



# Section 5.

# Appendices.

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

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## 5.1 Contents

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### 5.2A NEUTRAL & SUPPLY TESTER (MODEL M1110) – FAULT INVESTIGATION GUIDE

**Purpose** This fault investigation guide is to assist in rectification of faults discovered during the performance of connection testing procedures. Depending upon methods of testing and other distribution factors the Neutral & Supply Tester does not always identify all neutral faults. Therefore this guide is not designed for, nor should be used for circumstances where a fault has been reported to the Distribution Business.

**General Information** Given the variables in different connection procedures and supply arrangements, this guide is in the format of flow charts with Handy Hints indicated by the symbol  and number to be referenced at the bottom of each chart.

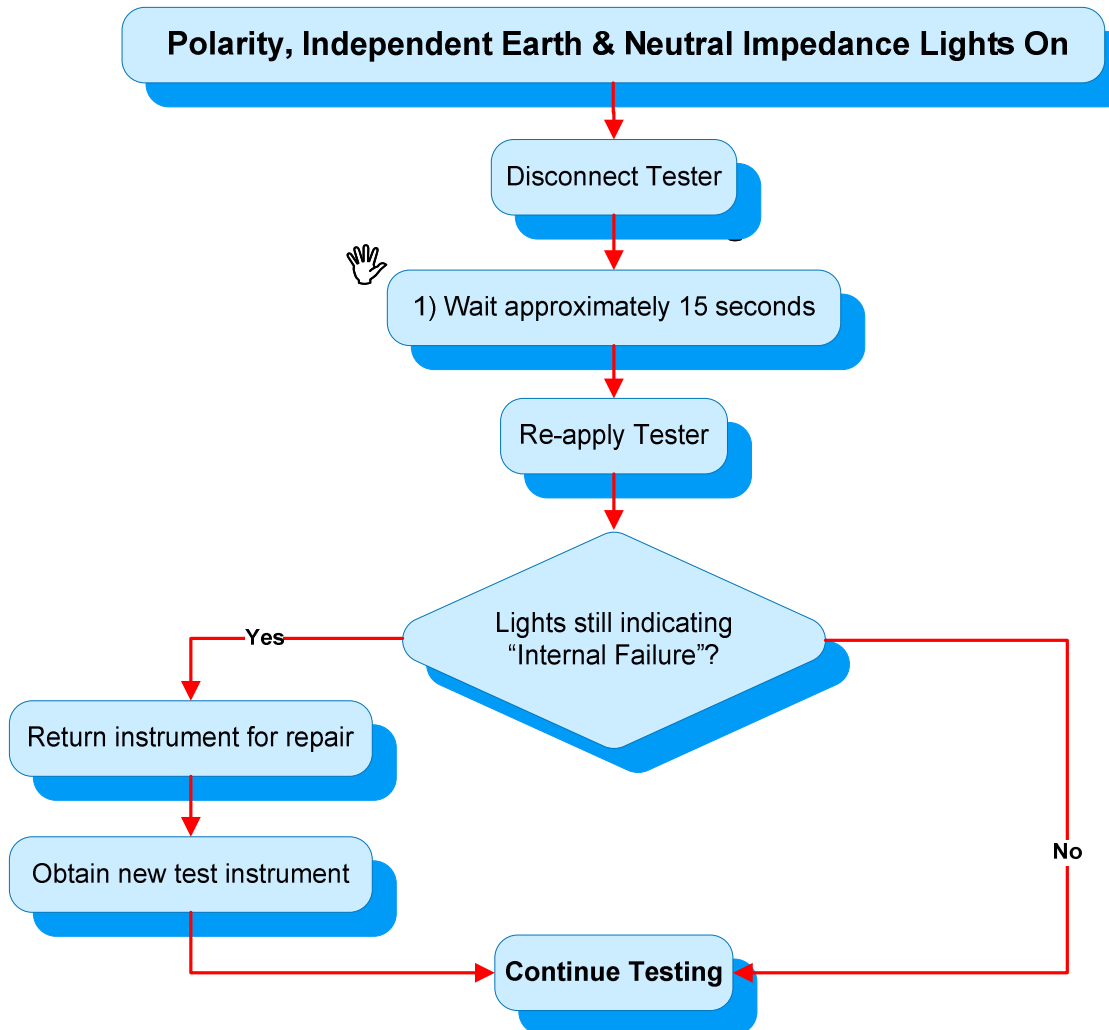
Test Step	Test Function	Power Green	Ready/ Pass (Green)	Ind. Earth (Red)	Polarity (Red)	Neutral Imp (Red).	ALARM	COMMENT
Self Check 1	Supply volts > 150V	OFF	OFF	OFF	OFF	OFF	OFF	No supply or instrument failure
		DIM	OFF	OFF	OFF	OFF	OFF	Voltage < 150V
		ON	OFF	OFF	OFF	OFF	OFF	Acceptable result, next test
Self Check 2	Instrument internal operation check	ON	OFF	Flashing	Flashing	Flashing	YES	Internal failure of tester
			OFF	OFF	OFF	OFF	NO	Acceptable result, next test
Live Test 1	Active to neutral voltage is within acceptable tester operation range of 205v – 264v (+ - 5%)	ON	Dim & flashing quickly	OFF	OFF	OFF	NO	Neutral connection made to isolated length of conductor – e.g. Floating neutral
			OFF	OFF	ON	OFF	YES	Voltage outside acceptable range
			OFF	OFF	OFF	OFF	NO	Acceptable result, next test
Live Test 2	Neutral to earth volts < Active to earth volts	ON	OFF	Flashing	Flashing	OFF	YES	Neutral to earth > Active to earth Probable reverse polarity
			OFF	OFF	OFF	OFF	NO	Acceptable result, next test
Live Test 3	Neutral to earth volts < 5v (+- 5%)	ON	OFF	ON	OFF	OFF	YES	Voltage of test neutral > than 5V
			OFF	OFF	OFF	OFF	NO	Acceptable result, next test
Live Test 4	Neutral to Earth Impedance < 10 kΩ	ON	OFF	ON	OFF	OFF	YES	Independent earth impedance > 10kΩ
			OFF	OFF	OFF	OFF	NO	Acceptable result, next test
Safe to Proceed	All the above tests pass	ON	Flashing	OFF	OFF	OFF	NO	Acceptable result, next test
Touch Pad (where fitted)	Active to Neutral Supply Impedance < 1Ω	ON	OFF	OFF	OFF	ON	YES	Active to Neutral impedance is > 1Ω
			ON	OFF	OFF	OFF	NO	Acceptable result – NST Pass

