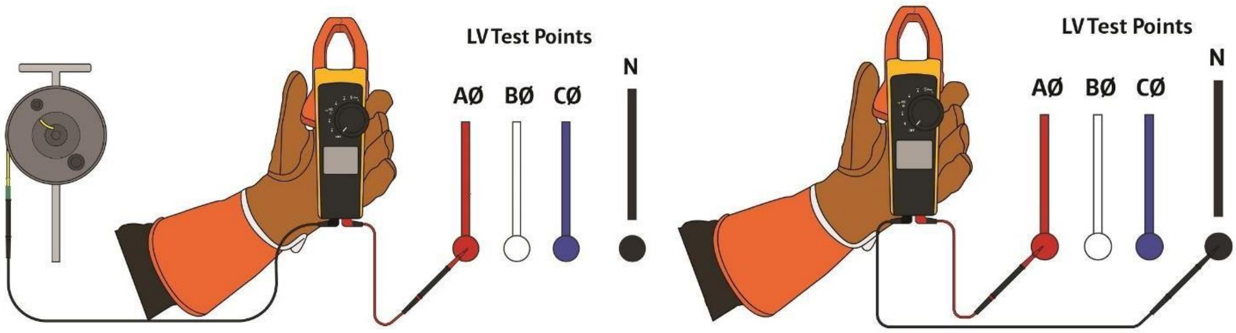
SECTION

OVERHEAD TESTING

2. OVERHEAD TESTING

This section applies to testing to allow safe energisation of overhead works related to conductoring, pole changes, service replacement, relocation and reconnection.

2.1 OH Mains Tests



All test results must be recorded in Cityworks.

PRIOR TO DISCONNECTION

1. Complete JRA, including review and implementation of controls from relevant SWMS in accordance with PO06100 Job Risk Assessment (pre-start) including mandatory PPCE
2. Perform Test 1 - PROXIMITY. OR Test 12 – POLE LEAKAGE DETECTION for pole inspectors
3. Perform Pre-test inspection
4. Perform Test 10 – PHASE ROTATION.
    - On mains if service neutrals remain unbroken
    - On each service if neutral broken

ISOLATE POWER (EAP)

5. Perform Test 2 - PROVE DE-ENERGISED.

Any voltage may indicate alternative supplies are present. Alternate supplies must be isolated prior to the installation being energised

6. Perform Test 8 – INSULATION RESISTANCE TESTING for in-service cable baseline results
7. Install LV bonders as per *Earthing Construction Manual*

PERFORM WORK

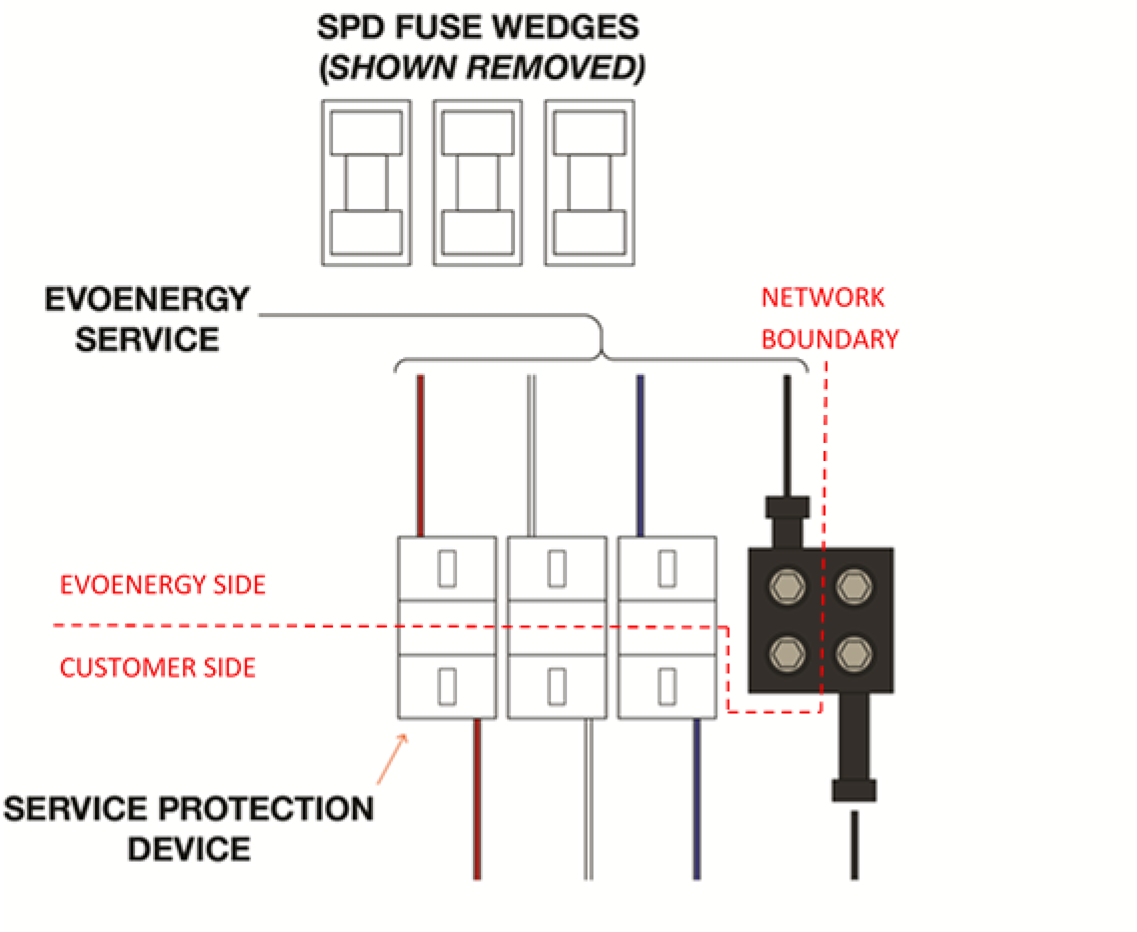
8. Ensure cable ends are disconnected at each end/connection point
9. Remove bonders for testing as per Earthing Construction Manual
10. Perform Test 8 – INSULATION RESISTANCE TESTING.
11. Check and confirm equipment/apparatus is safe to energise.

RESTORE POWER (EAP)

12. Perform Test 3 - NEUTRAL IDENTIFICATION and attach neutral identification tag
13. Perform Test 6 – POLARITY.
14. Perform Test 5 – VOLTAGE TESTING
15. Perform Test 10 - PHASE ROTATION.
16. Perform Test 9 – NETWORK PHASING.
17. Connect all cable ends as required by network.
18. Perform Test 1 - PROXIMITY.
19. Complete Post-test inspection.

2.2 OH Services Tests

The network boundary at an overhead Point of Attachment (PoA) is the customer side of the Service Fuse Holders and the customer side of the House Service Connector as per the Electricity Network Boundary Code 2017



All test results must be recorded in Cityworks.

Mandatory testing must be performed at the PoA end of the service

PRIOR TO DISCONNECTION

1. Complete JRA, including review and implementation of controls from relevant SWMS in accordance with Job Risk Assessment (pre-start) including mandatory PPCE
2. Perform Test 1 - PROXIMITY.
3. Perform Pre-test inspection.
4. Perform Test 10 - PHASE ROTATION.

SERVICE ISOLATED

5. Perform Test 2 - PROVE DE-ENERGISED.

Any voltage may indicate alternative supplies are present. Alternate supplies must be isolated prior to the installation being energised

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PERFORM WORK

6. Ensure cable ends are disconnected at each end/connection point.
7. Perform Test 8 – INSULATION RESISTANCE TESTING.
8. Check and confirm equipment/apparatus is safe to energise
9. Confirm PoA end of service remains open.

RESTORE POWER

10. Perform Test 3 - NEUTRAL IDENTIFICATION.
11. Perform Test 6 – POLARITY.
12. Perform Test 5 – VOLTAGE TESTING.
13. Perform Test 10 - PHASE ROTATION.
14. Voltage test between the service neutral and the installation neutral to ensure 0 Volts
15. Voltage test colour to colour across the service fuse holders (between the service and the consumer mains) to ensure 0 Volts.
16. Connect service neutral.
17. Perform Test 4 - NEUTRAL INTEGRITY. At switchboard (preferred) or at PoA.
    - Test 4A – NEUTRAL INTEGRITY BY FAULT LOOP IMPEDANCE; AND
    - Test 4B - NEUTRAL INTEGRITY BY INDEPENDENT EARTH AND VOLTMETER as detailed in 9.4.3
18. Connect neutral conductor.
19. Replace service fuses.
20. Perform Test 1 – PROXIMITY.
21. Complete Post-test inspection.

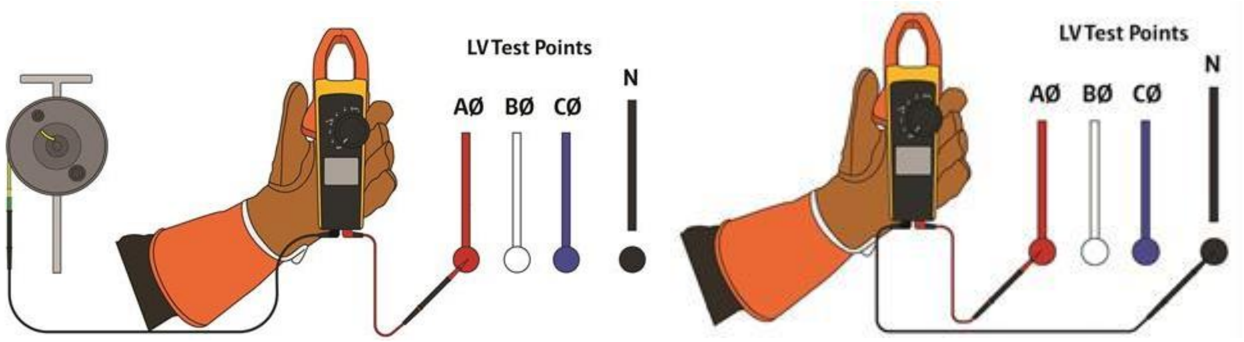
8

SECTION

UNDERGROUND TESTING

8. UNDERGROUND TESTING

8.1 UG Mains Tests



All test results must be recorded in Cityworks.

PRIOR TO DISCONNECTION

1. Complete JRA, including review and implementation of controls from relevant SWMS in accordance with *Job Risk Assessment (pre-start*) including mandatory PPCE
2. Perform Test 1 - PROXIMITY
3. Perform Pre-test inspection
4. Perform Test 10 – PHASE ROTATION.
   - On mains if service neutrals remain unbroken
   - On each service if neutral broken

ISOLATE POWER (EAP)

5. Perform Test 2 - PROVE DE-ENERGISED.

Any voltage may indicate alternative supplies are present. Alternate supplies must be isolated prior to the installation being energised

6. Perform Test 8 – INSULATION RESISTANCE TESTING for in-service cable baseline results
7. Install LV bonders as per *Earthing Construction Manual*

PERFORM WORK

8. Ensure cable ends are disconnected at each end/connection point

9. Remove bonders for testing as per *Earthing Construction Manual*
10. Perform Test 7 – CONTINUITY TESTING
11. Perform Test 8 – INSULATION RESISTANCE TESTING
12. Confirm cables connected at one end
13. Check and confirm equipment/apparatus is safe to energise

RESTORE POWER (EAP)

14. Perform Test 3 - NEUTRAL IDENTIFICATION.
15. Perform Test 6 – POLARITY
16. Perform Test 5 – VOLTAGE TESTING
17. Perform Test 10 - PHASE ROTATION.
18. Perform Test 9 – NETWORK PHASING
19. Connect all cable ends
20. Perform Test 1 - PROXIMITY.
21. Complete Post-test inspection.

8.2 UG Services Tests

The network boundary at an underground point of entry is the customer side of the service fuses and the customer side of the service neutral link as per the Electricity Network Boundary Code 2017

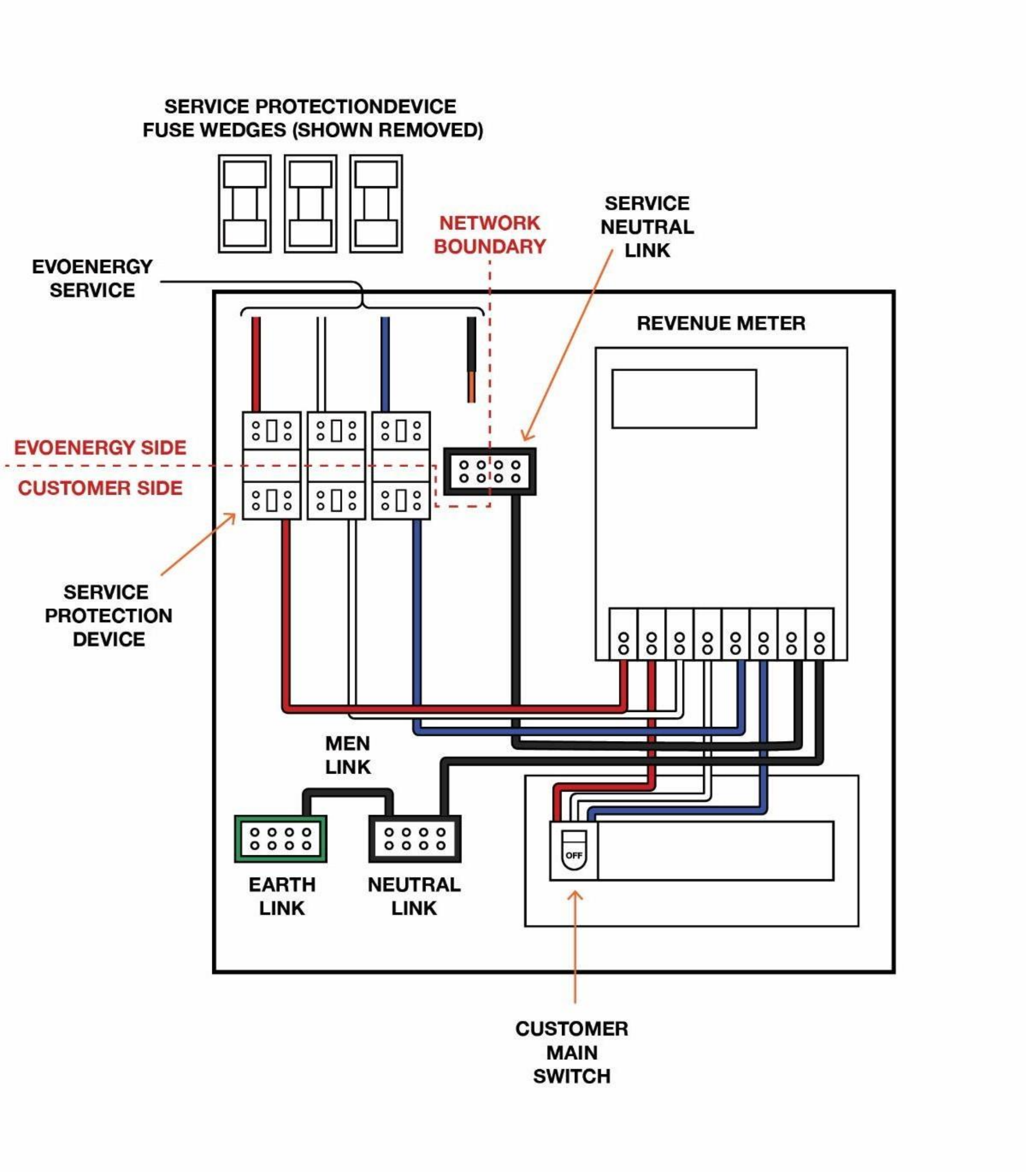


FIGURE 2. SERIES NEUTRAL METER CONNECTION

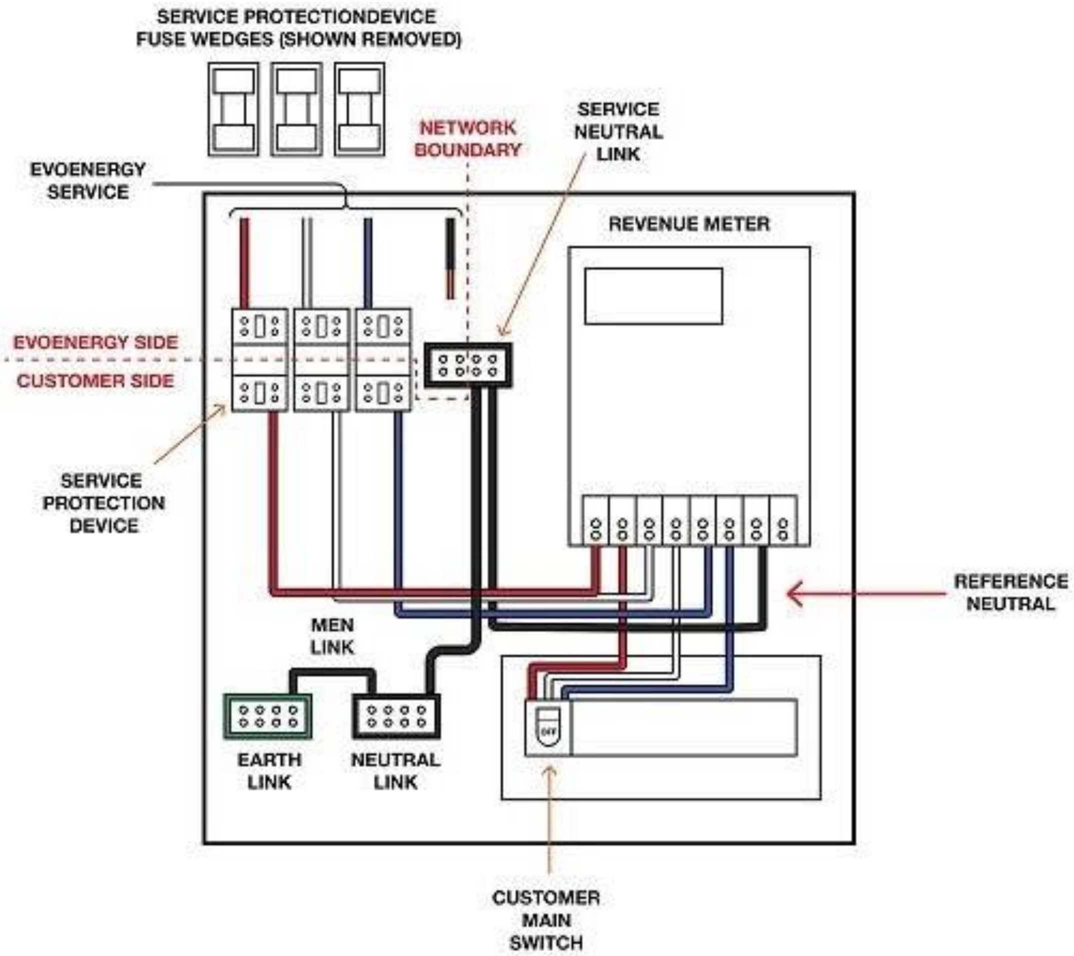


FIGURE 3. REFERENCE NEUTRAL METER CONNECTION

All test results must be recorded in Cityworks.

