Section 3.

Test Procedures

"Information contained within this section shall be read in conjunction with all sections of this Installation Supply Connection Tests & Procedures manual"

Non - Compliant Test Results

Where acceptable results are not attained in accordance with these tests and procedures during their application, the work site shall be maintained in a safe condition in accordance with distributor's procedures and:

- **Where the worker has the competency and authorisation to identify and rectify the cause of the deficient test result they shall do so.**
- **Where the worker does not have the competency and authorisation to identify and rectify the cause of the deficient test result, they shall report the matter to their supervisor and ensure affected persons are advised.**

3.1 Contents

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3.2 Test for De-Energised

Purpose

To prove that apparatus to be worked upon is de-energised prior to the commencement of work on the apparatus.

Equipment Required

- Voltage Indicator
- Independent Earth

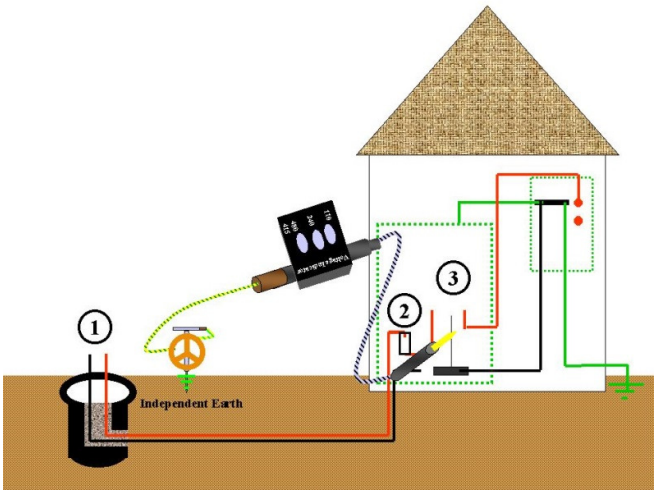
Method

1. Install independent earth, connect voltage indicator to independent earth: *(at least 2m from from any installation earths, water pipes and conductive structures - Refer Section 2.4).*
2. Test voltage indicator and circuit.
3. Test all apparatus to be verified as de-energised with voltage indicator.
4. Test the testing circuit and voltage indicator.

Results

Zero volt reading to be obtained.

Typical locations for testing for de-energised.



1. Underground consumer's mains at a pit, pillar etc.
2. Service fuses at a meter position or FOLCB (overhead supply)
3. Metal metering enclosures and metering conductors

Notes:

When performing works on existing installations test conductive components of the installation e.g. spouting, conductive roofs, raiser brackets, metal metering enclosures within the immediate work area.

For metering work ensure all adjacent exposed metalwork and exposed metal meter fixing screws are tested for de-energised.

Where there is reasonable cause to believe alternative supply may exist, also test between all conductors.

For additional information on Alternative Supplies see **Section 5** - **Appendices**

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3.3 Neutral Integrity Test Point (NITP) – Test

Purpose	**Equipment Required**
To establish a valid test point for the purpose of (Polarity) Check Testing and NST testing by ensuring continuity of the consumer mains neutral conductor and the electrical installation earthing system via the MEN connection to the NITP	➢ Insulation Resistance and Continuity Tester ➢ Trailing Lead, where required

Neutral Integrity Test Points

Single Occupancy

Acceptable test points are;

1. MEN bar Customers Main Switchboard
2. Metal Metering Enclosure
3. Installation Earth Electrode/System

Note: Older installations may have used the water reticulation pipes as part of their earthing system

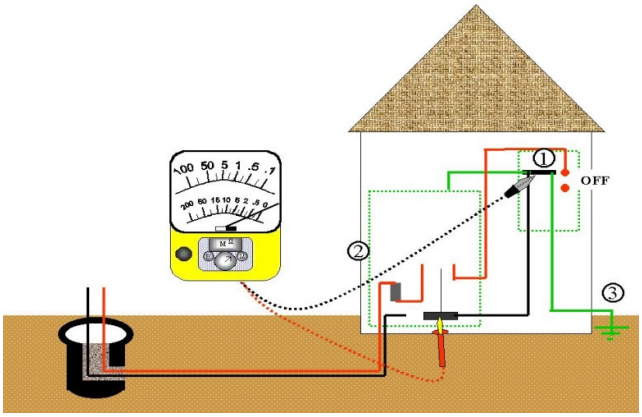
(Acceptable test points are shown numerically in diagrams below)