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### **Power Light On – Ready Pass Light Flashing Dim and Quickly**

Indication that the neutral under test is not connected to a point of different potential e.g. (floating).

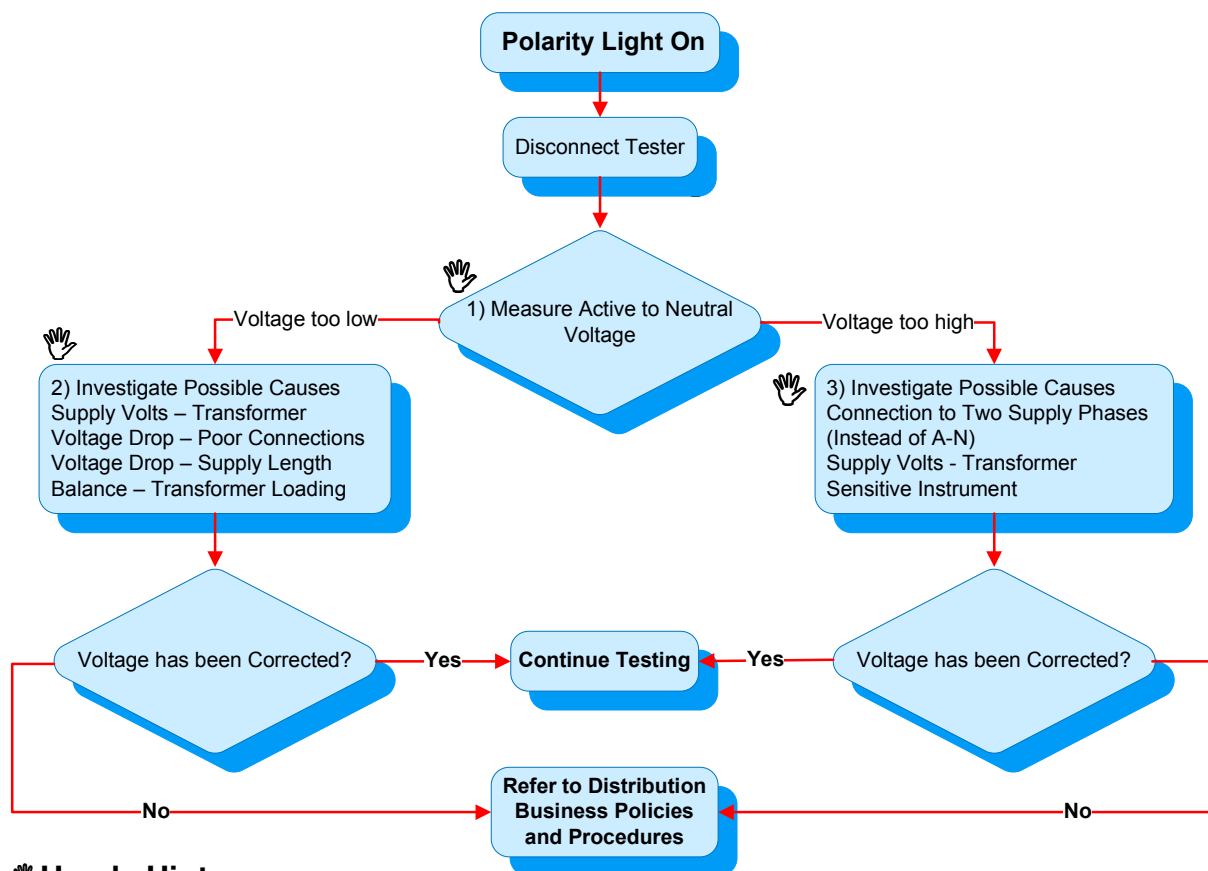
Note: Dependant upon other circuit factors this light may not activate in all circumstances, although the fault will be indicated through the activation of the polarity light (active to neutral supply voltage outside the acceptable test range), or other fault indication.