PRIOR TO DISCONNECTION

1. Complete JRA, including review and implementation of controls from relevant SWMS in accordance with *Job Risk Assessment (pre-start)* including mandatory PPCE
2. Perform Test 1 - PROXIMITY.
3. Perform Pre-test inspection
4. Perform Test 10 - PHASE ROTATION.

POWER ISOLATED

5. Perform Test 2 - PROVE DE-ENERGISED.

Any voltage may indicate alternative supplies are present. Alternate supplies must be isolated prior to the installation being energised

6. Perform Test 8 – INSULATION RESISTANCE TESTING for in-service cable baseline results

PERFORM WORK

7. Ensure cable ends are disconnected at each end/connection point
8. Perform Test 8 – INSULATION RESISTANCE TESTING
9. Perform Test 7 – CONTINUITY TESTING
10. Check and confirm equipment/apparatus is safe to energise

RESTORE POWER

11. Confirm cables connected at one end
12. Perform Test 3 - NEUTRAL IDENTIFICATION
13. Perform Test 6 – POLARITY
14. Perform Test 5 – VOLTAGE TESTING
15. Perform Test 10 - PHASE ROTATION.
16. Perform Test 4 - NEUTRAL INTEGRITY.
    - Test 4A – NEUTRAL INTEGRITY BY FAULT LOOP IMPEDANCE AND
    - Test 4B - NEUTRAL INTEGRITY BY INDEPENDENT EARTH AND VOLTMETER as detailed in 9.4.3.
17. Voltage test between the service neutral and the installation neutral to ensure 0 Volts
18. Voltage test colour to colour across the service fuse holders (between the service and the consumer mains) to ensure 0 Volts. (checking for alternate supply difference of potential)
19. Connect service neutral
20. Replace service fuses
21. Perform Test 1 – PROXIMITY.
22. Complete Post-test inspection

9

SECTION

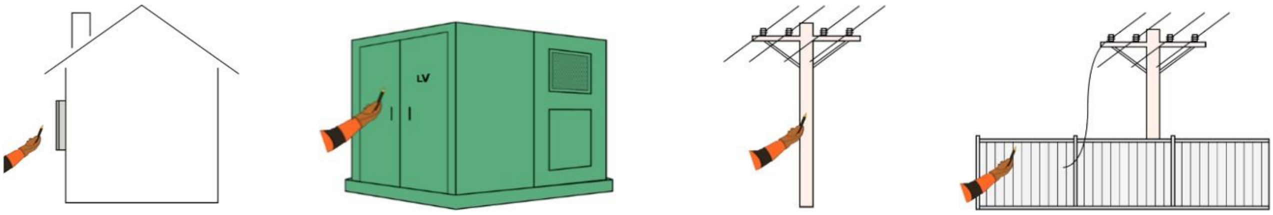
LOW VOLTAGE TESTS

9. LOW VOLTAGE TESTS

9.1 Test 1 - Proximity Testing

Appendix A – Non-contact test

Appendix B – Indication only



9.1.1 General

Proximity testing must be conducted:

- on approach to conductive structures/ enclosures such as meter boxes, PoE enclosures, padmount substations, conductive poles (see 9.14 Test 12 Pole leakage detection), roof gutters, riser brackets etc. Conductive elements mounted to non-conductive poles should also be checked
- after the energisation of equipment within or connected to the conductive structure/enclosure, or in the vicinity of equipment that may be energised.
- at conductive structures near to fallen conductors such as fences and hand rails

Proximity testing is a non-contact, indication only test for the presence of a hazardous voltage in a conductive structure or enclosure prior to physical contact being made by a worker.

The proximity detector is only effective on AC and will indicate a voltage has been detected when the tip of the device is placed in the proximity of 50-1000 Volts. The tip should be on or near the object being tested

As it is a non-contact device that utilises capacitive coupling to detect voltage, it can be affected by adjacent live equipment. If a live structure or enclosure is detected, verify the voltage present with a voltmeter and independent earth. If a voltage is present the worker must control the hazard by isolation or barricading, danger tag the isolating equipment, notify your supervisor and record in Cityworks

Proximity testing is not a suitable method to prove de-energised.
Test 2 - Prove de-energised is the only approved method to prove
a LV cable, conductor, apparatus or structure is de-energised for access.

9.1.2 Proximity Testing Equipment Required

- PPCE as per Personal Protective Clothing and Equipment - PO0605
- Greenlee GT12A Proximity Tester

9.1.3 Steps for proximity testing with Greenlee GT-12A

1. Visually inspect the tester for any damage, if damage is identified, remove tester from service, install out of service tag and report to supervisor
2. Turn tester on, LED in tip will flash every two seconds confirming ON status and battery OK condition. If LED remains on or instantly turns off – replace batteries

Hold the start button until LED in tip flashes once – this enables the beeper. If start button is held until the LED in the tip flashes twice – beeper is disabled.

USE THIS INSTRUMENT WITH THE BEEPER ENABLED

3. Where reasonably practicable, test the proximity tester on known source
4. The red LED in the tip will flash continuously while the device beeps at the same rate if an AC voltage between 50 and 1000 Volts is present
5. If the device does not detect an AC voltage between 50 and 1000 Volts, the LED in the tip will continue to flash at a rate of once every two seconds and there will be no beeping
6. If the instrument does not perform as described in point 5 above: replace batteries and re-test. If instrument still does not perform as inspected, remove from service, report and replace.
7. To test a conductive structure, place tip of instrument on or as near as possible to structure, hold for 3 seconds and move to another location on the structure. Test either side of hinged and bolted sections.
8. The red LED in the tip will flash continuously while the device beeps at the same rate if an AC voltage between 50 and 1000 Volts is present
9. If the device does not detect an AC voltage between 50 and 1000 Volts, the LED in the tip will continue to flash at a rate of once every two seconds and there will be no beeping
10. After use, inspect instrument for any damage and test instrument again on a known live source to verify operation

9.1.4 Escalation píocess foí live stíuctuíe/enclosuíe

PARAMETER	VALUE	ESCALATION STEPS
IF ENCLOSURE OR STRUCTURE IS FOUND TO BE LIVE BY PROXIMITY TEST	>50 volts	1. Notify anyone on-site that may contact the structure or enclosure and take steps to prevent any person coming in contact with the structure 2. Confirm by TEST 2 - PROVE DE-ENERGISED with a voltmeter and independent earth, also test structures and enclosures in close proximity that may be connected to the local earthing system

9.2 Test 2 - Prove de-energised

Live test

Test before you touch

All low voltage cables, conductors and equipment must be proven de-energised prior to being worked on

This test must be conducted in the following circumstances:

- Prior to the access of LV equipment as per *Energised Low Voltage Works Manual*
- Prior to the application of LV bonders as per the *Earthing Construction Manual*
- Prior to working on pilot cables
- When a proximity test on a structure or enclosure has indicated a voltage is present
- As required by the *Electrical Safety Rules*

9.2.1 Prove de-energised - equipment required

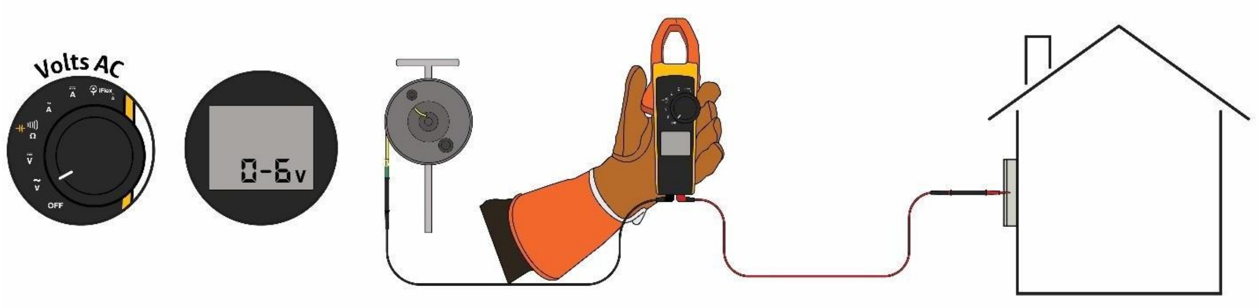
- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Voltage tester
- Fluke PRV 240 Voltage Proving unit
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

9.2.2 Steps for proving de-energised

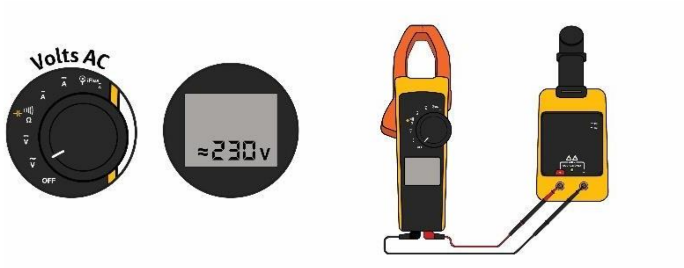
9.2.2.1 Structures and enclosures

1. Perform testing fundamentals checks
2. Ensure tester is switched to the correct function and range for AC voltage, e.g. 0-600V
3. Test the voltage tester on a known low voltage source or approved proving unit
4. Install independent earth at a minimum distance of 2 metres from any conductive object embedded in the ground connected to the system under test and connect to voltage tester lead

5. Voltage test between enclosure/structure and independent earth, note that coatings on such equipment such as paint may affect the reading so find an inconspicuous area to use the point of the test probe to dig in or scratch coating



6. Test the voltage tester on a known low voltage source or approved proving unit



7. Isolate and danger tag if voltage present and record any measured voltage.

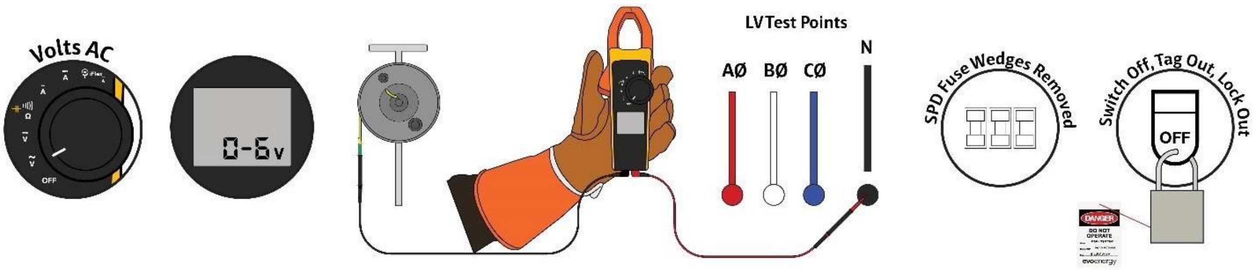
- Investigate or report issue as per 9.2.3 Escalation process for live structure/enclosure

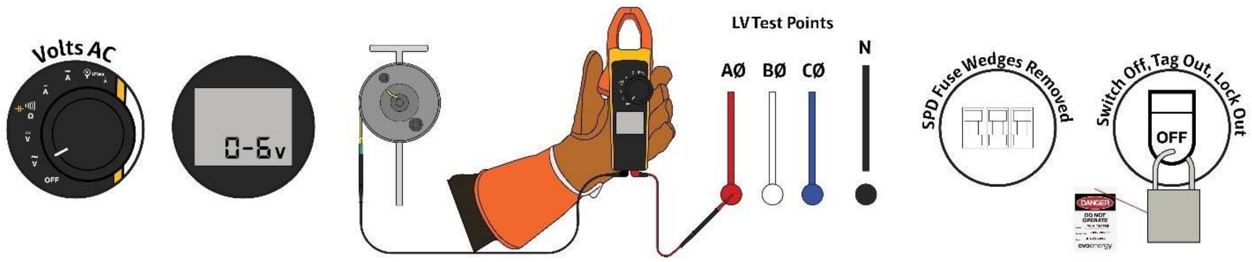
9.2.2.2 Electrical apparatus

1. Perform testing fundamentals checks
2. Ensure tester is switched to the correct function and range for AC voltage, e.g. 0-600 volts
3. Test the voltage tester on a known low voltage source or approved proving unit.

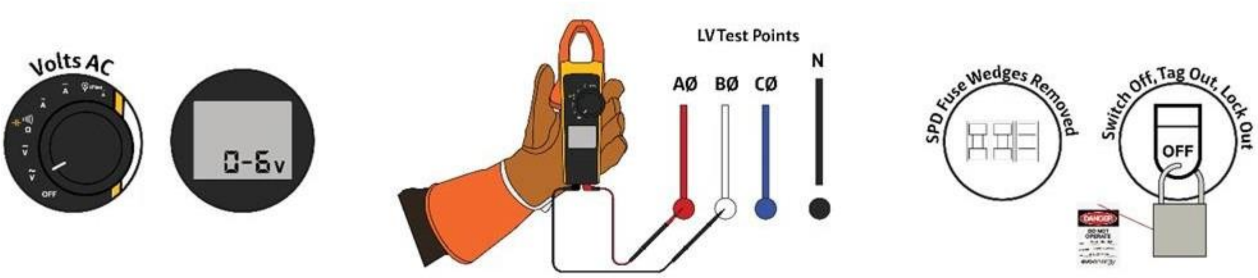
4. Install independent earth at a minimum distance of 2 metres from any conductive object embedded in the ground connected to the system under test and connect to voltage tester lead

5. Voltage test between independent earth and neutral, and, independent earth and each phase. A reading of ≈0 volts must be indicated on the voltage test device

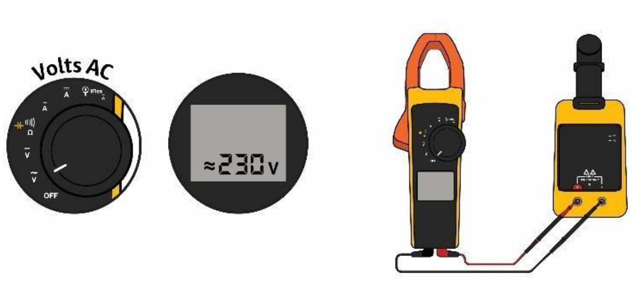




6. Disconnect independent earth and voltage test between each phase until each combination is tested. A reading of ≈0 volts must be indicated on the voltage test device.