Where acceptable NITPs are not accessible, alternative NITPs will be specifically nominated in the relevant connection procedure

Method	**Results**
1 Identify acceptable Neutral Integrity Test Point; 2 Select the Ohm scale and prove the tester operation; 3 Test between consumer's mains neutral and the selected Neutral Integrity Test Point; *and* 4 Prove the tester operation.	Resistance of 0.5 Ohm or less

TYPICAL & ACCEPTABLE NEUTRAL INTEGRITY TEST POINTS

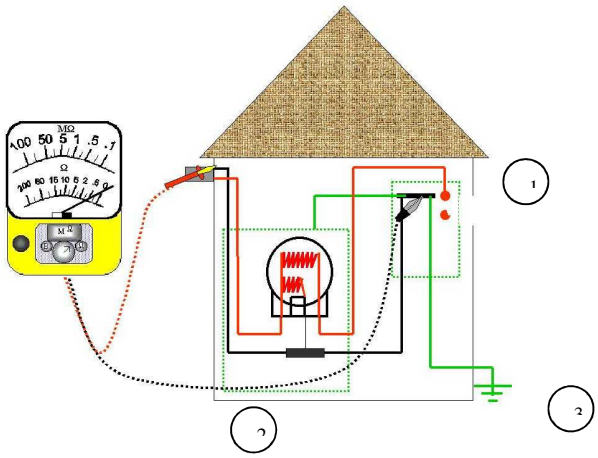
Underground Supply



Neutral Integrity Test Point test is conducted from the Meter board Neutral link to identified acceptable NITP

TYPICAL & ACCEPTABLE NEUTRAL INTEGRITY TEST POINTS cont

Overhead Servicing – New /Replacement



Trailing Lead Method –

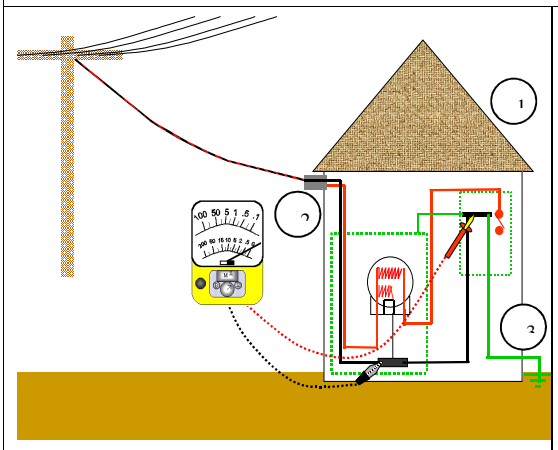
Neutral Integrity Test Point test is conducted from the consumer's mains neutral in the FOLCB to the identified acceptable NITP

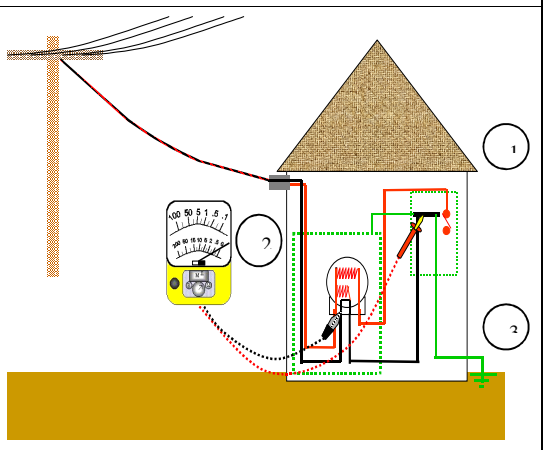
Note: NITP testing involving the FOLCB shall only be undertaken when the FOLCB is completely isolated

Note: NITP testing involving the FOLCB shall only be undertaken when the FOLCB is completely isolated.

Direct Metering Alteration and/or Addition - Single Occupancy

NITP test is conducted from the incoming neutral at the meter position to the identified acceptable NITP on the occupancy.





Neutral Integrity Test Points cont.

Multiple Occupancies

These tests & procedures for establishing a valid test point at a multiple occupancy installation will cover the majority of multiple occupancy configurations. Where these procedures cannot be applied, refer to individual Distribution company procedures.