#### **Handy Hints -**

- 1) An intermittent contact made with the active test probe during the testing may disturb the instruments test sequence resulting in the indication of an internal failure on some testers. The re-application of the tester after waiting approximately 15 seconds may reset the tester for correct operation.

Should the tester still indicate an internal failure, return the instrument for repair.



### Handy Hints -

- 1) Utilising a voltmeter, gain an accurate measurement of the voltage of the supply phase under test.
- 2) In some circumstances correct voltage may be obtained by balancing load across phases. If this is not achievable, increasing the secondary voltage of the supply transformer may be an option, although the resultant increase in voltage to customers upstream towards the supply transformer must also be considered in these circumstances.

Where poor connections are suspected, testing across the connection with a voltmeter is a valuable method of identifying abnormalities.

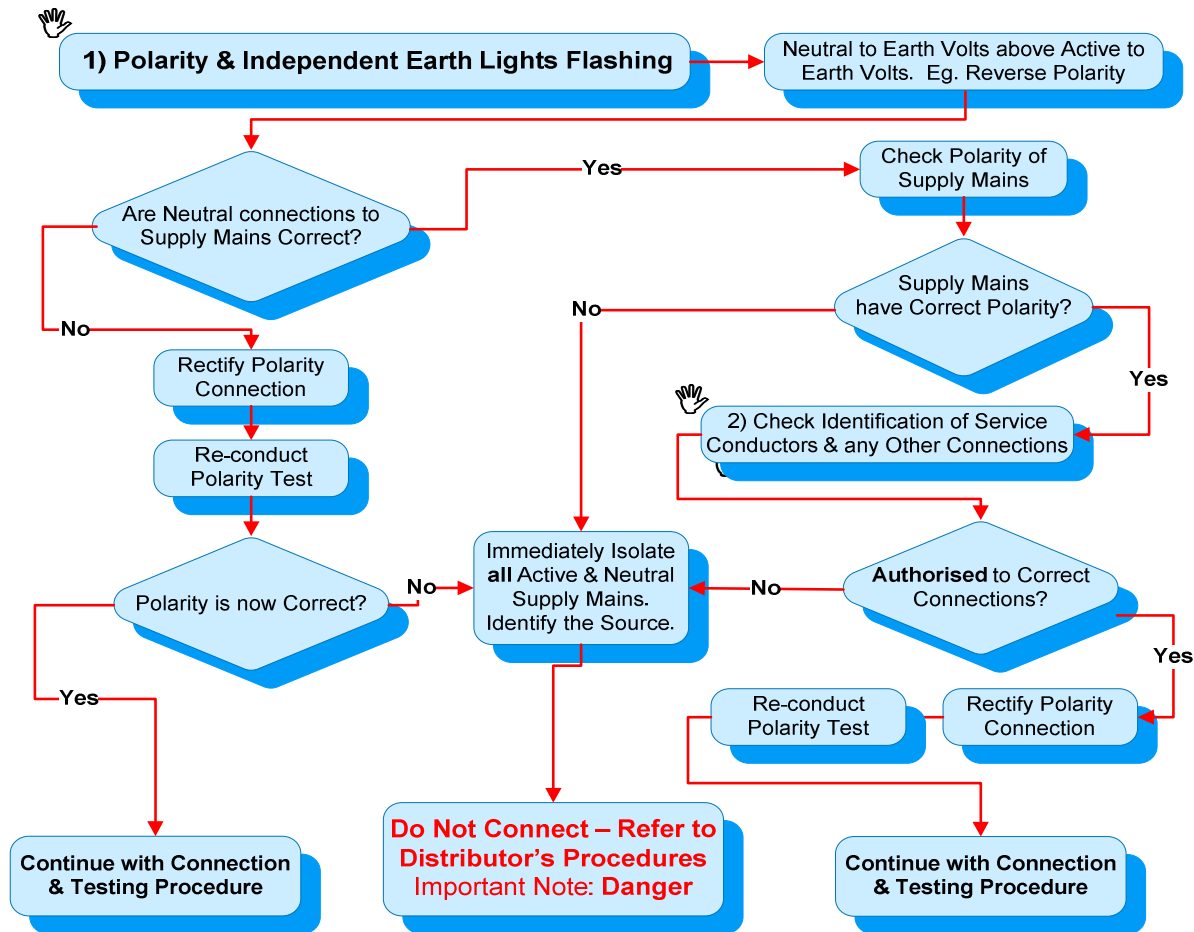
If the supply volts are low as a result of insufficient cable size or excessive supply length and cannot be rectified, refer to the Distribution Business policies and procedures.

- 3) Some Neutral and Supply Testers may indicate a fault with voltages that are within the acceptable supply range e.g. 252v. The application of another, less sensitive Neutral & Supply Tester may result in the correct testing results being obtained.

Where the supply voltage is high consider decreasing the secondary voltage on the supply transformer. Consideration must be given to the resultant effects on voltage to customers downstream in the supply system when exercising this option.

The **Power Light** activating immediately upon the neutral test lead being connected to the neutral under test, indicates the neutral under test is alive. **⚡ Danger** - The active test lead will immediately be alive in these circumstances.