7. Prove voltage tester on known low voltage source or approved proving unit



9.2.3 Escalation process for live structure/enclosure

PARAMETER	VALUE	ESCALATION STEPS
IF TEST 2 CONFIRMS ENCLOSURE OR STRUCTURE IS LIVE	> 6 volts	1. If reasonably practicable, isolate source immediately and notify Network Controller 02 62707557 or call Evoenergy Call Centre 131093 2. Apply locks and or danger tags at point of isolation 3. Re-test Test 2 - PROVE DE-ENERGISED at point originally tested 4. Revisit JRA, include the voltage level found with isolation and testing as the control 5. Investigate and repair if reasonably practicable, or call supervisor for assistance 6. Record relevant information, take photographs and report incorrect polarity to supervisor and in Guardian
IF ISOLATION IS NOT REASONABLY PRACTICABLE OR TESTER DOES NOT HAVE APPROPRIATE Trade Certificate		1. Notify anyone on-site that may contact the structure or enclosure and take steps to prevent any person coming in contact with the structure 2. If you are working alone, call your supervisor for assistance 3. Notify Low Voltage Network Controller 02 62707557 or call Evoenergy Call Centre 131093 4. Guard the structure to prevent persons from receiving a shock until the site can be de-energised, rectification works are completed and the structure is re-tested and proven safe to energise 5. Record relevant information, take photographs and report incorrect polarity and or energised structure/encloser to supervisor and in Guardian

9.3 Test 3 - Neutral Identification

Live test

Do not break neutral until actives are opened

9.3.1 General

The distribution network neutral conductor must be identified, confirmed by testing and tagged prior to any connection being made to the network neutral. Active conductors must be identified by testing to ensure correct phases present and voltage is within tolerance

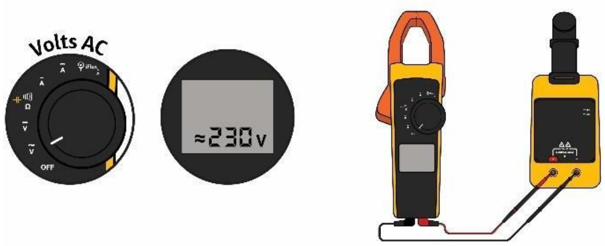
The neutral conductor must be the FIRST conductor to be connected and the LAST to be disconnected in all circumstances

9.3.2 Neutral identification equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Voltage tester
- Fluke PRV 240 Voltage Proving unit
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures
- Neutral identification tags

9.3.3 Neutral identification steps

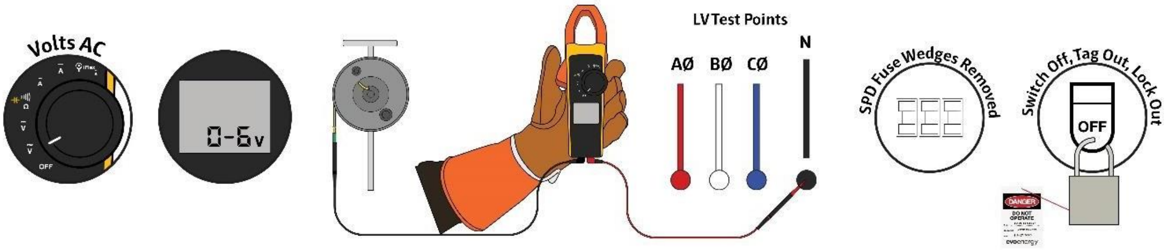
1. Perform testing fundamentals checks
2. Ensure voltage tester is switched on the correct function and voltage range for AC voltage, e.g. 0 – 600 Volts
3. Test and verify the voltage tester on a known live low voltage source or approved proving unit.



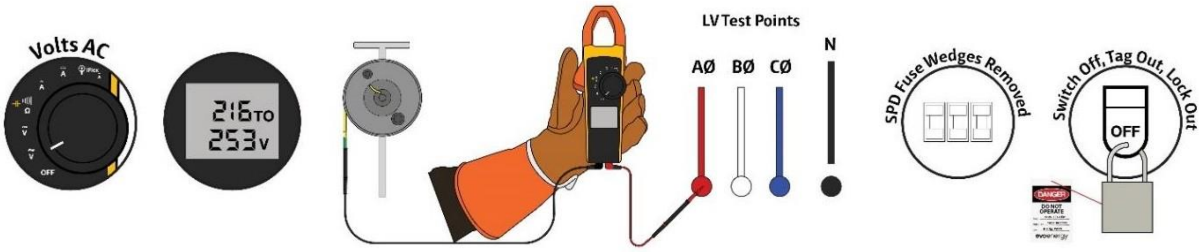
4. Install independent earth at a minimum distance of 2 metres away from any conductive object embedded in the ground connected to the system under test and connect independent earth to voltage tester lead
5. Isolate supply.

6. Voltage test between each core or conductor to the independent earth

- ≈0 Volts should be measured between a neutral conductor and an independent earth

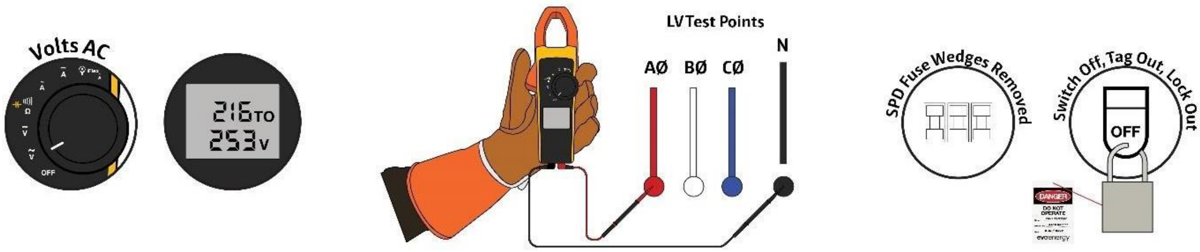


- ≈230 volts between any phases and the independent earth



- 230 volts between any phases and neutral

7. Once identified, the neutral must be tagged by a neutral identification tag.



9.3.4 Escalation process if neutral cannot be positively identified

PARAMETER	ESCALATION STEPS
UNABLE TO IDENTIFY NEUTRAL CONDUCTOR	1. Do not energise installation until neutral can be identified 2. Apply danger tags/ lock to prevent inadvertent energisation 3. Ensure test equipment is operational 4. Re-test installation 5. If neutral still cannot identified, contact supervisor for assistance

9.4 Test 4 - Neutral Integrity

Live Test

Neutral integrity is critical in maintaining a safe network

The integrity of an electricity distribution system neutral is essential to ensure the safety of persons, and property.

Neutral integrity testing is used to:

- Confirm that the neutral has been correctly identified
- Identify ineffective neutral connections

Neutral integrity must be tested in the following circumstances:

- After installing, jointing, re-terminating or replacing UG or OH services and network mains
- When a high neutral to earth voltage is measured
- Electric shock investigation
- Investigation of power quality complaints such as high, low, large deviations (flicker) or phase voltage imbalances.

This manual details two tests to verify the integrity of the neutral connected to an installation, both may be required depending on results of fault loop impedance test, see 9.4.3
Test 4A - NEUTRAL INTEGRITY BY FAULT LOOP IMPEDANCE utilises a fault loop impedance test device to measure the impedance of the neutral circuit between the installation and the transformer that supplies it.
Test 4B NEUTRAL INTEGRITY BY INDEPENDENT EARTH AND VOLTMETER measures the potential (voltage) difference between the neutral conductor and independent earth with a voltmeter.

Fault loop impedance (Z_{LN}) measures of the impedance of the entire loop including the active (line), neutral and transformer winding. Separate neutral impedance and line impedances measured by some instruments may be used to assist in identifying the cause of a high fault loop impedance reading.

9.4.1 Fault Loop Impedance theory

The multiple earthed neutral system (MEN) requires a low impedance neutral to maintain the neutral and earth at the same potential and to ensure adequate fault current flows to operate protective fuses and circuit breakers in the event of a phase to earth fault at an installation.

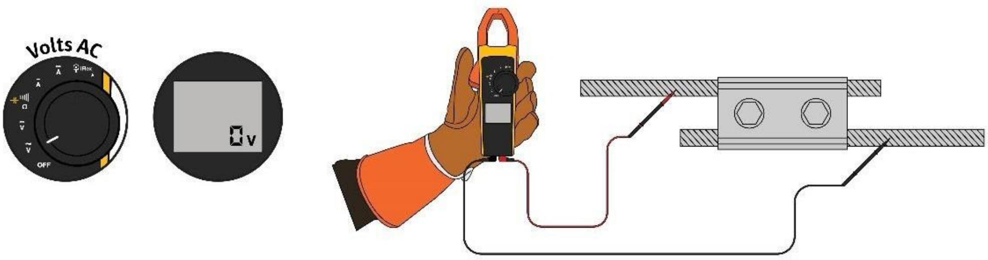
Loop impedances should be kept as low as possible to ensure operation of upstream protective devices.

Values of fault loop impedance, Z_{LN} for standard services should be below 0.5Ω.
Direct sub fed commercial services should be below 0.2Ω
See 9.4.3.Neutral Integrity Decision Tree for values and escalation process.

9.4.2 Causes of high loop impedance

High loop impedance can be caused by one, or a combination of factors listed below,

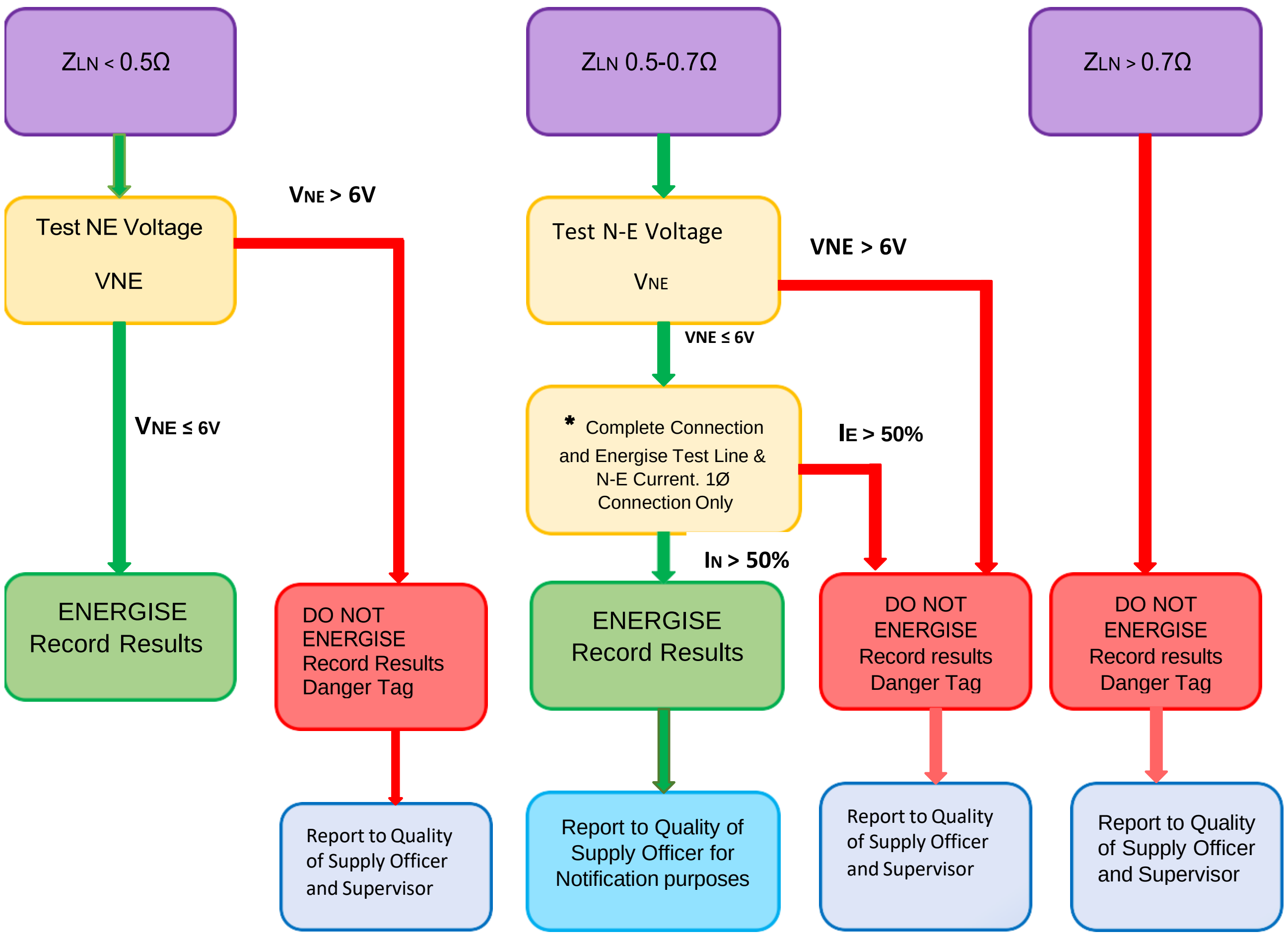
- Loose connection
  - Incorrect connector for size of cable.
  - Connector not correctly installed
  - Thread bound up prior to reaching full level of conductor compression
  - Shear-bolt sheared before reaching specified torque
  - Loosened by vibration, wind etc.
  - Mechanical failure of connector or fastener (over tightened, faulty etc.)
  - Connector not correctly installed
  - Cables/conductors not twisted in tunnel terminals
- High resistance/open circuit connection
  - Incorrect connector i.e. aluminium only on copper conductor, bi-metal installed the wrong way around with copper to aluminium and aluminium to copper
  - Failure to make neutral connection
  - Cables/conductors not inserted into connector far enough to make adequate contact
  - Moisture ingress into sealed connection (HSC)
  - Poor contact or burnt fuse/fuseway contacts
  - Failure of teeth to pierce insulation and make adequate contact with conductor
  - Copper above aluminium in bare overhead arrangement degrading connection
  - Arcing from insulation breakdown degrading conductor
  - Crimped with incorrect or faulty tool or dies
  - Broken conductor or connector
  - Transformer fault
- Voltage drop
  - Long circuit length from substation with large voltage drop in mains and service cables/conductors



Checking connections:
Measuring voltage drop across a connector, should ≈0V, any volts dropped are a result of impedance from a poor connection *see image above.*

9.4.3 Neutral Integrity Decision Tree

9.4.3.1 Neutral integrity for services NOT directly connected to a substation



Legend

Z_{LN} Test 4A-Loop Impedance of line Neutral through transformer winding

V_{NE} Test 4B -Service Neutral to Independent Earth Voltage

I_N Test 4B- Neutral Current

I_E Test 4B – Main Earth Current

Red Arrows

Where red arrows occur, the cause of non-compliant results should be investigated and repaired. **9.4.2**, provides a guide to causes of high loop impedance. Re-test and if results improve to acceptable levels follow the green arrows.

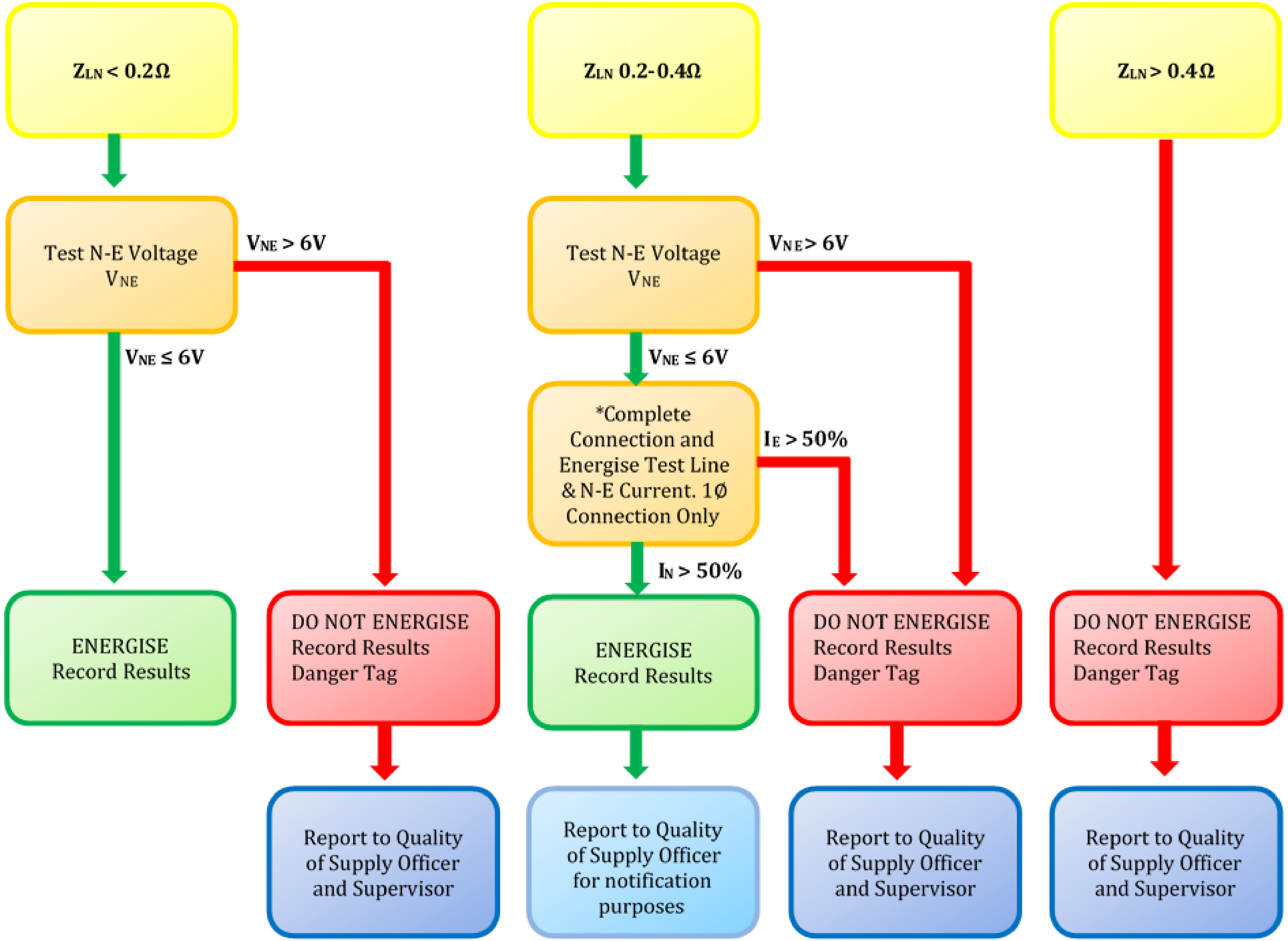
Escalation

If the cause of non-compliant results, cannot be determined or repaired, report all test results to Quality Supply Officer who will determine whether further investigation is required. The Supervisor will determine repair and replacement options in conjunction with the Quality of Supply Officer and relevant SME`s

*Current Split

This test is only applicable to single phase installations.