New Installation*:-*

Test points for new installations are the;

- **MEN bar at the main switchboard;**
- **Neutral bar at individual group metering positions;**
- **Any point proven to be connected to the above points; *and***
- **MEN bar/ Neutral bar at the occupancy switchboard**

Refer to 4.8 for Test & Connection procedure

Overhead service replacement – Multiple Occupancy

- **Establishment of NITP is the same as for single occupancy**

Refer to Test and Connection procedure 4.11, 4.12 or 4.13 as applicable

Underground Service repair/replacement – Multiple Occupancy

- **The MEN link or MEN bar or any point proven to be connected to these points**

Neutral Integrity Test Points cont

Direct Metering Alteration and/or Addition – Multiple Occupancy

Existing Installation *:-*

Neutral Not Disturbed

Acceptable test points for work on existing Multiple Occupancies where the main or occupancy neutral is not disturbed are :

- **Visually confirmed point where the main earth and main neutral are connected (MEN), *or***
- **The neutral bar/ link of a meter position that is remote to the location of the MEN**

N.B. The location of the point where the main neutral and main earth are connected will be at the main switch board or neutral link on the meter panel.

Further clarification on NITP location and methods to establish the valid NITP on particular types of Multiple Occupancies may be found in the individual connection procedure 4.14A

Neutral Disturbed

Acceptable test point for work on existing Multiple Occupancies where the main or occupancy neutral is disturbed is:

- **Neutral bar at the occupancy switchboard**

OR

- **MEN bar at the occupancy switchboard (Only where an independent earth can be established {Appendices 5.3 not applicable})**

Further clarification on NITP location and methods to establish the valid NITP on particular types of Multiple Occupancies may be found in the individual connection procedure 4.14B

NOTE: If an Independent earth is unavailable, refer to Appendices 5.3 of these Procedures

3.4 Underground Consumers Mains Test

Purpose

The purpose of testing underground consumers mains is to prove:

- The insulation resistance between conductors.
- The insulation resistance between conductors to earth.
- The continuity of the mains cables.

Equipment Required

- Insulation Resistance and Continuity Tester.
- Bridging lead

Method

1. Establish Earth Reference.-(refer **Note)**
2. Ensure consumer mains conductors are separated from each other and any other conductive material.
3. Select the 500 V M/Ohm scale on the tester prove the tester operation.
4. Test each consumer's mains conductor to the established Earth Reference.
5. Test between all consumers' mains conductors.
6. Discharge conductors
7. Prove the tester operation.
8. Select the Ohm scale and prove the tester operation
9. Bridge one end of the consumer's mains neutral conductor and active conductor.
10. Test continuity of consumer's mains.
11. Disconnect bridge and re-test
12. Repeat test on each active conductor.
13. Prove the tester operation.

Note: Earth reference – Installation earth electrode, proven point connected to installation earth electrode or independent earth.

Results – New Consumer's Mains

Insulation Resistance	
Conductor Length	*Result*
Up to 50 m	Not less than 50 Meg Ohm
Greater than 50m	5 Meg Ohm reduction for each 25 m over 50m
Must not be less than 5 Meg Ohm regardless of length.	
Continuity Test/s	
Conductors Bridged	Less than 0.5 Ohm
Bridge Removed	Open Circuit

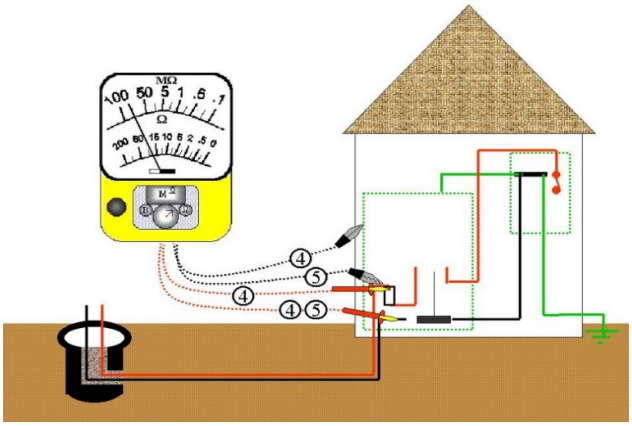
Results – Existing Consumer's Mains

For reconnection of existing mains or repaired mains, the IR test result shall be a minimum of 5 Meg Ohms. Where this value cannot be obtained, refer to individual Distributor Procedures.