**Handy Hints –**

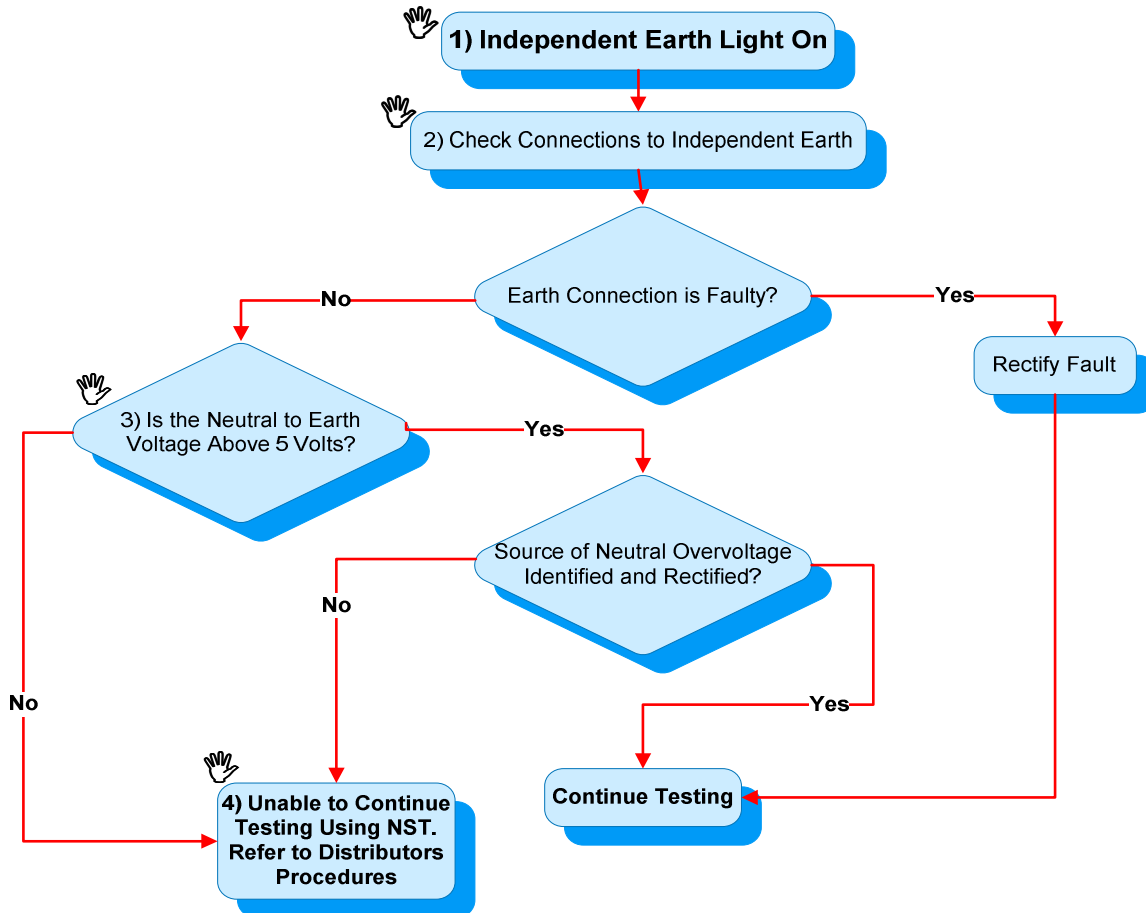
- 1) The **Power Light** activating immediately upon the neutral test lead being connected to the neutral under test, indicates the neutral under test is alive. **⚡ Danger** - The active test lead will immediately be alive in these circumstances.
- 2) Sources of incorrect polarity may include incorrect identification of conductors by persons not directly involved in the connection process e.g. Licensed Electrical Contractor. If the source of the reverse is unable to be identified, or the connector is not authorised to correct the source of reverse, isolate all active and neutral service conductors from the supply mains and refer to the Distribution Business policies and procedures.

**Note:** Work shall only be conducted by persons **authorised** to perform such work in accordance with Section 1 Clause 1.10 of these procedures.