9.4.3.2 Neutral integrity for services DIRECTLY connected to a substation



Legend

Z_{LN} TEST 4A - Loop Impedance of Line and Neutral through Transformer Winding

V_{NE} TEST 4B - Service Neutral to Independent Earth Voltage

I_N TEST 4B - Neutral Current

I_E TEST 4B - Main Earth Current

Red Arrows

Where red arrows occur, the cause of non-compliant results should be investigated and repaired. 9.3.2, provides a guide to causes of high loop impedance. Re-test and if results improve to acceptable levels follow the green arrows.

Escalation

If the cause of non-compliant results, cannot be determined or repaired, report all test results to Quality of Supply Officer who will determine whether further investigation is required. The Supervisor will determine repair and replacement options in conjunction with the Quality of Supply Officer and relevant SMEs.

*Current Split

This test is only applicable to single phase installations.

9.5 Test 4A - Neutral Integrity by Fault Loop Impedance Tester

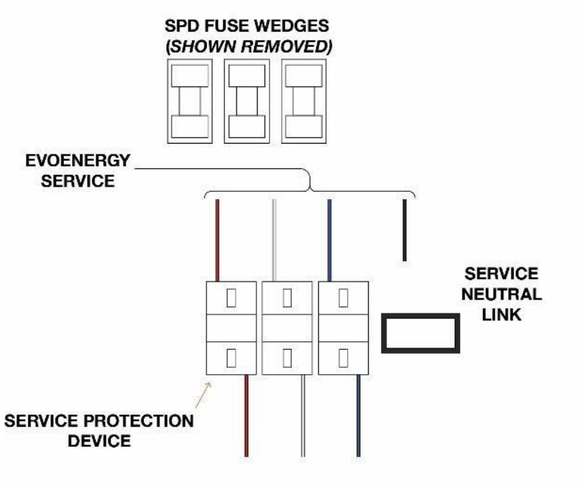
Live test

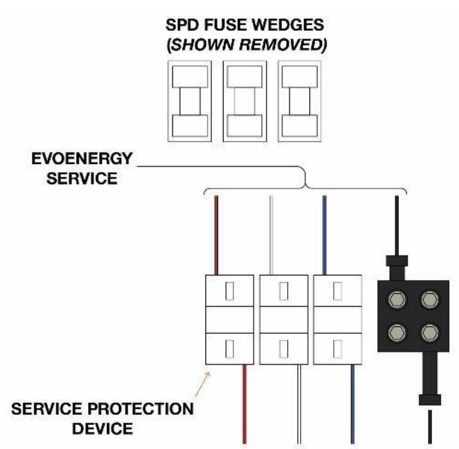
9.5.1 Neutral integrity by fault loop impedance - equipment required

- PPCE as per Personal Protective Clothing and Equipment
- CABAC T2726 Neutral integrity tester
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

9.5.2 Neutral integrity by fault loop impedance steps

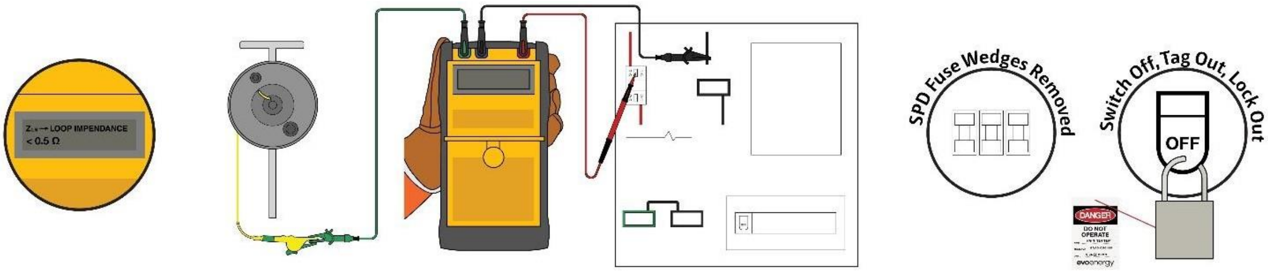
1. Perform testing fundamentals checks
2. Install independent earth at a minimum distance of 2 metres away from any conductive object embedded in the ground or connected to the system under test and connect independent earth to voltage tester lead
3. Isolate the supply to the installation and disconnect the service neutral from the installation (MEN break).
    - For meter box and PoE, disconnect the service neutral conductor NOT the MEN link.
    - For PoA, Terminate the service in the house neutral connector, leave the consumer mains out. Remove one of the consumer main shear-bolts and temporarily replace with the approved test bolt.

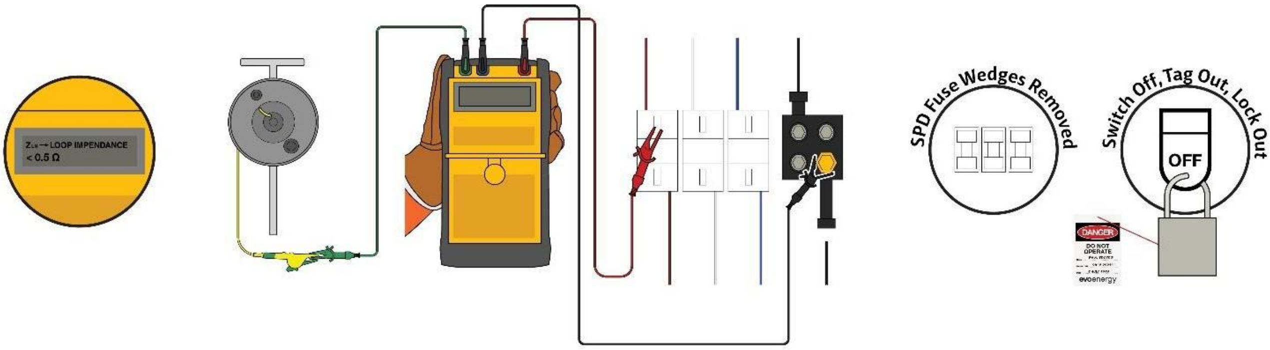




4. Connect and test the fault loop impedance as per the following:

- E terminal (green), via green test lead, to an independent earth AS4741 mentions that the eaíth íefeíence shall be an effective independent eaíth. Ťhe installation may be used as the independent eaíth, if the eaíthing system is píoven to be isolated fíom the neutíal.
-
- N terminal (blue), via black test lead, to service neutral (for PoA, connect alligator clip to head of test bolt).
- L terminal (red), via red test lead, to each service phase

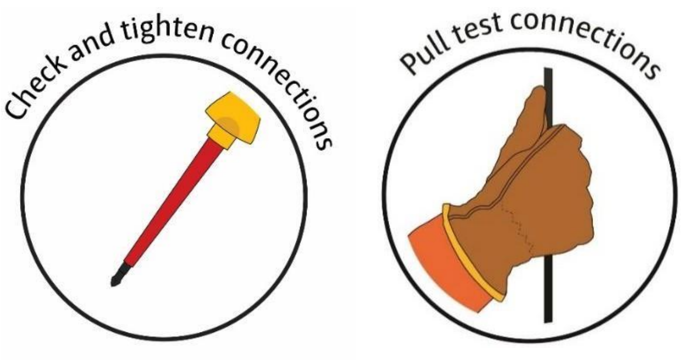




5. Record the impedance values in Cityworks.
6. If the measured value is above the values in 9.4.3 Neutral Integrity Decision Tree, the result must be approved by the Quality of Supply Officer.

Do not re-energise the installation until advised that it is safe to do so. If reasonably practicable visually inspect the service and mains between the installation and the transformer, pay particular attention to connections and terminations being loose, burnt, damaged or missing

7. If an issue on the neutral is identified and rectified, re-perform this test to verify neutral integrity, keep any failed connectors or components and raise a Guardian incident, including relevant information and photographs.
8. Restore the service neutral (remove test bolt and replace with shear-bolt from house neutral connector for PoA) – ensure all connections under test are re- tightened and pull tested.



9. Perform Post-test inspection

9.6 Test 4B - Neutral Integrity By Independent Earth And Voltmeter

Live Test

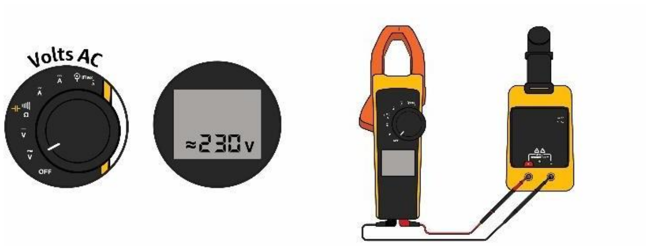
Used in conjunction with fault loop impedance testing

9.6.1 Neutral integrity by independent earth and voltmeter - equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Tong Ammeter
- Fluke PRV 240 Voltage Proving unit
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

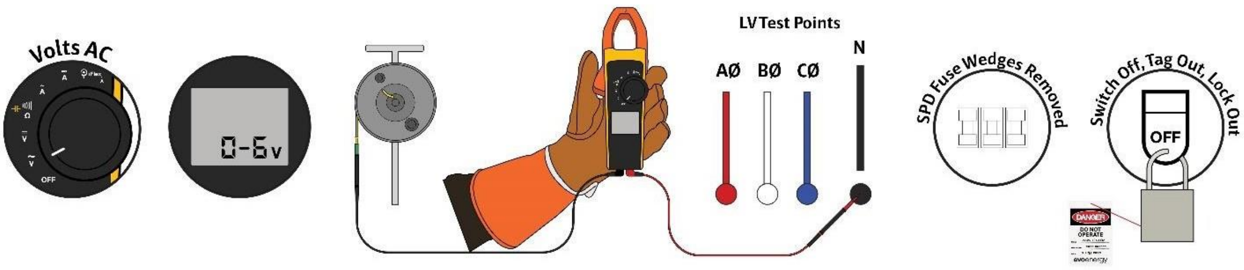
9.6.2 Neutral integrity by independent earth and voltmeter steps

1. Perform testing fundamentals checks
2. Ensure voltage tester is switched to the correct function and voltage range for AC voltage, 0 – 600 V
3. Test and verify the voltage tester on a known low voltage source or approved proving unit.



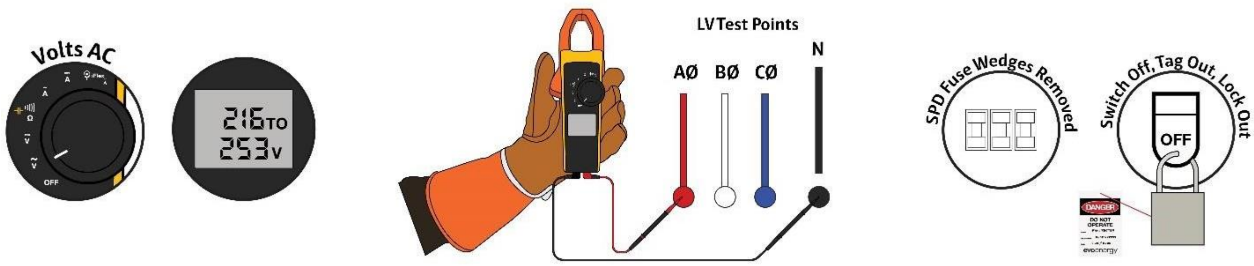
4. Install independent earth at a minimum distance of 2 metres away from any conductive object embedded in the ground or connected to the system under test
5. Perform Test 6 - Polarity to confirm the polarity of the supply is correct
6. Isolate the supply and disconnect the neutral.

7. PART A - Measure and record the voltage between the supply neutral and the independent earth

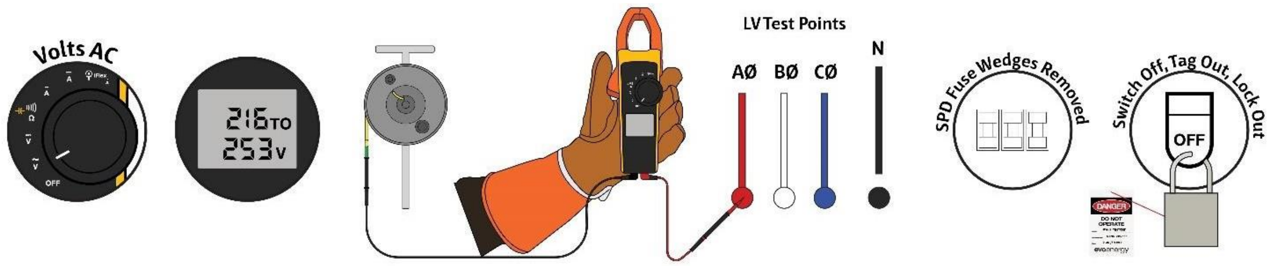


8. Measure and record the voltages between

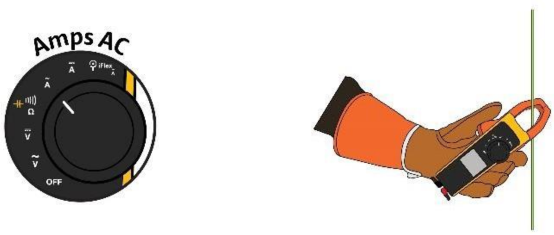
   i. each phase and neutral;



   ii. each phase and independent earth.

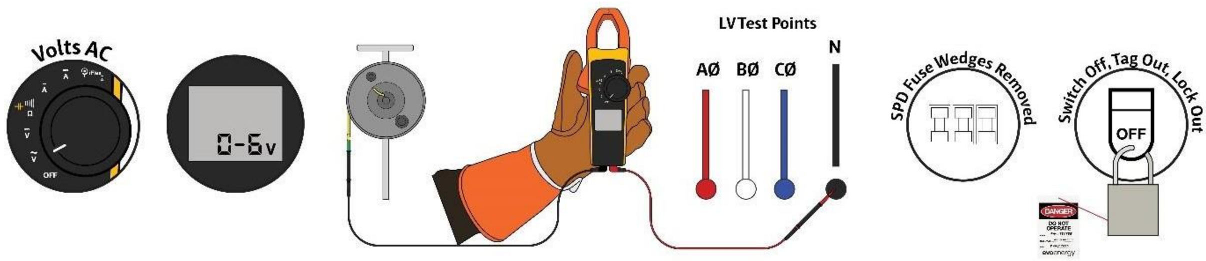


9. Measure the current on the main earth with an approved tong ammeter and record the result. If access is not available – escalate to Quality of Supply

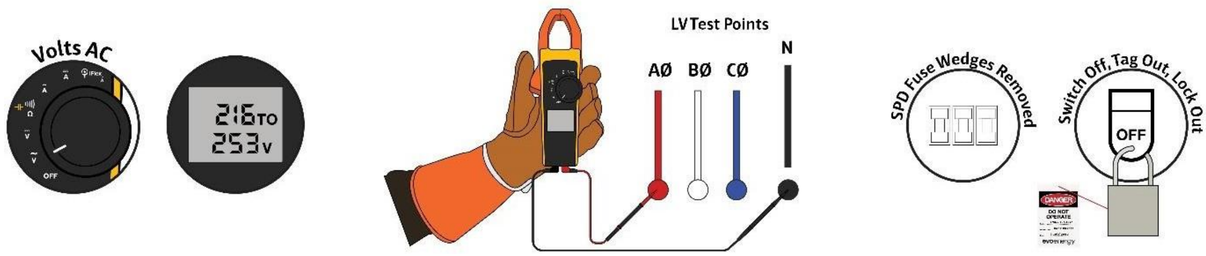


10. PART B - Install an approved load bank so that it is the only load on the service (individually on each phase) Use the test bolt for house neutral connector if testing at PoA.