Typical Insulation Resistance Testing (Steps 4 & 5)

4. Test each consumer's mains conductor to the established Earth Reference.

5. Test between all consumer's mains conductors.



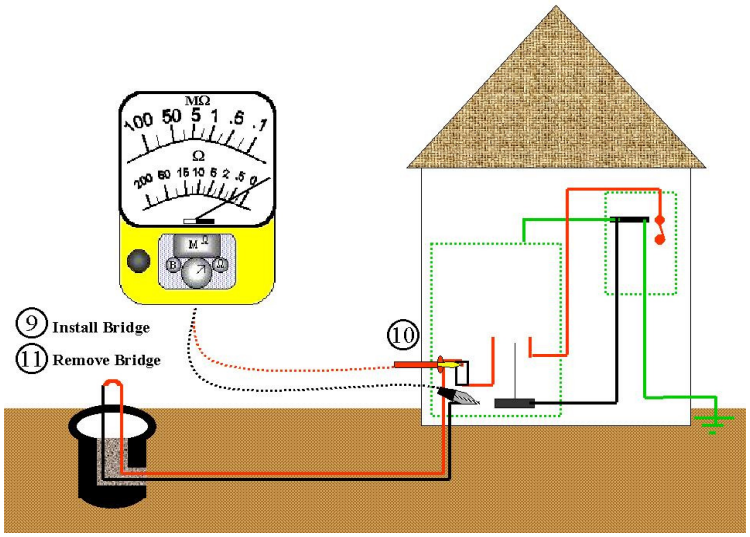
Underground Mains Testing… cont

Typical Continuity Testing Steps (9,10 & 11)

9. Bridge one end of the consumer's mains neutral conductor and active conductor.

10. Test continuity of consumer's mains.

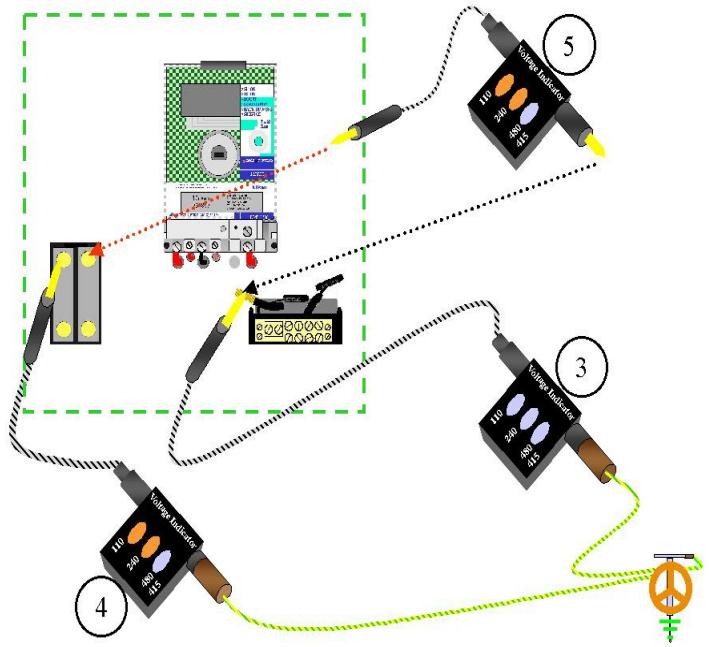
11. Disconnect bridge and re-test



3.5 Polarity Test

Purpose	**Equipment Required**
To prove the supply neutral is not connected to an energised active conductor and the supply active/s are connected to the mains active.	➢ Voltage Indicator ➢ Independent Earth ➢ Neutral & Supply Tester (see Note)
Method	**Results**
1) Isolate Supply Conductors a. Supply active/s from installation active. b. Supply neutral from installation neutral. 2) Test the supply conductors as follows: 3) Independent earth to supply neutral. 4) Independent earth to supply active/s. 5) Supply active/s to supply neutral. 6) Between supply actives.	Zero Volts 240 Volts 240 Volts 415/480 Volts