**Important Note: ⚡ Danger**

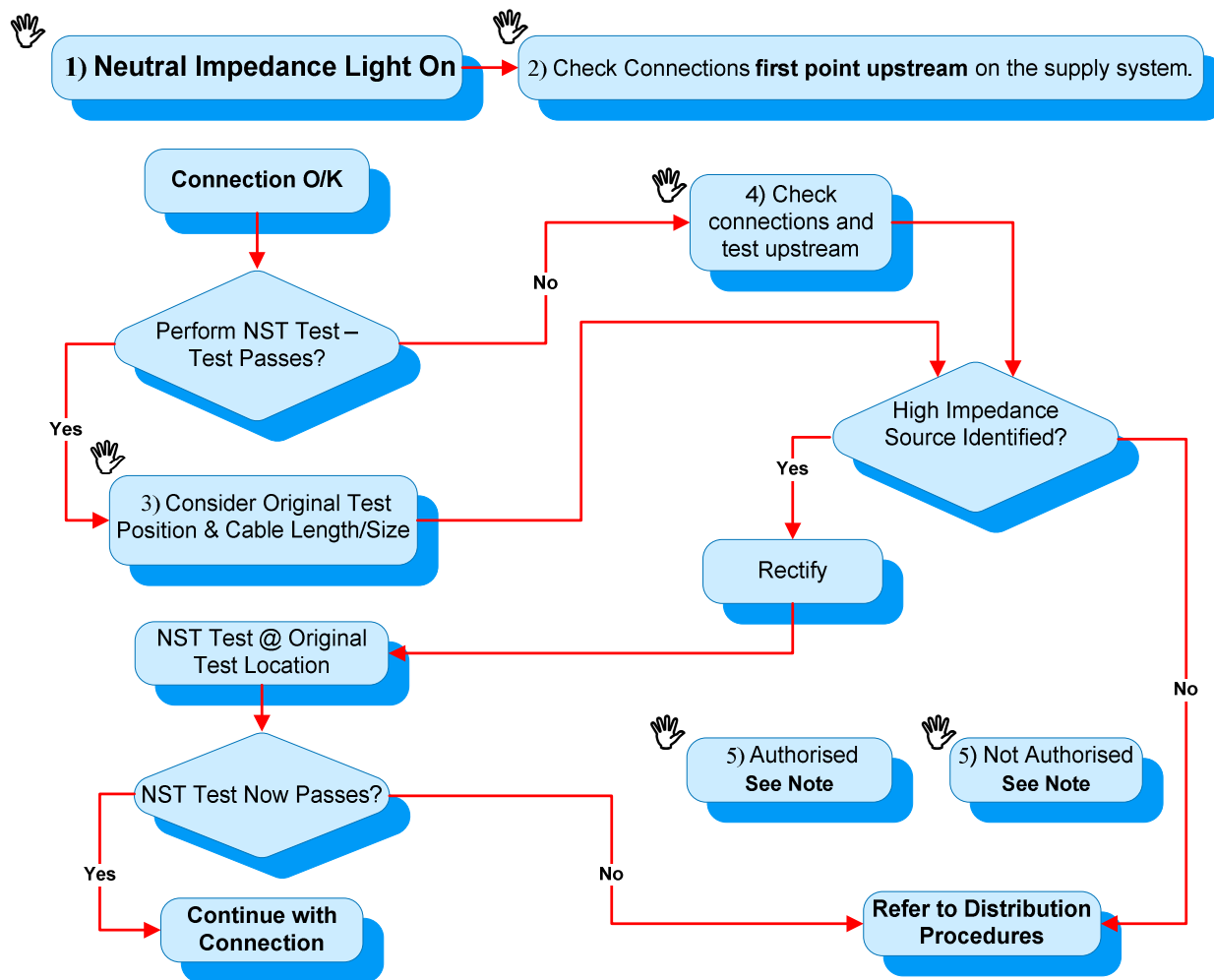
A reverse polarity will result in the earthing system of an electrical installation becoming alive.

In circumstances where the polarity of supply mains is reversed it is essential that the source is immediately identified. In addition to this, all installations connected to the supply network downstream of the source, shall have all active and neutral conductors isolated from the network and each installation prepared for polarity testing prior to the polarity of the supply mains being corrected. Upon re-energisation each installation shall be tested individually to ensure correct polarity and neutral impedance is obtained to all installations.



### Handy Hints -

- 1) The activation of this light may indicate one of two testing faults being either, the connection of the independent earth is above 10kΩ to earth, or the voltage of the supply neutral is greater than 5 Volts.
- 2) The connection of the test instrument to earth is the most common cause of this fault. Check the continuity of the testing circuit to earth and that the independent earth is in a good body of soil and that the reel and connections are in good condition
- 3) Where voltage on the neutral conductor is suspected gain an accurate indication of voltage testing with a voltmeter to an independent earth.  
Although not without weaknesses, greater than five volts on the supply neutral may often be the result of an existing high impedance neutral under load from other customers within the sub circuit. This may be due to insufficient cable size, excessive supply length or poor conductor connections. Where conductor connections are suspected, testing across either side of neutral connections with a voltmeter is a valuable method of identifying abnormalities.  
In addition to this, the balance of load within the system will also have effects upon the neutral voltage although should not be looked at as the primary source unless the supply neutral conductor and connections are considered suitable.
- 4) In some installations voltage may be found on the neutral conductor through the harmonic effects of the electrical apparatus on the circuit. This is particularly common in large installations e.g. shopping centres and may not be capable of being rectified by the connector. In such circumstances refer to Distributors policies and procedures for guidance.



### Handy Hints -

- 1) Ensure that the connections of the test instrument to the apparatus under test are electrically sound, as unsatisfactory connections will effect the testing results.
- 2) *The neutral impedance light activates when the supply Active to neutral impedance is greater than  $1\Omega$ . Therefore the impedance may be within the supply active, the supply neutral or a collective combination of both.*
- 3) *Consider the original test position in relation to the cable length and size. An increase as low as  $.1\Omega$  may result in a test failure when there is existing impedance of  $1\Omega$  upstream.*
- 4) Although not without weaknesses, neutral impedance located on supply mains of a LV circuit would most likely be indicated with the Independent Earth Light (Neutral greater than 5 volts) activating on the Neutral & Supply Tester as a result of load from other customers. As this neutral voltage will depend upon distribution loading this handy hint has weaknesses but should be considered when investigating such faults.
- 5) Sources of high impedance may include connections or conductors that are not the responsibility of persons involved in the connection process e.g. Licensed Electrical Contractors.  
**Note:** Work shall only be conducted by persons authorised to perform such work in accordance with Section 1 Clause 1.10 of these procedures.