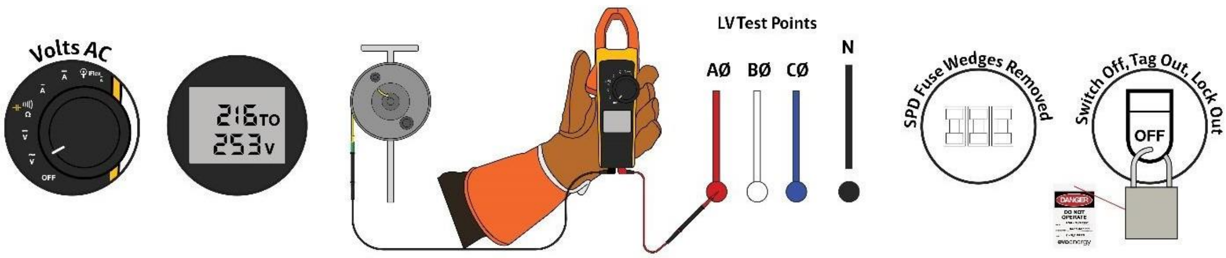
11. Measure and record the voltage between the supply neutral and the independent earth



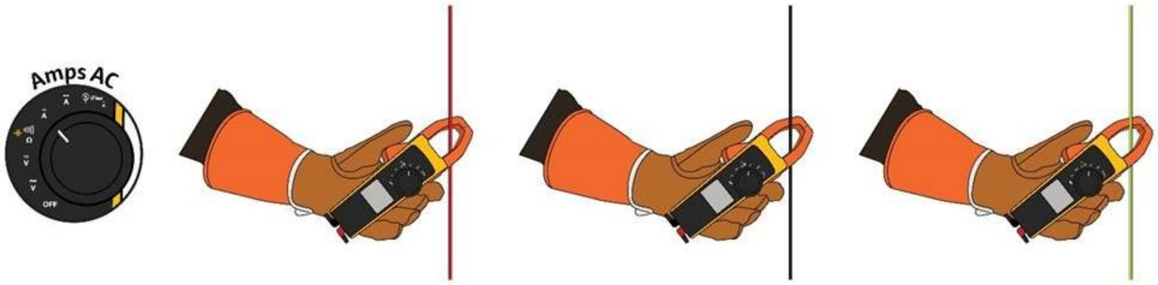
12. Measure and record the voltages between
    i. each phase and neutral and;



    ii. each phase and independent earth.



13. PART C - Measure the currents flowing through both the supply neutral and the main earth.



The neutral must be carrying more than 50% of the total current to be considered acceptable

9.7 Test 5 - Voltage testing

Voltage testing is essential to ensure:

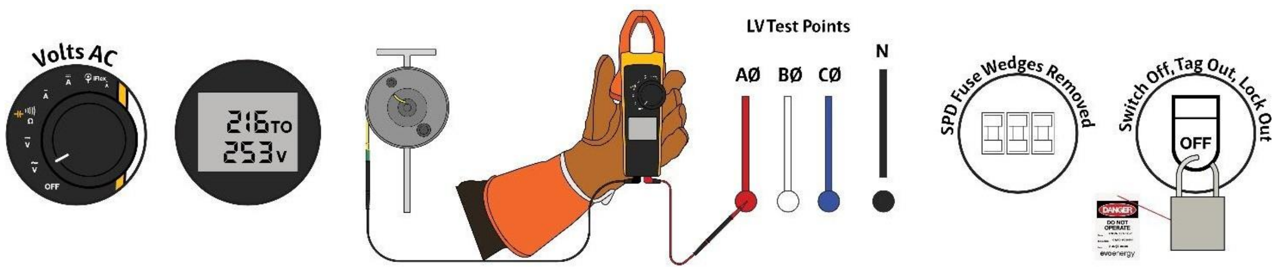
- The state of energisation of any cable, conductor or piece of equipment
- The correct polarity of cable cores and conductors prior to energising a customer installation or at any point within the network
- The voltage supplied to a customer installation is within the voltage tolerance defined in *AS60038 and AS61000.3.100*

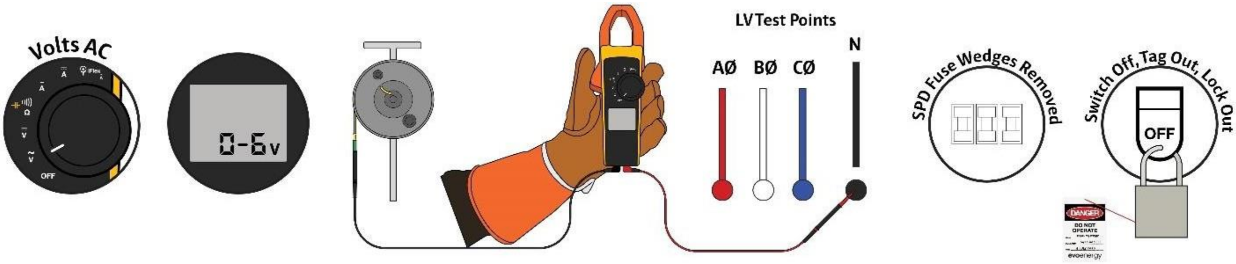
9.7.1 Voltage testing - equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Voltage tester
- Fluke PRV 240 Voltage Proving unit
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

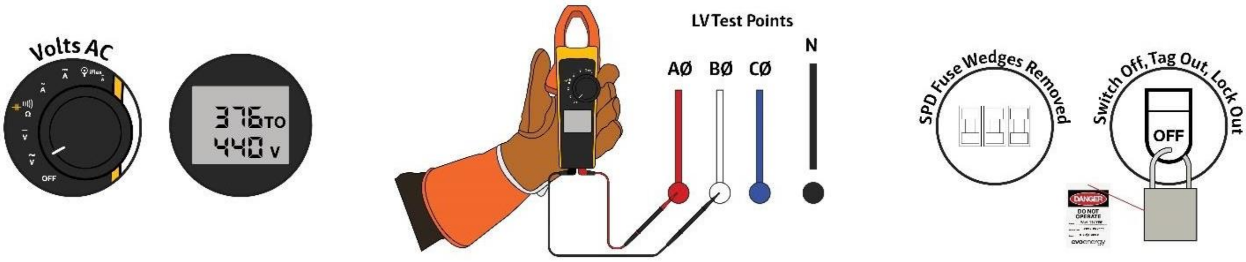
9.7.2 Steps for voltage testing

1. Perform testing fundamentals checks
2. Ensure tester is switched to the correct function and range for AC voltage, 0-600 Volts
3. Test and verify the voltage tester on a known low voltage source or approved proving unit.
4. Install independent earth at a minimum distance of 2 metres away from any conductive object embedded in the ground connected to the system under test and connect independent earth to voltage tester lead
5. Voltage test between each phase, and neutral cable conductor, to independent earth. See 9.7.3 for acceptable voltage tolerances.

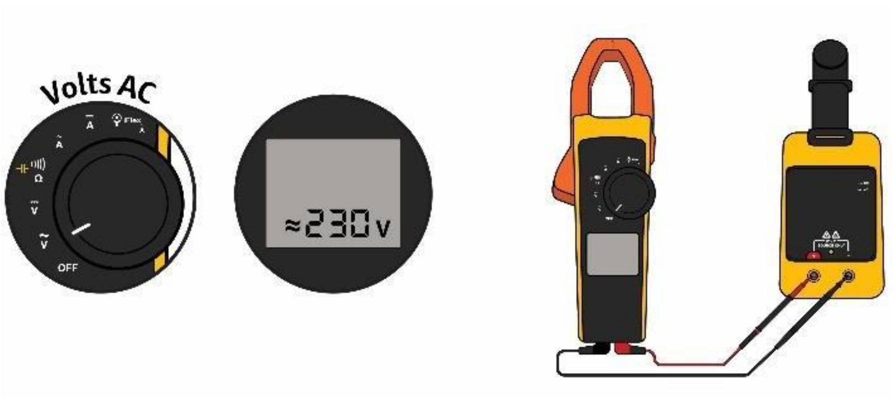




6. Disconnect independent earth and then voltage test between each conductor until each combination of pairs is tested. See 9.7.3 for acceptable voltage tolerances



7. Record results in Cityworks
8. Prove voltage tester on known low voltage source or approved proving unit



9.7.3 Voltage Tolerance

The nominal voltage for a low voltage system in Australia, in accordance *Australian Standard AS60038* is:

- 230 Volts measured from a phase to earth or neutral and
- 400 Volts measured between any two phases.
- The voltage tolerance is +10%, -6% of the nominated supply voltage.

Non-compliance with the Australian Standard voltage tolerances listed in Table 5 may cause damage to network and customer's equipment

Australian Standard Voltages and Voltage Tolerances for Low Voltage Systems

TEST TYPE	CONNECT VOLTAGE TEST DEVICE BETWEEN	NOMINAL VOLTAGE READING	VOLTAGE TOLERANCE
N to E	Independent Earth and Supply Neutral	0 volts	0 – 6 volts
Ø to E	Independent Earth and Supply Active(s)	230 volts	216 – 253 volts
Ø to N	Supply Neutral to Supply Active(s)	230 volts	216 – 253 volts
Ø to Ø	Supply Active/s	400 volts	376 – 440 volts
Ø to Ø	Supply Actives of same phase	0 volts	0 – 30 volts

9.7.4 Voltage tolerance escalation process

PARAMETER	VALUE	ESCALATION STEPS
VOLTAGE TOLERANCE	>253 volts, A - N	• Perform neutral integrity (Test 4A), record results on Cityworks form, note date, time and weather conditions. • Forward form to Quality of supply for action
	<216 volts, A - N	• Perform neutral integrity (Test 4A), record results on Cityworks form, note date, time and weather conditions. • Forward form to Quality of supply for action
3∅ VOLTAGE BALANCE	> +10%(23v), -6%(14v), ∅ - ∅	9. Perform neutral integrity (Test 4A) 10. Forward form to Quality of supply for action

9.8 Test 6 - Polarity Testing

Live Test

Essential test for proving neutral

In order for polarity testing to be effective the neutral at the installation being tested must be separated from the earthing system at the PoE/PoA. The earth reference for testing purposes is achieved by the use of an approved independent earth or system earth as denoted in the earthing hierarchy described in the Electrical Safety Rules.

Polarity testing is essential to ensure:

- The prevention of electric shock by identifying conditions where active and neutral conductors have been incorrectly connected (transposed).

Note: If the neutral is to be disconnected from the earthing system at an installation, the actives must be de-energised first

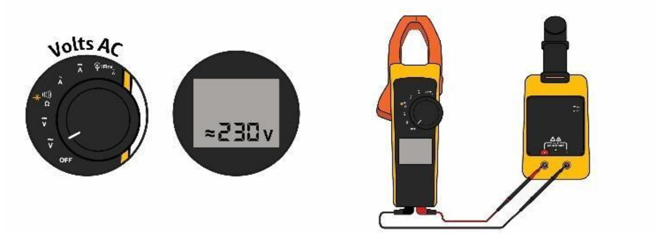
The transposition of active and neutral conductors will result in the energisation of the earthing system and consequently the energising of exposed conductive parts connected to the earthing system.

9.8.1 Polarity testing – equipment required

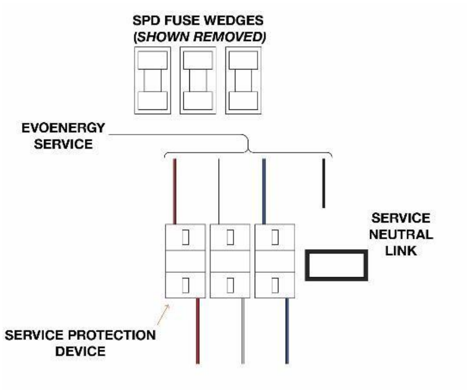
- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Voltage tester
- Fluke PRV 240 Voltage Proving unit

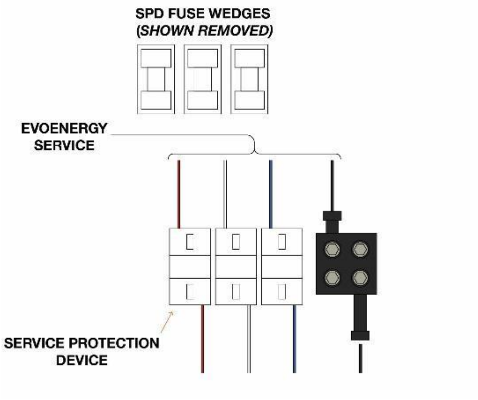
9.8.2 Polarity testing steps

1. Perform testing fundamentals checks
2. Ensure tester is switched to the correct function and range for AC voltage, 0-600 Volts
3. Test and verify the voltage tester on a known low voltage source or approved proving unit.

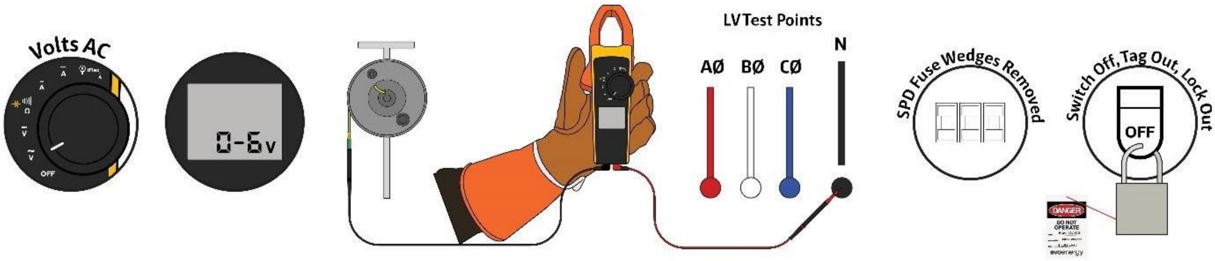


4. Install independent earth at a minimum distance of 2 metres away from any conductive object embedded in the ground connected to the system under test and connect independent earth to voltage tester lead
5. Ensure that the neutral under test is disconnected.