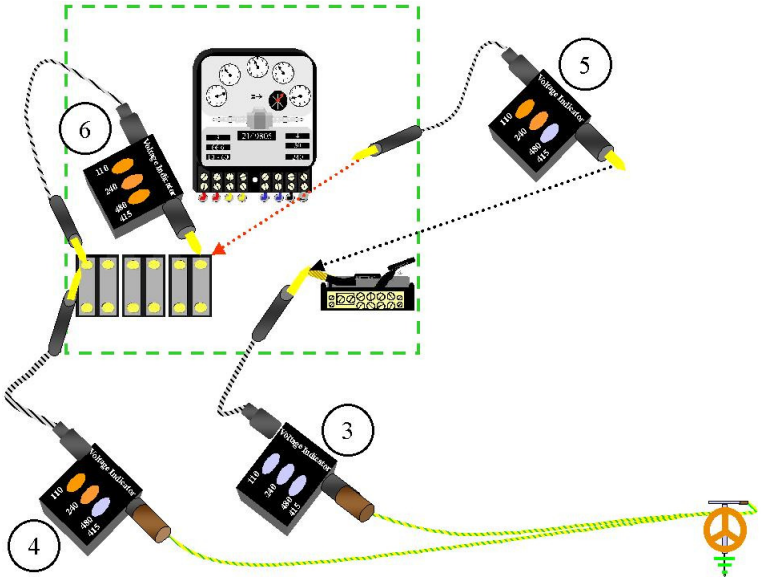
Typical Polarity Testing at Meter Position Single Phase (Steps 3 – 5)



3) Independent earth to supply neutral.
4) Independent earth to supply active.
5) Supply active to supply neutral.

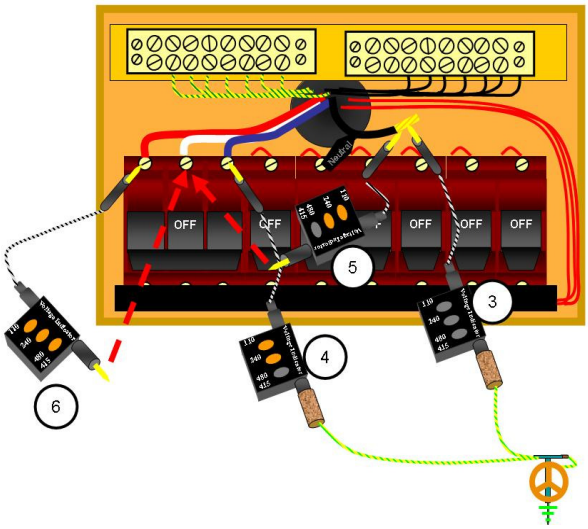
Polarity Test .. cont

Typical Polarity Test on a Multiphase Installation (Steps 3 – 6)



3) Independent earth to supply neutral.
4) Independent earth to supply active/s.
5) Supply active/s to supply neutral.
6) Between supply actives.

Typical Polarity Test at Installation Switchboard (Steps 3 – 6)



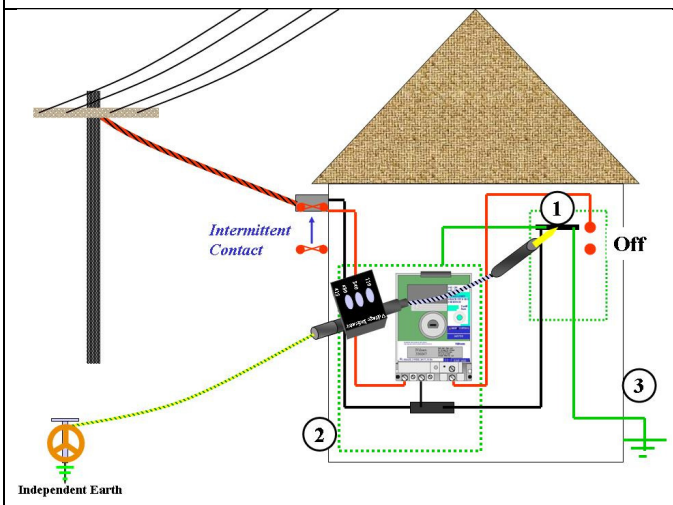
3) Independent earth to supply neutral.
4) Independent earth to supply active/s.
5) Supply active/s to supply neutral.
6) Between supply actives.

Note: Polarity testing at installation switchboards is permitted by authorised personnel only.

3.6 Check Test

Purpose	**Equipment Required**
To assist in proving the polarity of supply to the Customers Main switchboard is correct.	➢ Voltage Indicator ➢ Independent Earth ➢ Low Voltage Stick & Fuse Head where required ➢ Trailing lead where required.
Method	**Results**
1. Install independent earth, connect voltage indicator to independent earth, test voltage indicator and circuit. 2. Intermittently energise installation wiring via the service protection device (SPD) and simultaneously test between the independent earth and the established Neutral Integrity Test Point. 3. Test voltage indicator and circuit. 4. Energise installation via the service protection device. 5. Energise all active terminals at the meter position and simultaneously test between independent earth and the Neutral Integrity Test Point. 6. Test voltage indicator and circuit. NOTES: For *Single Person Check Testing – Trailing Lead Method*, a trailing lead is placed in series with the circuit at Point 1. The SPD may be either service fuse/s or a circuit breaker in an underground situation.	Zero Volts reading to be obtained for all Check Tests – Peak & Off Peak Loads and all Switching terminals.