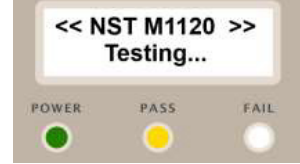
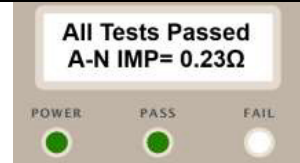

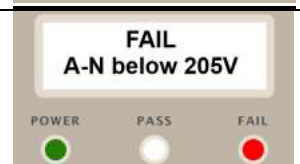

## 5.2B Digital Neutral Supply Tester (Model M1120) Screen display

Users of the Digital NST (M1120) should refer to the manufacturer’s manual for the instrument’s specifications, operational information including care and use.

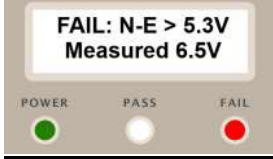
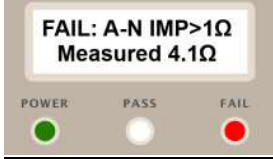
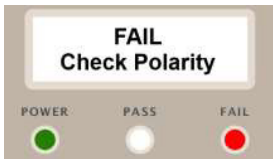


The message screens listed have been extracted from the manufacture’s users guide that indicate a range of PASS/FAIL situations that may be encountered

A number of these equate to similar results that are indicated with LCD and audible output combinations of the earlier model NST (M1110).

Where a “**FAIL**” (and value) is encountered, reference to the – ***NST Fault Investigation Guide*** and **Fault Flow** charts in 5.2A may assist personnel in identifying the cause to enable an appropriate response to rectify such faults.

LCD MESSAGE	DESCRIPTION	COMMENT
	Active or Neutral may not be continuous.	-No supply registered by the instrument -Defective leads/connections -Faulted instrument
	NST is conducting its series of tests.	Normal testing cycle taking place
 	All measurements are within specifications. Screens alternates between <input type="checkbox"/> Active to Neutral impedance value shown. <input type="checkbox"/> Active to Neutral and Neutral to Earth Voltages	All tests successfully completed
	Active to Neutral voltage is less than 205VAC threshold. The NST will beep every second until disconnected	Low Volts – connection/supply issue
	Active to Neutral voltage is above 264VAC threshold. The NST will beep every second until disconnected.	High Volts- supply issues

**NST M1120 display cont ...**

<b>LCD DISPLAY</b>	<b>DESCRIPTION</b>	<b>COMMENT</b>
	<p>Neutral to Earth voltage is above 5.25VAC threshold. Second line shows actual voltage reading. The NST will beep every second until disconnected.</p>	<p>Needs addressing for rectification Some LV situations have this as an inherent system problem. –seek assistance</p>
	<p>Active to Neutral impedance is above 1Ω threshold. The NST will beep every second until disconnected</p>	<p>Needs addressing and rectification A &amp;/or N connection issues</p>
	<p>Active and Neutral leads have been connected incorrectly and must be swapped. The NST will beep every second until disconnected</p>	<p>Urgent and dangerous Immediate action required</p>
	<p>The reference resistor has overheated and the NST has shut down. Resume measurements once the NST has cooled sufficiently. The NST will beep every second until disconnected</p>	<p>Operational temp range is -10 to 55 deg.C Multiple consecutive tests or storage in vehicles in hot weather could possibly produce this message</p>
	<p>Internal NST fault has been detected. Return the instrument to the manufacturer for service. The NST will beep every second until disconnected.</p>	<p>Instrument fault - require alternative unit to complete tests</p>

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### 5.3 Unavailable Independent Earth - Multiple Occupancy Installation

Electrical Testing and Connection Testing Procedures within Multiple Occupancy Installations often pose a dilemma to the connection worker due to a lack of suitable independent earth positions. This has been particularly relevant within multi story buildings and shopping centres.

During the connection process of multiple occupancy installations it is imperative that Polarity Testing and NST Testing of the supply conductors to the main switchboard are conducted using an independent earthing system.

Where occupancies are to be connected downstream of the main switchboard or Metering Alterations/Additions are to be conducted at multiple occupancy installations, an installations earthing system may be used in substitution for the independent earth if;

- a suitable independent earth position is not available; and
- the occupancy switchboard earthing system is directly connected to the main switchboard earthing system by means of an earth conductor; and
- the supply conductors to the main switchboard had been Polarity and NST tested using an independent earth in accordance with established procedures upon connection.

*Note: For an existing installation already on supply, it is considered that the appropriate installation tests have been carried out at the time of connection.*

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## 5.4 Alternative Supplies

### Introduction

Alternative supplies at electrical installations may take the form of either approved or non approved supply sources, and have potential to pose a serious electrical hazard to workers performing connection tasks.

Alternative supplies may include:

- Break before Make Alternative Supplies; (typically back up or emergency generation) Grid Connected Energy Systems via Inverters; (typically, solar photo voltaic cells, mini hydro generators, wind generators, etc).
- Portable generators
- Portable invertors
- Supplies from neighbouring properties and other such sources.