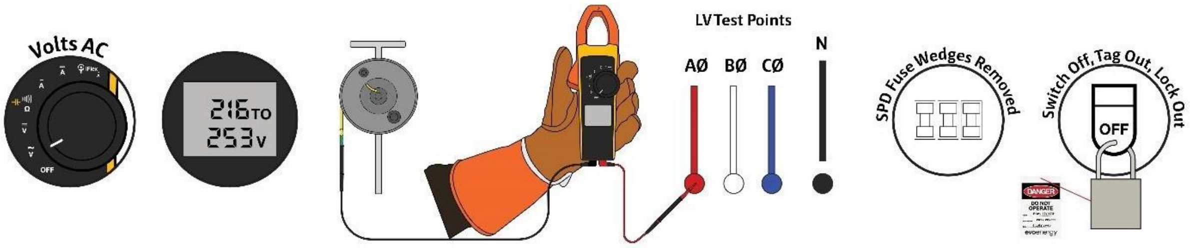




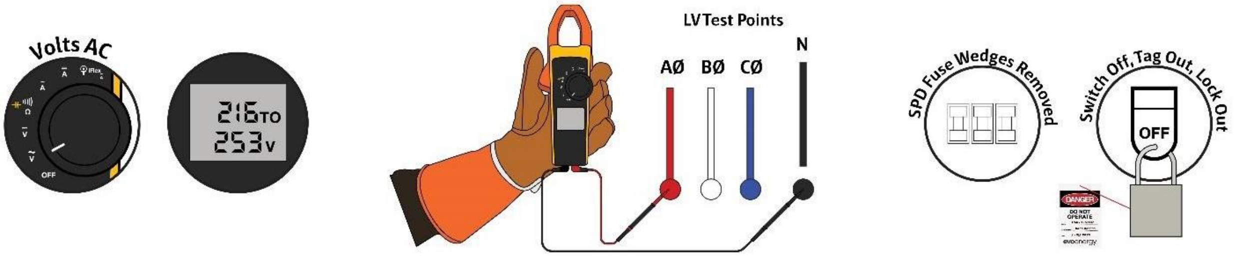
6. Perform Test 3 – Neutral identification and mark neutral
7. Perform tests and record in Cityworks:
   i. Independent earth to neutral –≈ 0 volts



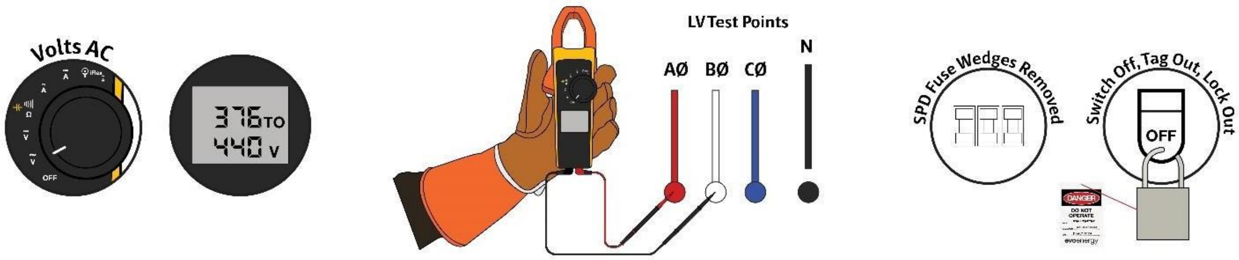
   ii. Independent earth to each phase – 230 volts



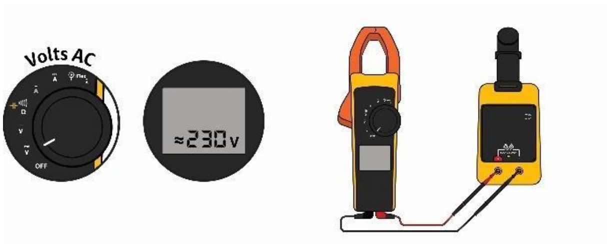
iii. Neutral to each phase - 230 volts



iv. Each combination of phase to phase – 400 volts



8. Prove voltage tester on known low voltage source or approved proving unit



9.8.3 Polarity testing escalation process

PARAMETER	MEASUREMENT	ESCALATION STEPS

INCORRECT POLARITY	System voltage on neutral conductor	• Do not energise. Apply danger tags/lock out as required
		• Notify supervisor
		• Investigate and identify source of incorrect polarity by one or a number of the following:
		  • Visual inspection (Pre-test)
		  • Continuity test (Test 7)
		  • Insulation resistance (Test 8)
		  • Voltage test at remote end (Test 5)
		• Rectify polarity
		• Re-test and confirm polarity correct

		• Record relevant information in Guardian

9.9 Test 7 - Continuity Testing

De-energised test

Identifies open circuit situations

Continuity testing is conducted prior to insulation resistance testing to ensure testing there are no open circuit cores within the cable and to identify and verify the cores have not been transposed in a cable joint or other connection in the circuit

Continuity testing is also utilised to verify cable “colours” to ensure the correct cores are joined in an inline joint so that correct polarity and phasing can be achieved. Insulation tape must be used to mark cores

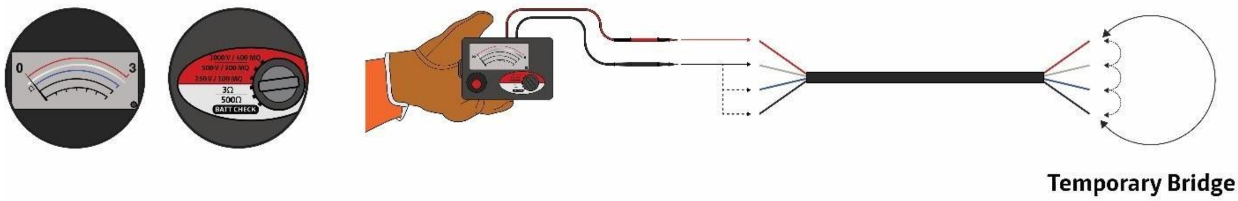
Coloured cable cores do not guarantee that there has not been a “roll” in a cable joint

9.9.1 Continuity testing – equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Kyoritsu 3132A Insulation Resistance and Continuity Tester
- Test leads, ideally with alligator clamps for creating temporary short circuits for testing
- Communication device such as mobile phone or walkie talkie for long cable runs
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

9.9.2 Continuity testing steps

1. Perform testing fundamentals checks
2. Isolate equipment to be tested and perform Test 2 - PROVE DE-ENERGISED
3. Ensure that the equipment under test is isolated from equipment that may affect the test results
4. Install the shorting test leads at the remote end. If a long length of cable is being tested, a second person with a communication device may be required to operate the short circuit test leads.



5. Select the cores or conductors to be tested. Using an approved insulation resistance tester set on the Ω setting, test between each core until each combination of pairs is tested.

Results should be within 10% of each other – if not it may indicate a loose connection and/or a high resistance joint.

A reading of ∞ will indicate non-continuity

9.10 Test 8 - Insulation Resistance Testing

De-energised test

Hazardous voltages may exist

Insulation resistance testing is a final step prior to energisation of cables and/or equipment and must be carried out after the cables have been terminated and/or backfilled, the backfill compacted, the cables clamped. It is used to prove;

- Equipment is safe to energise
- The apparatus, conductor, associated joints and terminations are not damaged or degrading to a point that may cause a short in the circuit, or a current leakage resulting electric shock or temperature rise, further damaging insulation.

Existing cables shall be insulation resistance tested upon de-energisation and prior to re-energisation to ensure that no damage has occurred while the cable was de-energised

9.10.1 Insulation resistance tester - Safety

Insulation resistance testers can deliver voltages hazardous to humans and can be damaging to electrical equipment. It is essential that the person conducting the testing is fully aware of the scope of the test, i.e. all connected equipment subject to test voltages.

Insulation resistance testing can also cause equipment, particularly cables to retain a voltage after the testing is complete. This is due to the capacitance characteristic of combinations of conducting and insulating materials. Long cable runs in particular can store a vast amount of energy and must be discharged when testing is complete

9.10.2 Insulation resistance tester - Controls

As per the *Electrical Safety Rules* the person conducting the test must mitigate the risk of electric shock by assessing the situation and applying applicable controls including:

- Communication – Tell people that testing is to be conducted and that they must stand clear until notified of completion
- The use of safety observers – To prevent persons coming into contact with equipment under test
- Insulated covers and or mats – To insulate people from equipment under test
- Signage/Danger tags - To warn people of equipment under test
- Secured cabinets and enclosures – Where reasonably practicable, close and lock doors to prevent contact
- Discharge tested equipment after test – ensure that residual voltage cannot cause electric shock

9.10.3 Precautions when insulation resistance testing

Electrical and electronic equipment can be irreparably damaged by voltages in excess of the equipment's rated value. Test voltages must only be applied to equipment on the Evoenergy side of the network boundary.

Fuses, circuit breakers or main switches must be opened to prevent test voltages being applied to consumer equipment.

Cables and apparatus should not be subjected to insulation resistance tests at a test voltage that is higher than the rated insulation value specified by the manufacturer of the equipment. This can cause damage and premature failure of the insulation. Voltage values stated in 9.10.5 must be adhered to and care must be taken to ensure that insulation resistance testers are set to the correct test voltage prior to testing.

9.10.4 Insulation resistance testing of OH and UG mains and services.

Insulation resistance testing of OH and UG mains and services is mandatory in the following circumstances:

- Prior to energising new installations
- After the installation of any new or replacement service or mains cable or apparatus
- Prior to and after the replacement, augmentation, repair or relocation of service or mains cable or apparatus
- When a cable or apparatus is suspected to have a fault
- When there is any doubt about condition, particularly the integrity of insulation of a cable or apparatus

Note: Wet and humid conditions can lower the value of insulation resistance test results

9.10.5 Effective insulation resistance testing

As this test is a resistance measurement, it is essential that the test probes and clamps make an effective connection with the material being tested thus preventing an elevated insulation resistance reading. This can be achieved by:

- Brushing of conductors to remove contaminants and oxidisation
- Being aware that dirt, oil, rust, surface coatings such as paint, powder coat, galvanisation, plating anodising etc. can cause elevated insulation resistance readings. Select an appropriate place to attach probes and clean surface if necessary

LV apparatus must not be tested at voltages that exceed the apparatus insulation rating.

TABLE 1. INSULATION RESISTANCE TEST VOLTAGES, DURATIONS AND EXPECTED INSULATION RESISTANCE VALUES FOR LOW VOLTAGE EQUIPMENT

EQUIPMENT TYPE	TEST VOLTAGE (V)	TEST DURATION (MINS)	NEW EQUIP [3] (MΩ)	EXISTING EQUIP [4] (MΩ)	PERSON AUTHORISED [1]
CONSUMER MAINS [2]	500	1	50	50	Licensed Electrician
CUSTOMER INSTALLATION [2]	500	1	1	1	Licensed Electrician
LV UG & OH SERVICES	500	1	100	20	Authorised Worker
LV UG & OH MAINS	500	1	100	20	Authorised Worker
LOW VOLTAGE SWITCHGEAR	500	1	100	20	Authorised Worker

1. A worker with technical knowledge or sufficient experience who has been approved or has the delegated authority to act on behalf of the electrical distribution company to perform the duty concerned
2. This testing is beyond the network boundary and not normally undertaken by Evoenergy staff
3. New is defined as apparatus that has not previously been commissioned
4. Existing applies to apparatus that has previously been in service
5. When test results do not meet the above requirements see section 11 for Advanced Testing.

Insulation resistance tests must be minimum 1 minute duration

9.10.6 Insulation resistance testing of de-energised existing cables

Where a cable has had an Insulation Resistance Test within three hours of de-energisation, this pre-work IRT value (baseline) must be reached or exceeded before re-energisation. An appropriate priority defect must be raised in line with Section 11.1.3. Low Voltage Insulation Test Escalation Process. If the baseline value cannot be met or exceeded, follow the flow chart outlined in Section 11.1.3. Low Voltage Insulation Test Escalation Process.

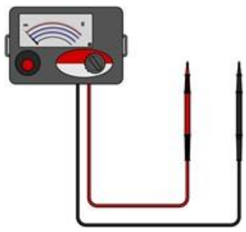
Equipment

- PPCE as per Personal Protective Clothing and Equipment
- Kyoritsu 3132A Insulation Resistance and Continuity Tester
- Pacific Test Equipment - Trailing Earth Lead
- Insulating materials (e.g., LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

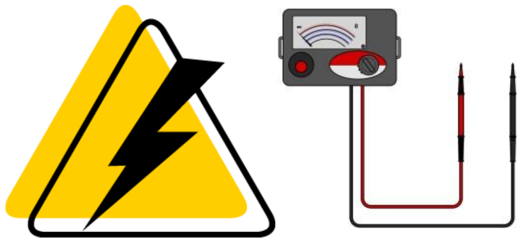
9.10.7 Insulation resistance testing steps

1. Perform testing fundamentals checks
2. Isolate equipment to be tested and perform Test 2 - PROVE DE-ENERGISED
3. Ensure that the equipment under test is isolated from equipment that may be adversely affected by the testing or may affect the test results

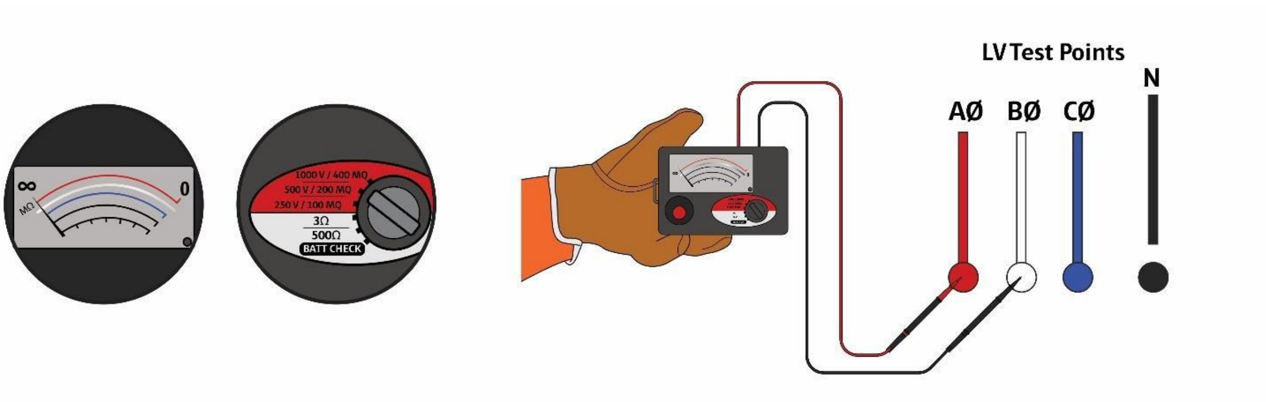
4. Select the test voltage on the insulation resistance tester as defined in 9.10.5
5. Connect the test leads together and press test button. The result should be 0Ω. If the result is not 0, check and replace the batteries and adjust the zero point as described in the manual for the insulation resistance tester



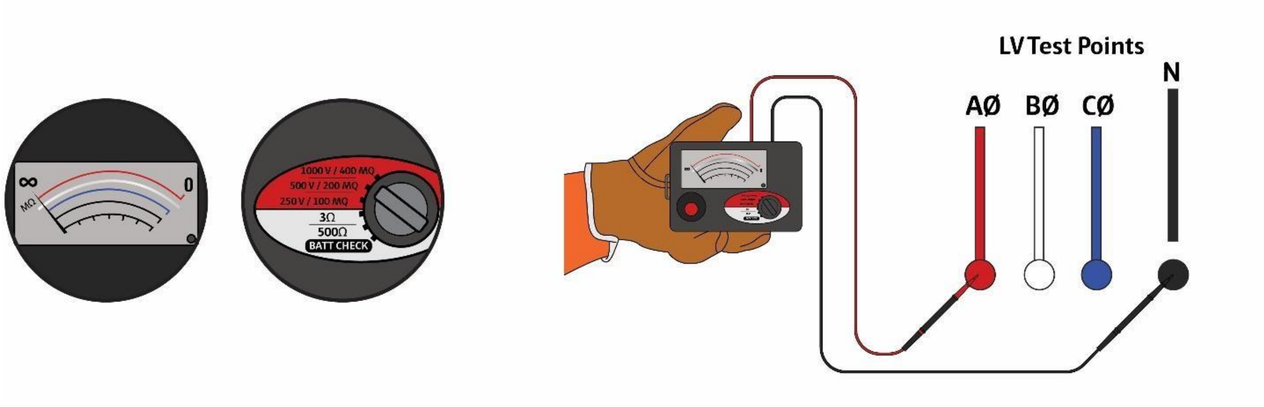
6. Notify people in vicinity the type testing taking place and the equipment under test. Ensure people cannot receive a shock from the test, implement controls identified by the JRA,



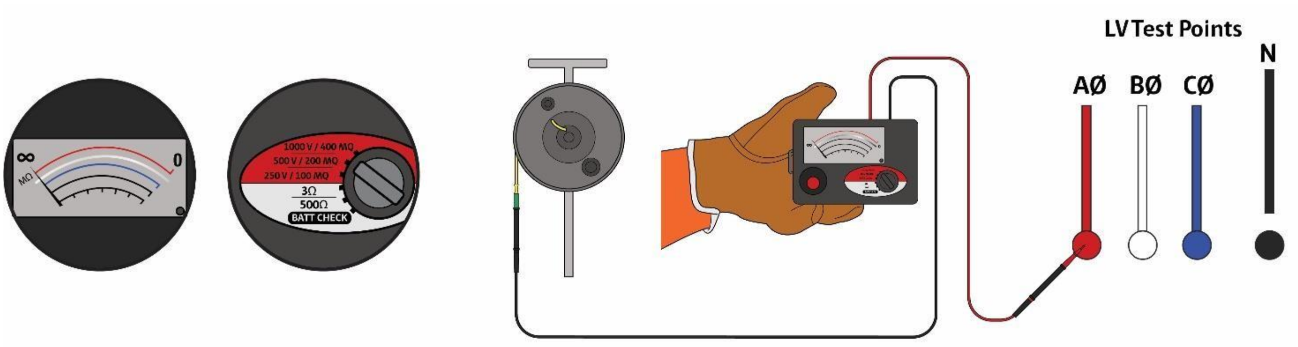
7. Perform tests and record in Cityworks
   - Test each combination phase to phase



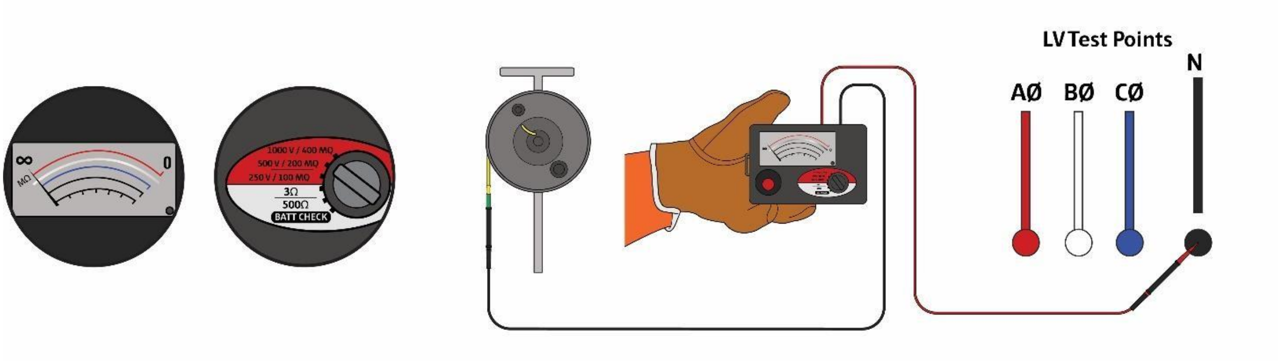
   - Test each combination phase to neutral



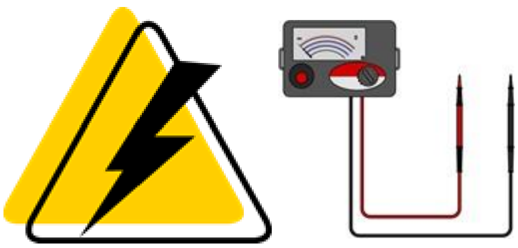
- Test each combination phase to earth



- Test neutral to earth



8. Discharge tested equipment, this can be done by the insulation resistance tester – refer testers cover for instructions



9. Notify people on-site testing and discharging is complete

9.11 Test 9 - Network Phasing

Live Test

Must be done before connecting two potential sources of supply

The paralleling of network circuits can cause serious injury. Connection of different phases will result in a short circuit explosive/arc flash environment.