Typical Check Test Arrangement (Two Persons Required).

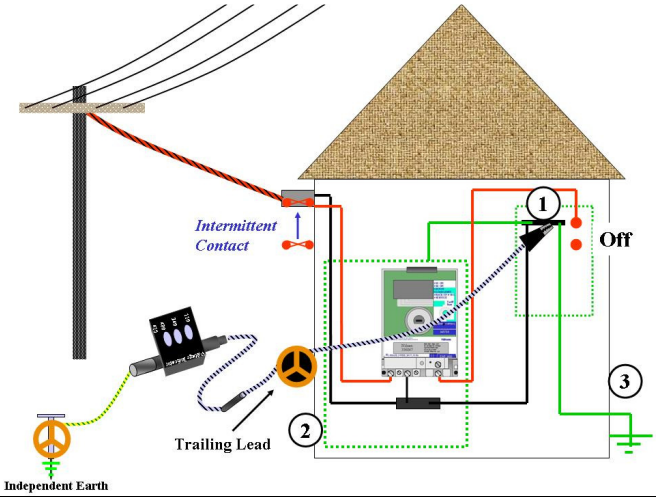


Arrangement Required

One person intermittently energises the installation via the SPD whilst the other simultaneously tests at the NITP.

Check Test is conducted to the previously established Neutral Integrity Test Point (NITP).
.

Typical Check Test Arrangement OH (Single Person – Trailing Lead Method).

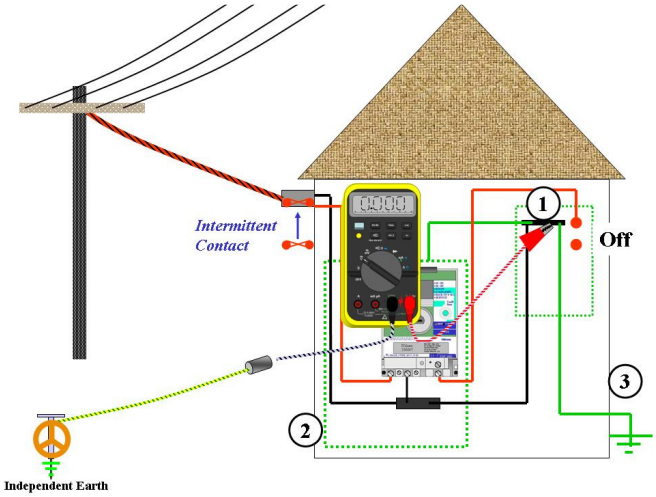


Arrangement Required

A trailing lead placed in series with the testing equipment is used to extend the testing circuit and allows for a single person to perform Check Testing.

Check Test is conducted to the previously established Neutral Integrity Test Point (NITP).

Typical Check Test Arrangement OH (Single Person – Volt Meter Method).

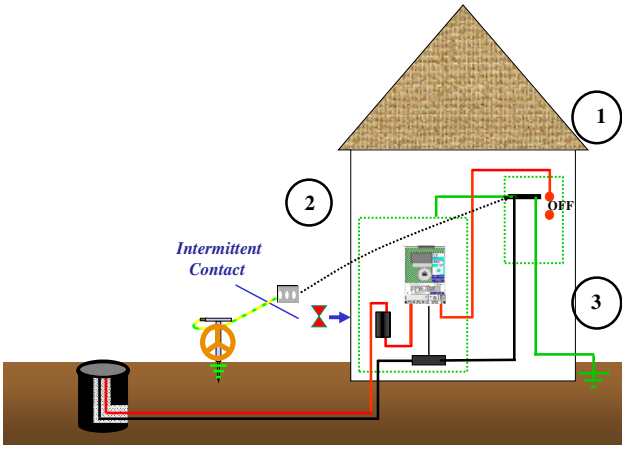


Arrangement Required

An approved digital multi/volt meter.

Check Test is conducted to the previously established Neutral Integrity Test Point (NITP).