### Non Approved Sources of Supply

Where non approved alternative supplies are identified the connection workers shall:

- Where authorised ensure the electrical installation is in a safe condition by either isolating or arranging the immediate isolation of the non-approved supply to the installation.
- Immediately notify the relevant Distribution Network Operator.
- Discontinue further connection works on the installation until notified by the Distribution Network Operator.

### Approved Alternative Sources of Supply

Installations fitted with Break before Make alternative supplies shall have a prominent label fixed on the main switchboard, including information on the sections of the electrical installation they supply and their point of control.

Installations fitted with Grid Connected Energy Systems may be identified by the following:

- The switchboard must be clearly and permanently labelled as having an inverter energy system connected to it. The circuit breaker, fuse or switch must also be clearly labelled: and
- A label indicating that an alternative power supply system is connected to the electrical installation shall be fitted at the FOLCB for an overhead electricity supply or at the consumer terminals and service fuse for underground supply.

Upon identification of an approved alternative supply the connection worker shall ensure the following actions are taken.

- Where Break before Make alternative supplies are installed the worker shall ensure the isolation of the alternative supply from the Distribution System by visually checking the isolation point and where appropriate locking of devices.
- Where Grid Connected Energy Systems are installed the isolation switch connecting the alternative supply to the grid shall be turned to, and locked in, the open/off position: and
- All apparatus deemed to be de-energised shall be confirmed to be de-energised by test before the commencement of work on that apparatus.

**Note:** These instructions do not apply to connection works involving other forms of Grid Connected Alternative Supplies.

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## 5.5 Orders in Council

### – Background

The original development of the Neutral & Supply Tester and associated procedures in the late 1990's identified that changes to the Electricity Safety Act 1998 (the Act) were required to allow electrical workers to access terminals of a customer's electrical installation for the purpose of testing. E.g. Lifting of installation neutral at main switchboards for NST testing.

The principal order G17 April 1999 exempted certain electrical contractors and certain electrical workers, certain electrical installation work from compliance with specified provisions of the Act in specified circumstances.

Over the ensuing period, other issues were identified with the development of additional VESI connection procedures and the Government AMI smart meter program proposed in 2006 that required additional changes to the Electricity Safety Act.

Changes to accommodate improved testing requirements, qualifications, training and approval of electrical workers to undertake installation connection work were introduced with amendments to the Act through additional Orders in Council :-

- i) Victorian Government Gazette G36 7 Sept 2000
- ii) “ “ “ G33 11 Aug 2009

Extracts (in part) of these 3 Orders in Council are presented for general information in the following pages

Victoria Government Gazette

G 17

29 April 1999

**Electricity Safety Act 1998**

DECLARATION UNDER SECTION 4

Order In Council

The Governor in Council under section 4 of the **Electricity Safety Act 1998** declares that such of the provisions of this Act specified in this Order do not have effect to such extent as is specified -

**Part 1**

**Section 4(1)(a) of the Electricity Safety Act 1998**

**Electrical contractors and electrical workers**

**Part 2**

**Section 4(1)(b) of the Electricity Safety Act 1998**

**Electrical equipment**

1. Divisions 1, 2 and 3 (with the exception of section 43) of Part 3 of the Act do not have effect in relation to the following **electrical installations** -

Electrical installations -

- (a) upstream of the point of supply except electrical installations used for the consumption of electricity by the electricity supplier;
- (b) comprising of connections to consumers terminals for the purpose of providing electricity supply;
- (c) owned by an electricity supplier for metering or the control or protection of metered or metering circuits;
- (d) used in the operation of mining under licence within the meaning of the **Mineral Resources Development Act 1990**;
- (e) comprising of fixed electrical equipment designed to be easily transportable connected to the electricity supply by the insertion of a plug into a socket designed for such a plug;
- (a) used in a cathodic protection system or a mitigation system.

This Order is effective from 3 May 1999.

Dated 28 April 1999.

Responsible Minister:

ALAN R. STOCKDALE Treasurer

Victoria Government Gazette

G36

5 Sept 2000

**Electricity Safety Act 1998**

DECLARATION UNDER SECTION 4

Order in Council

The Governor in Council under Section 4 of the **Electricity Safety Act 1998** (the Act), declares that certain provisions of the Act specified in this Order, do not have effect to the extent specified-

**Section 4(1)(a) of the Electricity Safety Act 1998  
Electrical contractors and electrical workers.**

1. Sections 30 and 36 of the Act do not have effect in relation to an **electrical contractor** contracting or undertaking to carry out the disconnection or reconnection of a consumers mains or submains neutral for the purpose of conducting neutral and polarity testing using a Victorian Electricity Supply Industry ("VESI"), Neutral and Supply Tester.

2. Sections 36 and 38(a) of the Act do not have effect in relation to an **electrical installation worker** disconnecting or reconnecting a consumers mains or submains neutral for the purpose of conducting neutral and polarity testing using a VESI Neutral and Supply Tester if the electricity supplier supplying or to supply electricity to the electrical installation has authorised the worker to carry out the testing and has certified that the worker has satisfactorily completed-

- (b) the VESI Neutral and Supply Tester Course; and
- (c) a practical assessment in performing the functions of the VESI Neutral and Supply Tester; and
- (d) training in the safety aspects of the disconnection and reconnection of consumers mains or submains neutrals and of neutral and polarity testing; and
- (e) a practical assessment in safely disconnecting and reconnecting consumers mains or submains neutrals; and
- (e) training in the limitations of the work.