9.11.1 Phasing must be carried out

- Prior to closing of links, switches and bridges that will connect one or more active phases
- Across network open points after work to conductors or cabling that may affect the phases connected to either side of the open point

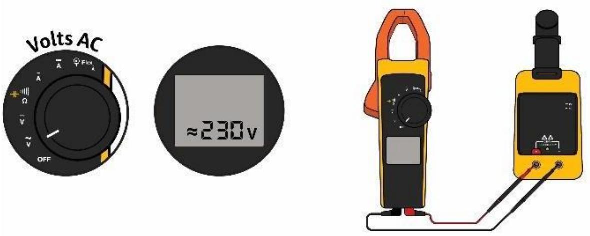
9.11.2 Network phasing equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Pacific Test Equipment - Trailing Earth Lead
- Fluke 374 Voltage tester
- Fluke PRV 240 Voltage Proving unit
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures
- Neutral identification tags

9.11.3 Steps for Network Phasing

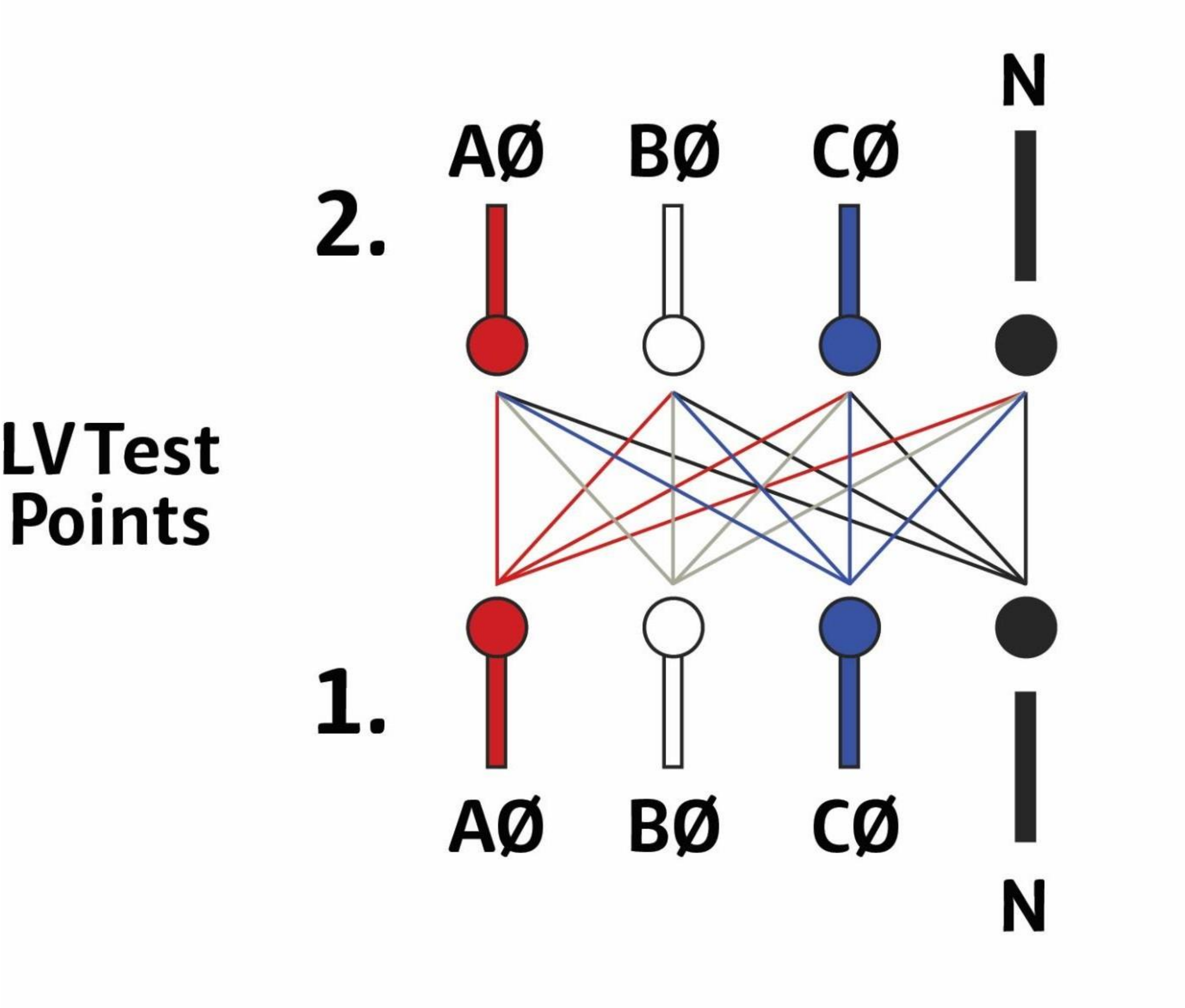
Sides of test will be described as Side 1 and Side 2

1. Perform testing fundamentals checks
2. Test and verify the voltage tester on a known low voltage source or approved proving unit if known source is not available



3. Identify the neutrals on both sides of the open point by performing Test 3 – Neutral identification.

4. Test voltage between each side (1) & (2) and record results



i. (1) neutral to (2) neutral (0V)
ii. (1) neutral to (2) A, B, C (230V)
iii. (1) A phase to (2) A (0V)
iv. (1) A phase to (2) B (400V), C (400v), N (230V) and back to A (0V)
v. (1) B phase to (2) B (0V)
vi. (1) B phase to (2) A (400V), C (400V), N (230) and back to B (0V)
vii. (1) C phase to (2) C (0V)
viii. (1) C phase to (2) A (400V),B (400v), N (230V) and back to C (0V)

9.12 Test 10 - Phase Rotation

Non-contact OR live test

Essential for 3 phase equipment

Phase rotation testing ensures that three phase machines rotate in the correct direction. This ensures safe and correct operation of rotating machinery.

Three phase machinery rotating in the wrong direction can cause death or serious injury to operators, failure of machines to operate or operate correctly. This may affect refrigeration and air-conditioning equipment, pumps etc.

Note: Correct network phasing DOES NOT ensure correct phase rotation

9.12.1 Phase rotation testing must be carried out

After any network alteration that may alter the order of phase connections to an installation. Alterations made on both the HV and LV networks can affect phase rotation.

For existing network installations, the phase rotation should be tested and recorded prior to being de-energised. Phase rotation must be recorded in Cityworks.

Note: All new installations must be connected with a CLOCKWISE rotation

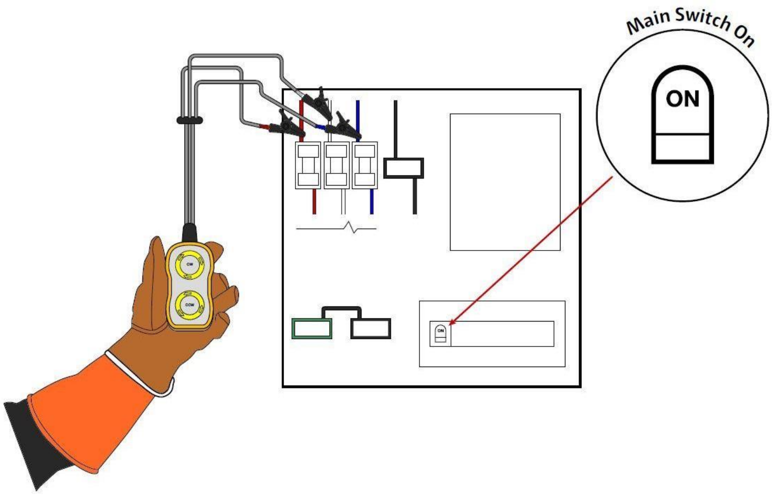
For reactive outages, if the phase rotation prior to loss of supply is unknown, the supply must only be reconnected if the connected three phase equipment can be inspected to ensure correct rotation/operation. If the there is no access or the rotation of the equipment cannot be ascertained the service must not be connected and danger tagged until it can be proven safe to energise.

9.12.2 Phase rotation testing equipment required

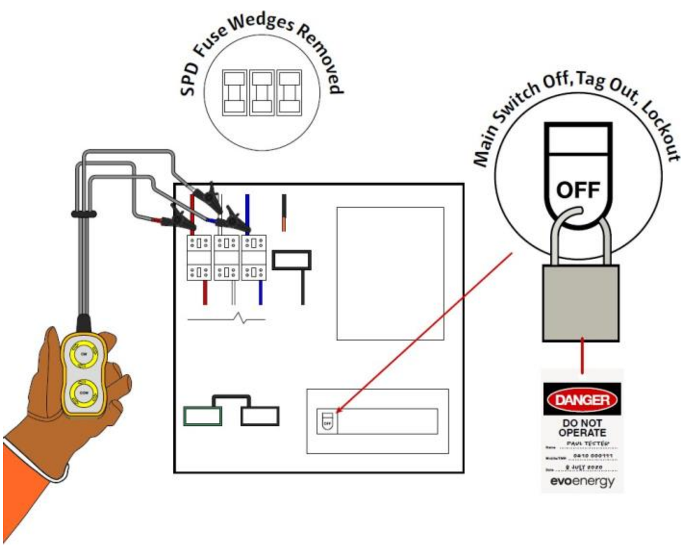
- PPCE as per Personal Protective Clothing and Equipment
- SEW 890 PR Phase Indicator
- Greenlee GT12A Proximity Tester
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

9.12.3 Steps for phase rotation testing

1. Perform testing fundamentals checks
2. Perform Test 1 - PROXIMITY on conductive structures and enclosures associated with the equipment being tested
3. Connect the phase rotation tester probes or clamps to the supply to be tested. The leads are coloured red, white and blue and should be connected to the same coloured phase to be tested. If there is no colouring on the supply being tested, i.e. all black conductor insulation, the conductors must be marked red, white and blue with insulating tape in the following sequence: left to right, red, white, blue.



4. Ensure that the installation is disconnected from the network while work is conducted, so that when the network is restored, the installation remains disconnected until testing is completed and rotation can be proved.
5. Record the phase rotation test results in Cityworks
6. When restoration of the network is completed, perform the following tests and record in Cityworks:
   - Test 1 Proximity test
   - Test 2 Neutral identification
   - Test 4A or 4B Neutral integrity
   - Test 6 Polarity test
7. Once the above tests are satisfactorily completed, re-perform step 5 to test the phase rotation.



9.13 Test 11 - Current Measurement With a Tong Ammeter

Non-contact test

Determines circuit load

9.13.1 General

Measuring the current flowing in an active, neutral or earth conductor is useful in determining circuit load, or current share.

The measurement of current flowing in a conductor can indicate the potential for drawing a dangerous electric arc if the circuit is opened at a certain point or if the current flowing exceeds the rated braking current of a piece of electrical apparatus. If the maximum rated breaking load is less than the measured current, the load must be reduced or the circuit isolated at an adequately rated apparatus

9.13.2 Effective current measurement

The tong ammeter will only provide an accurate result if measuring one conductor's current at a time. If measuring more than one conductor, conductors must be individually tonged and results added together for the final overall measurement.

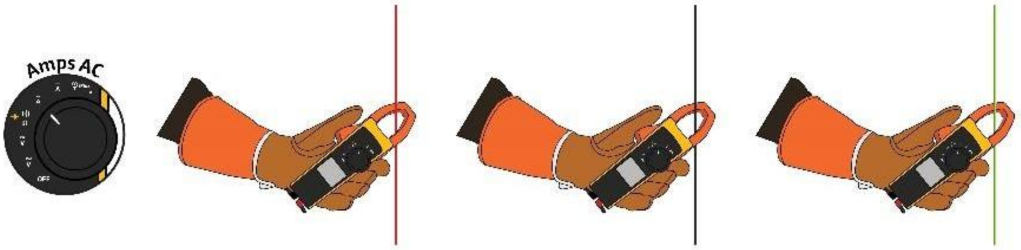
Ensure that the tong is fully closed when taking a measurement otherwise the magnetic circuit will not be complete and false readings of zero or lower than actual current may occur.

9.13.3 Current measurement equipment required

- PPCE as per Personal Protective Clothing and Equipment
- Fluke 374 Tong Ammeter
- Greenlee GT12A Proximity Tester
- Insulating materials (e.g. LV insulating mats/covers) where required as identified in the JRA or relevant SWMS, and applied per Evoenergy procedures

9.13.4 Steps for current measurement with a tong ammeter

1. Perform testing fundamentals checks
2. Perform Test 1 - PROXIMITY on conductive structures and enclosures associated with the equipment being tested
3. Ensure tester is switched to the correct function and range for AC current
4. Ensure that the voltage test leads have both been removed from the input jacks and are not wrapped around the tester while performing current measurements
5. Open the tong and close around the conductor to be tested and ensure the tong is fully closed and the two halves of the tong are not misaligned. Centre the conductor between the marks on each tong



9.14 Test 12 - Pole Leakage Detection

Non-contact test

Performed by all Worker approaching conductive structures

9.14.1 General

Pole leakage detection conducted with an approved pole leakage detector forms part of asset inspection tasks, however may be utilised at any time that there is uncertainty about a pole having a higher potential than the surrounding ground.

The pole leakage detection equipment is suitable only for conductive poles such as concrete, steel and CCA treated timber and poles that have a continuous earthing conductor run down the pole such as substation poles, poles that have surge arrestors, catenary earthing wires, or uninsulated stay wires.

9.14.2 Pole leakage detection equipment required:

- PPCE as per Personal Protective Clothing and Equipment
- Approved pole leakage detector

9.14.3 Steps for pole leakage detection

1. Perform testing fundamentals checks
2. Insert the earth spike into the ground a minimum of 150mm at a minimum distance of 1m away from the pole
3. Attach free end of earth lead to screwed terminal on earth spike assembly. Attach telescopic probe by screwing it into the top of the instrument housing.
4. Prove the operation of the instrument by applying the probe to the test terminal on the side of the earth spike assembly. A deflection of between 3 and 8 divisions proves correct instrument operation. If the above deflection is not indicated by the instrument, replace the battery. Re-check for full-scale deflection, if not achieved with a new battery, there is a fault with the instrument and it must be danger tagged and removed from service
5. To perform leakage test, apply test probe to pole

PARAMETER	VALUE	ESCALATION STEPS
GREEN ZONE	No leakage present,	
ORANGE ZONE	Audible sound is heard, Some leakage present	Hazard exists, risk assessment to determine next action.
RED ZONE	Audible sound There is dangerous leakage current	Contact supervisor, System Control and prevent any person from approaching pole, beware that step potential may be caused and keep 2 metres of exclusion around pole

9.15 Test 13 - Pole Leakage Detection – High Voltage Pole with Modiewark GLM MINI

1. Switch the unit to the “ON” position, a Green LED power light will immediately illuminate, indicating good battery condition and circuitry connectivity.
2. For power pole testing place the Sensitivity Switch to HIGH (to the RIGHT) and the Sensitivity Dial to the far RIGHT to position 12.
3. Confirm the low battery LED is still GREEN and continue to step 4. If the (orange) LED illuminates, replace battery before use or recharge NIMH battery with approved charger and repeat steps 1 - 3.
4. Press the Self-Test Button to check the unit is operating correctly. A repeating tone will be heard indicating a correct operation. A two second delay will occur between the self-test operation and the normal unit detection operation. The GLM Mini is ready for operation.
5. It is recommended that regular checks using the self-test function be made before and during the safe approach of electrical voltage testing.
6. Always hold the GLM MINI with your thumb placed on the indicated position with your arm outstretched. This allows maximum effectiveness and detection.
7. For the initial calibration procedure on a high voltage system, it is recommended that the minimum distance from the pole under test be 10 metres and stand directly below the conductor.
8. If trees are in close proximity or low voltage wires are below the high voltage conductors, stand at right angles (still 10 metres from the pole) to the line and pole to enable the detection of high voltage.