Typical Check Test Arrangement UG (Single Person – Trailing lead method)



Arrangement Required

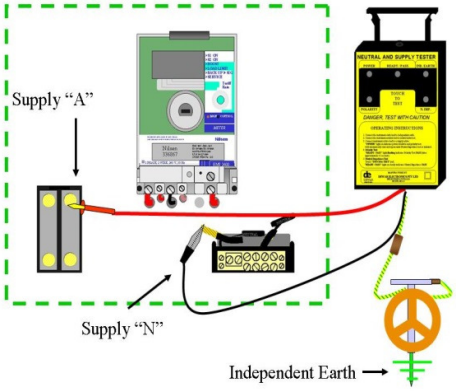
A trailing lead placed in series with the testing equipment is used to extend the testing circuit and allows for a single person to perform Check Testing.

Check Test is conducted to the previously established Neutral Integrity Test Point (NITP).

3.7 Neutral & Supply Test

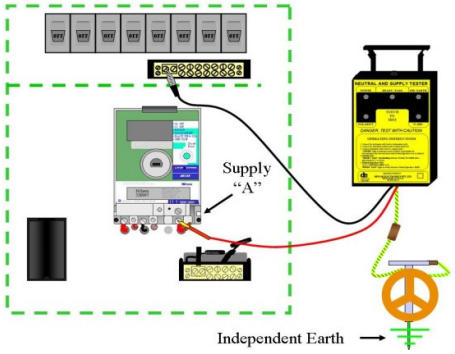
Purpose	**Equipment Required**
The purpose of testing with a Neutral & Supply Tester in accordance with these *Installation Supply Connection Tests & Procedures* is to demonstrate that the active and neutral connections from the network supply to the customers installation are correct.	➢ Neutral & Supply Tester ➢ Independent earth ➢ Trailing Leads where appropriate
Method Ensure test location is appropriately prepared. 1. Connect the instrument earth lead to the independent earth. 2. Connect the instrument neutral lead to the supply neutral. 3. Connect the instrument active lead to the supply active. **4. Polarity Test.** **5. Neutral Impedance Test** - Touch "Touch to Test" pad where fitted.	**Results** **POWER** light on indicates power available and polarity test will automatically start and repeat until the Neutral Impedance test is initiated **READY/PASS** light flashing indicates Polarity Test **PASS** **OR** digital display NST- indicates **PASS** & test result value **READY/PASS** light on steady Neutral Impedance **PASS.** **OR** digital display NST- indicates **PASS** & test result value **Note**: this may include parallel earthing paths via MEN points of connected installations.

Typical NST Test at a Meter Position



Neutral & Supply Test …cont

Typical Neutral & Supply Testing at a NITP



Note: Neutral & Supply Testing at a Neutral Integrity Test Point is conducted after all neutral connections have been made.

NEUTRAL AND SUPPLY TESTER ALARMS – TROUBLE SHOOTING ERROR INDICATION

Power	No **"POWER"** light indicates no supply or instrument failure. Test the instrument on known live supply. If no " POWER" indication return the instrument for service. If applied voltage is less than 150 VAC "POWER" light will be dim but no subsequent test will be undertaken and no change of indication will occur. Check with voltmeter, isolate service and notify supervisor.
Polarity Test	**"IND. EARTH", "POLARITY" & "N. IMP"** flashing in sequence indicates instrument failure. Use alternative tester to complete Polarity Test and return the instrument for service. **"POLARITY"** light **on** indicates active voltage outside acceptable range. Confirm with voltmeter or approved tester and check connections. If confirmed, immediately isolate the service and then identify the fault. **Possible Causes**: ➢ Instrument connected phase to phase ➢ Supply voltage outside range due to poor connections on test probes ➢ Overloaded transformer ➢ Poor connections on supply active ➢ High circuit impedance (eg. excessive cable length). **"IND. EARTH" & "POLARITY"** lights flashing in sequence indicates voltage on neutral is higher than voltage on active. Immediately isolate the service and identify the fault. **Possible Causes:** ➢ Reverse polarity. **"IND. EARTH"** light on indicates independent earth connections too high for accurate test or voltage on neutral too high. Check connections to independent earth, try for more effective earth and repeat all tests. **Possible Causes** ➢ Poor connections to independent earth. ➢ Neutral impedance too high Voltage rise in neutral (excessive neutral current e.g. phases out of balance).

Neutral & Supply & Test … cont

Neutral Impedance Test	**"N. IMP"** light on indicates higher than acceptable (1 Ohm) impedance in supply neutral and/or active ***Immediately isolate the service and identify the fault.*** **Possible causes**: ➢ Active to Neutral impedance too high due to: ⇒ Poor connections on test probes ⇒ Damaged conductors in supply neutral and/or active ⇒ MEN system impedance above 1 Ohm ⇒ Supply cable too small or too long ⇒ Connection has been made to de-energised active or switch conductor

NOTE: See Section 5 Appendices for NST Indicator chart and Fault finding for both M1110 and M1120 NST units.