3. Sections 45(1) and 45A of the Act do not have effect in relation to a registered electrical contractor or a licensed electrical installations worker who is a responsible person under section 41A of the Act responsible for the carrying out of the disconnection or reconnection of a consumers mains or submains neutral for the purpose of conducting neutral and polarity testing using a VESI Neutral and Supply Tester.

Except where expressions are defined in the Act, expressions used in this Order have the same meaning as they have in the **Electricity Safety (Installations) Regulations 1999**.

This Order is effective from the date on which it is published in the Victoria Government Gazette [7 September 2000]

Dated 5 September 2000.

Victoria Government Gazette

G 33

13 August 2009 2207

ORDERS IN COUNCIL  
**Electricity Safety Act 1998**

AMENDMENT OF ORDER IN COUNCIL

The Lieutenant-Governor, as the Governor's Deputy, with the advice of the Executive Council, acting under section 4 of the **Electricity Safety Act 1998** ('the Act') makes the following amendment to the Order in Council made under section 4 of the Act on 28 April 1999 and published in the Government Gazette on 29 April 1999 (G17) and subsequently amended by Orders in Council published in the Government Gazette on 16 December 1999 (G50), 27 January 2000 (G4), 7 September 2000 (G36), 24 October 2002 (G43), 16 December 2004 (G51) and 19 October 2006 (G42):

For the first paragraph of clause 1 of Part 2 of the Order substitute –

1. Divisions 1, 2 (with the exception of section 39 but only for the purpose of clause 1(c) of this Order) and 3 (with the exception of section 43) of Part 3 of the Act do not have effect in relation to the following **electrical installations** –'

For clause 1(c) of Part 2 of the Order substitute –

- '(c) used for metering or the control or protection of metering circuits, and equipment connected or to be connected to metering owned by a distribution company on the condition that only limited and ancillary electrical installation work that is necessary as part of the metering work is carried out. To maintain the integrity and safety of the customer's electrical installation the work must be carried out by a person who –
- (i) possesses the qualifications, proficiency, competency and experience to at least Certificate III level or equivalent as a lineworker, meter technician or electrician to enable that work to be performed; and
  - (ii) has been properly trained in the safety aspects and limitations in relation to that work; and
  - (iii) has satisfactorily completed a course and practical assessment in accordance with the Certificate III ESI Distribution (Power Line) Metering Installations Unit or demonstrated equivalent competency; and
  - (iv) undertakes testing in accordance with the requirements of the Victorian Electricity Supply Industry (VESI): Installation Supply Connection Tests & Procedures manual to ensure integrity of supply to the customers main or occupancy switchboard or equipment to be supplied and the correct operation of metering equipment; and
  - (v) prior to enabling the electrical installation to be used by the customer verifies as far as practicable that the installation is safe to energise; or.
  - (vi) is working under supervision as allowed under section 39 of the **Electricity Safety Act 1998** and such supervision is provided by a person who satisfies sub-paragraphs (i) through to (v) of this paragraph (c).'

Except where expressions are defined in the Act or otherwise defined in this Order, expressions used in this Order have the same meaning as they have in the Electricity Safety (Installations) Regulations 1999.

This Order is effective from the date on which it is published in the Government Gazette.

Dated 11 August 2009

Responsible Minister

PETER BATCHELOR MP

Minister for Energy and Resources

TOBY HALLIGAN

Clerk of the Executive Council

## 5.6 ESV Safety Alert

**ELECTRICAL SAFETY ALERT**



25 Jan 2011

### **FAILING TO PERFORM A POLARITY TEST CAN KILL**

Energy Safe Victoria has issued this Safety Alert to warn of the danger of failing to conduct an electrical test when installing metering equipment i.e. smart meters. The warning follows a number of reported reverse polarity incidents (transposition of active and neutral conductors of the consumer's mains cables) in Victoria during the last nine months.

A reversed polarity of the consumers mains cables creates a life threatening situation to customers or anyone who contacts exposed metal parts connected to the installations main earth system, such parts include the metal meter box, metallic plumbing fixtures, and the earthed frame of power tools and appliances.

Reversed polarity errors have been the cause of fatalities.

The most recent reverse polarity connection was made during the replacement of an electricity meter at a residential property. It energized the meter box and metallic plumbing fittings (hot water unit, water taps, etc..) to 240 volts. A lady received an electric shock to her hand when turning a water tap at the rear of the property.

Victoria's Director of Energy Safety, Mr Paul Fearon said: "ESV has a zero tolerance when it comes to reverse polarity connections. It is crucial that appropriate electrical tests be conducted when connecting or reconnecting supply to a customer's installation.

"ESV will take action against workers if they fail to perform the required tests, and electricity companies must ensure that a safe system is effectively implemented to ensure service connections are correct."

Mr. Fearon stressed that safety must never be compromised and workers must adhere to safe work procedure.

Failing to perform a polarity test is **NON NEGOTIABLE**.

Paul Fearon  
DIRECTOR OF ENERGY SAFETY



Main Switchboard/Metering Enclosure



Smart Meter



Live and Load Terminals of the Smart Meter

Energy Safe Victoria  
5025 9700  
ABN 27 402 247 837  
2187

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