Note: Electíic fields fíom poweí lines can be distuíbed and íediíected by objects that aíe gíounded.

A tíee neaí a poweí line will loweí the stíength of an electíic field which may cause adjustments to the settings on the GLM Mini.

Otheí factoís which influence the electíic field and the initial calibíation setup include íainy and humid conditions.

9. After correct test instrument procedure has been carried out, raise the tester above the head and adjust the sensitivity dial until the voltage in the line above is detected

Method: Placing your right hand on the tester as indicated use the other hand to move the Sensitivity Dial slowly to the left until the alarm is a strong and continuous sound.

10. If Tester does not alarm If overhead mains cannot be detected by the GLM Mini at arm’s length at **HIGH 12**. It is our recommendation that with the self-test function showing correct battery voltage and circuit operation, the self-test function can then be used as a dependable correct safety procedure to approach the pole.

Note: If the sensitivity switch and dial aíe adjusted coííectly to pick up the live conductoís. A stíong field would píoduce a switch setting of low sensitivity position and the sensitivity dial would be in a position suited, to the onsite conditions. A low field would píoduce a switch setting of high sensitivity position and sensitivity dial would be in a position suited, to the onsite conditions.

11. When the overhead line conductor is located (by the activation of the alarm), lower the tester to chest height, at this point no alarm should be heard. The overhead field will be broken and the approach to the pole can be made. If the tester continues to alarm at chest height raise it above the head again and adjust the sensitivity dial one position to the left to desensitise it, then repeat step 11.

Method: By leaving the hand placed on the tester with the thumb as indicated, remove the other hand and lower the unit to chest height. ***Note:*** When using the unit on power lines where lower voltage mains, i.e., 415V AC are beneath the HV conductors
a null or dead zone will occur. To overcome this situation, move out from beneath the HV line until the alert tone is heard.

12. Verify the calibration of the overhead mains again to check voltage is still present and lower to chest height where the alert tone should dissipate. The tester should not alarm in this position or pole test will not be correct.

13. With the tester at arm's length approach the pole to be tested.

Method: Whilst approaching the pole keep arm out stretched and your other arm beside your body; walk calmly and slowly towards the pole, to a point where the Test Area Label is 25mm (1 inch) from pole. If the Tester alarms while approaching the pole, stop and raise the GLM mini towards the overhead conductors to make sure the GLM Mini is not picking up overhead field, if field is still broken above (no alert tone) proceed to step 15.

14. If the tester does not alarm there is no significant voltage running through the pole.

Method: At this point to verify results touch the pole with unit on the end marked Test Area only. The contact will increase sensitivity.

15. If an alert signal is heard do not panic but check your results proceed to step 16.

Method: To check your results take a step back until signal has discontinued then take a step forward to verify activation of unit. Please note the further you are away from the pole and the tester is alarming, the higher the leakage in that pole. A set of calibration tables are available for switch positions and voltages if required.

16. Follow standard isolation procedures with a ten-metre perimeter, assess the area around pole to ensure no conductive material have contacted pole. I.e., Fences, machinery and water, as where you are standing may be live.

Note: If a voltage cannot be detected by the GLM Mini at aím's length at HIGH 12, then thíee possible situations can exist:

▮he oveíhead mains aíe not alive.

▮he oveíhead mains voltage does not have a stíong enough field to be picked up.

Low voltage mains aíe below the High voltage conductoís causing a null.

In these circumstances it is our recommendation that because the self-test function checks battery and circuitry it can be relied upon (after the self-test procedures have been carried out) that safe pole approach can be carried out.

9.16 Test 14 - Pole Leakage Detection – Low Voltage Pole with Modiewark GLM MINI

9.16.1 Geneíal

In situations where a test is required to check the voltage leak of a pole, where low voltage (415 volts) is the overhead supply, the following procedure is recommended.

1. Switch the unit to the “ON” position, a green LED power light will immediately illuminate, indicating good battery condition and circuitry connectivity.
2. For low voltage pole testing place the Sensitivity Switch to HIGH (to the RIGHT) and the Sensitivity Dial to the far RIGHT to position 12. This setting will allow testing with the Modielive mark 3 testing unit which is supplied separately. If applicable.
3. Confirm the low battery LED is still (green) and continue to step 4. If the (orange) LED illuminates, replace battery before use or recharge NIMH battery with approved charger and repeat steps 1 - 3.
4. Press the Self-Test Button to check the unit is operating correctly. A repeating tone will be heard indicating a correct operation. A two second delay will occur between the Self-Test operation and the normal unit detection operation. The GLM Mini is ready for operation.
5. It is recommended that regular checks using the self-test function be made before and during the safe approach of electrical voltage testing.
6. Always hold the GLM mini with your thumb placed on the indicated position, with your arm outstretched. This allows maximum effectiveness and detection.
7. For the initial calibration procedure on a low voltage mains pole keep the pole to be tested at a minimum distance of three metres (3m) at the initial setup.
8. Place yourself directly under the low voltage line away from hazards such as trees, other electric fields keeping a distance of 3m from the pole under test.

Note: Electíic fields fíom poweí lines can be distuíbed and íediíected by objects that aíe gíounded. A tíee neaí a poweí line will loweí the stíength of an electíic field which may cause adjustments to the settings on the GLM Mini. Otheí factoís which influence the electíic field and the initial calibíation setup include íainy and humid conditions.

9. After correct test instrument procedure has been carried out, raise the tester above the head and adjust the sensitivity dial until the voltage in the line above is detected.

Method: Placing your right hand on the Tester as indicated use the other hand to move the Sensitivity Dial slowly to the left until the alarm is a strong and continuous sound.

10. If Tester does not alarm If overhead mains cannot be detected by the GLM Mini at arm’s length, at **HIGH 12**. It is our recommendation that with the self-test function showing correct battery voltage and circuit operation, the self-test function can then be used as a dependable correct safety procedure to approach the pole.

Note: If the sensitivity switch and the sensitivity dial aíe adjusted coíiectly to pick up the live conductoís.

• A stíong field would píoduce a switch setting of low sensitivity position and the sensitivity dial would be in a position suited, to the onsite conditions.

• A low field would píoduce a switch setting of high sensitivity position and the sensitivity dial would be in a position suited, to the onsite conditions.

11. When the overhead line conductor is located (by the activation of the alarm), lower the tester to chest height, at this point no alarm should be heard. The overhead field will be broken and the approach to the pole can be made. If the Tester continues to alarm at chest height raise it above the head again and adjust the sensitivity dial one position to the left to desensitise it, then repeat step 11.

Method: By leaving the hand placed on the Tester with the thumb as indicated, remove the other hand and lower the unit to chest height.

12. Verify the calibration of the overhead mains again to check voltage is still present and lower to chest height where the alert tone should dissipate. The tester should not alarm in this position or pole test will not be correct.
13. With the tester at arm's length approach the pole to be tested.

Method: Whilst approaching the pole keep arm out stretched and your other arm beside your body; walk calmly and slowly towards the pole, to a point where the Test Area Label is 25mm from pole. If the tester alarms while approaching the pole, stop and raise the GLM mini towards the overhead conductors to make sure the GLM mini is not picking up overhead field, if field is still broken above (no alert tone) proceed to step 15.

14. If the tester does not alarm there is no significant voltage running through the pole.

Method: At this point to verify results touch the pole with unit on the end marked Test Area only. The contact will increase sensitivity.

15. If an alert signal is heard do not panic but check your results proceed to step 16.

Method: To check your results take a step back until signal has discontinued then take a step forward to verify
activation of unit. Please note the further you are away from the pole and the tester is alarming the higher the leakage in that pole. A set of calibration tables are available for switch positions and voltages if required.

16. Follow standard isolation procedures with a ten-metre perimeter, assess the area around pole to ensure no conductive material have contacted pole. E.g., Fences machinery and water, as where you are standing may be live.

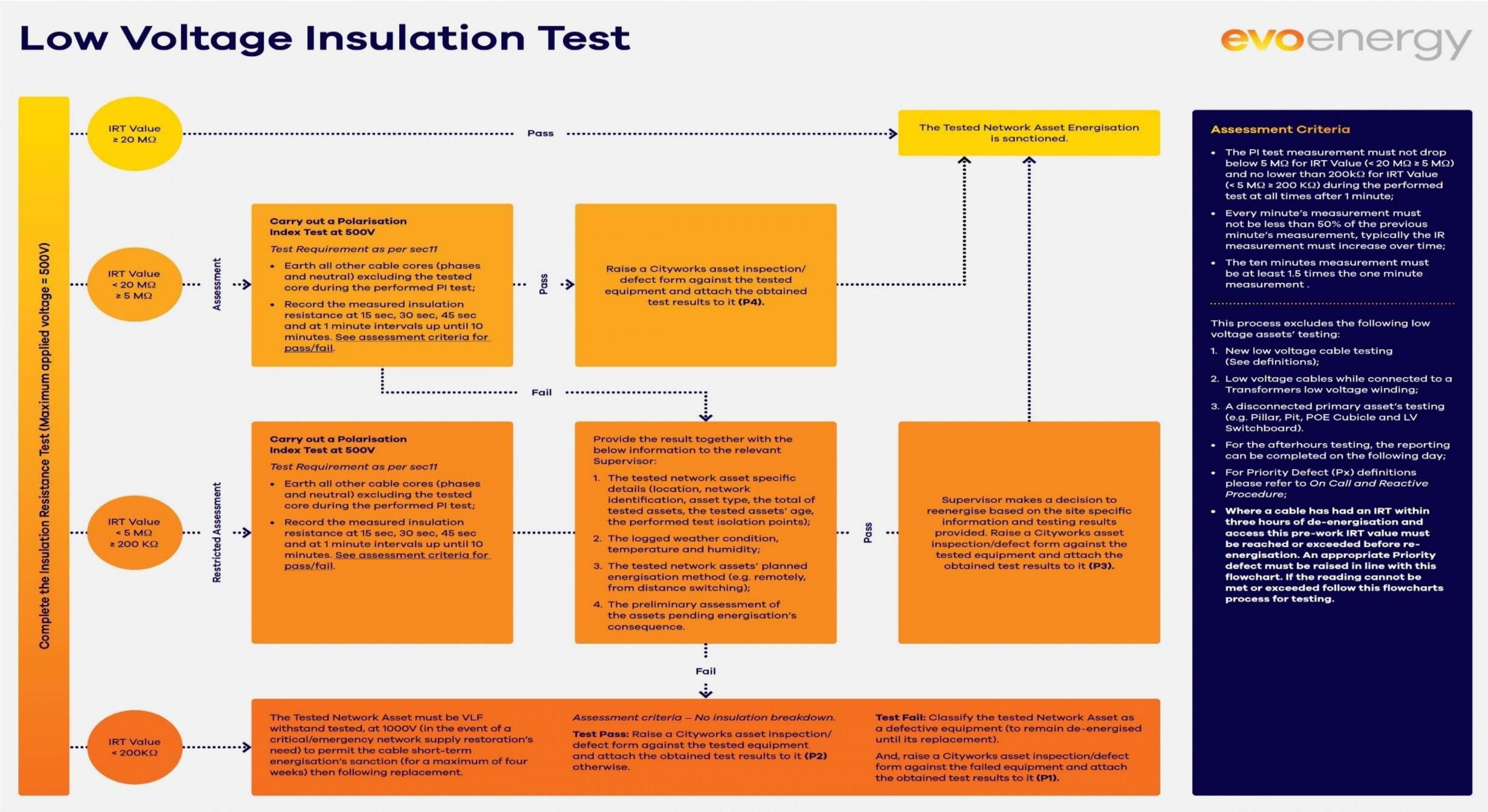
Noīe: **If a voltage cannot be detected by the GLM Mini at aím’s length at HIGH 12 then thíee possible situations can exist:**

- **Ťhe oveíhead mains aíe not alive.**
- **Ťhe oveíhead mains voltage does not have a stíong enough field to be picked up.**
- **Low voltage mains aíe below the High voltage conductoís.**

In these circumstances it is our recommendation that because the self-test function checks battery and circuitry it can be relied upon (after the self-test procedures have been carried out) that safe pole approach can be carried out.

IF A VOLTAGE IS DETECTED, THERE IS NO NEED TO BRING THE DETECTOR ANY CLOSER TO THE VOLTAGE

11.1.1 Low Voltage Insulation Test Escalation Process



VERSION CONTROL

VERSION	DETAILS	APPROVED
7.0	Complete rewrite	Wayne Cleland
8.0	Added neutral integrity at PoA and amended insulation resistance testing escalation path	Wayne Cleland
9.0	Update to new template and amended insulation resistance testing escalation path. Inclusion of Advanced testing section	Wayne Cleland
10	Update to align with training package. Minor changes	Wayne Cleland
11	Updated to include Modiewark GLM MINI pole leakage test. Changed PPE to PPC, Change PI test to Timed IR test, Document name change.	Brendan Commons
12	Update proximity pen picture to reflect new testing unit to replace old tester.	Brendan Commons
13	Section 9.10.6 amended to point to Section 11.1.3 Low Voltage Insulation Test Escalation Process	Brendan Commons

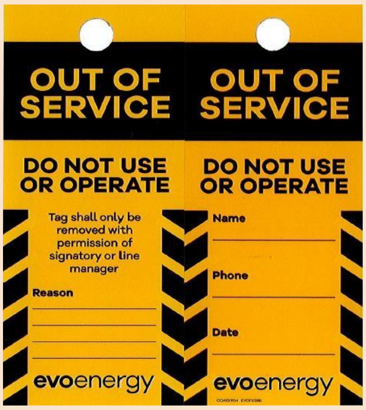
DOCUMENT CONTROL

DOCUMENT OWNER	DOCUMENT CUSTODIAN	PUBLISH DATE	REVIEW DATE
Group Manager Strategy and Operations	Electrical Work Practices Team Lead	31/05/2023	31/05/2025

APPENDIX A – OPERATIONAL CHECKS AND INSPECTION

EQUIPMENT	PRE OPERATIONAL CHECKS	PERIOD
PROXIMITY TESTER	• Check batteries • Check test lead insulation • Check for damage on instrument	Not required
TONG AMMETER / VOLT METER	• Check batteries • Check test lead insulation • Check lead continuity • Check for damage on instrument • Prove voltage test	12 months
PHASE ROTATION TESTER (CONTACT OR NON-CONTACT)	• Check batteries • Check test lead insulation • Check for damage on instrument	Not required
INDEPENDENT EARTH	• Continuity check <10Ω • Check connections • Inspect insulation	Not required
INSULATION RESISTANCE TESTER	• Check batteries • Check test lead insulation • Check for damage on instrument • Check lead continuity	12 months
FAULT LOOP IMPEDANCE TESTER	• Check batteries • Check test lead insulation • Check lead continuity • Check for damage on instrument	12 months
TEMPORARY LOAD BANK	• Check batteries • Check test lead insulation • Check for damage on instrument	Not required
POLE LEAKAGE DETECTOR	• Check batteries • Check for damage on instrument • Check probe and leads	Not required

APPENDIX B – LABELS AND TAGS FOR TESTING

LABEL/TAG TYPE	WHERE USED	IMAGE	STOCKCODE
CROSSARM NEUTRAL IDENTIFICATION TAG	Low voltage crossarms		1197422
ZIP TIE NEUTRAL IDENTIFICATION TAG	Neutral cables, cable cores and conductors		1197433
DANGER TAG	Electrical apparatus		Laminated- 1204429 Paper- 1204418
OUT OF SERVICE TAG	Damaged or defective test equipment		1195926
DANGER LIVE STICKER	Service protection devices when the service has been energised		1204649