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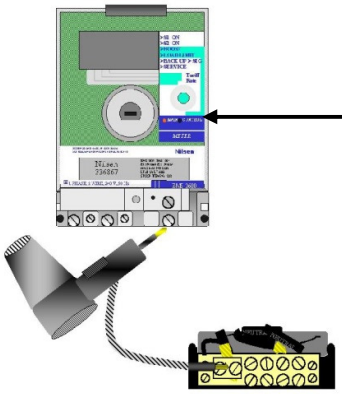
3. 8 Meter Load Test

Purpose	**Equipment Required**
To verify that the metering equipment is registering consumption of electrical energy.	➢ Load Tester
Method	**Results**
With the first connection being made to the supply neutral test between the neutral and each load active conductor.	Consumption of electrical energy is registered.

Typical Load Testing on Meters



Early model electronic meter indicates consumption by a pulsing indicator

NOTE:-
Refer to Manufacturer/Distributor instructions that may apply to various makes/types of meters

Electro Mechanical meters indicate energy consumption by the rotation of the disc in the direction identified on the meter face.

Note: Hair dryer type testers have potential to disturb dust and debris that may be present in close proximity of test location e.g. meter enclosures. Alternative testers are available.
(Refer to individual Distributor procedures)

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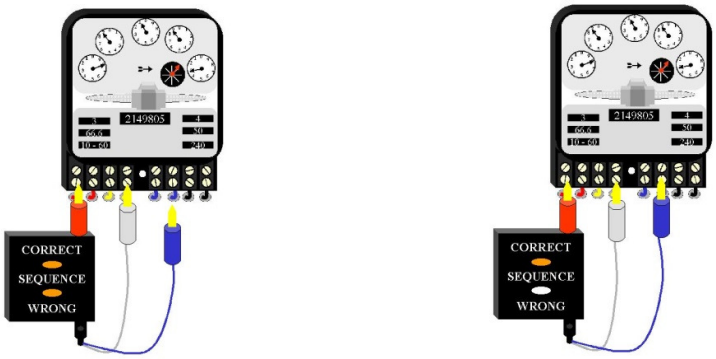
3. 9 Phase Sequence Test

Purpose	**Equipment Required**
The purpose of phase sequence testing is to ensure that: ➢ Phase sequence is correct at the meter position on new installations; and ➢ The original phase sequence is restored to the customer's main switchboard on existing installations.	➢ Phase Sequence Tester.
Method At the test location: 1 Connect the red phase probe to the red phase position 2 Connect the white phase probe to the white phase position 3 Make intermittent contact with the blue phase probe.	**Results** No Lights "Correct" and "Wrong" Lights Glow "Correct" Light Glows intermittently.

Typical Phase Sequence Test at a Meter - Steps 2 & 3



Notes

- Incorrect phase sequence at metering equipment may cause the metering equipment to register incorrectly.
- Incorrect phase sequence at a three-phase motor will cause the motor to run in reverse.

Phase sequence test …cont

WORK TYPE	PHASE SEQUENCE TEST
New Installations and Occupancies	Tests must be performed to ensure each 3 phase meter's phase sequence is correct.
Previously Connected Installations & Occupancies	Where work is performed upstream of a customers switchboard which may affect phase rotation, tests and checks must be performed to ensure the original phase sequence is restored to the metering and customers equipment, ie:
a) Phase sequence determined at customer's end prior to disconnection eg. Replace a connected service cable or 3 phase meter	Mark corresponding supply cable terminals and ensure replacement cable is connected in accordance with the original phase sequence. *(Note: For meter changes where there is a possibility of transposition of wiring, a phase sequence test is to be conducted at the customer's switchboard before and at the completion of the work)*
b) Phase sequence not determined at customer's end prior to disconnection eg. Replace a disconnected service cable or 3 phase meter	Test to ensure each 3 phase meter phase sequence is correct; and i) Where it is known or suspected that the customer's equipment includes 3 phase motors - ensure their correct rotation. ii) Where correct rotation of the customers motors is unable to be determined: ▪ *Connector* must not connect supply to that equipment until the motor/s correct rotation can be established. ▪ The customer must be advised of this condition.