CIRCUIT TESTING

BEST PRACTICE MODEL FOR ELECTRICIANS

Introduction

These notes have been prepared to provide support and guidance to qualified persons (typically electricians) conducting electrical installation safety and compliance verification tests as, prescribed by AS/NZS 3000 – 2018 Electrical installations (“The Wiring Rules”)

In NSW, the Gas and Electricity (Consumer Safety) Regulation 2018 requires electrical installation work to be carried out in accordance with the Wiring Rules. Further, there is a requirement that an electrical installation, or part thereof, must not be energised unless its safe operation and compliance with the Wiring Rules has been established by a safety and compliance test.

The Regulation Part 9 Electrical installations at Section 36 - Conduct of safety and compliance tests, states at sub-clause (1) “A safety and compliance test on electrical installation work on an electrical installation, or part of an electrical installation, must be carried out by a qualified person in accordance with the requirements of this clause after the completion of the work.”

Purpose of this paper

The purpose of this paper is to promote a best practice circuit testing model for electricians on circuit testing and reporting of results thereof, to augment the current NSW Office of Fair Trading (OFT) Certificate of Compliance for Electrical Work (CCEW). It has been developed following growing requests from a range of industry practitioners and specifically electricians for more detailed information to be publicly available that would help improve understanding and encourage best practice in electrical installation compliance testing.

The model is based on the requirements of the Wiring Rules and AS/NZS3017. Alternative testing methods could be employed provided that the test results are obtained and recorded.

It is suggested that a copy of the test results should be provided to the customer, and another retained for evidence if required in the future (refer - Best Practice Model - Electrical Installation Circuit Test Results Sheet).

For more information and access to a range of position papers and model Safe Work Procedures (SWPs) visit the Electrical Safety Project website: http://www.esproject.com.au/

Information to be reported

Client Information

As much information as is needed is to be provided to the customer. At the very least this includes:

- A description of the electrical installation work done;
- Identifies the electrical installation concerned including switchboard;
- Specifies the name and authority number of each person who carried out, or supervised the carrying out of, the electrical installation work concerned, and if applicable, the name and authority number of any person engaged by the owner or occupier of the installation (whether or not for fee or reward) to provide, or arrange for the provision of, the electrical installation work concerned (**the electrical installation work provider**);
- Specifies the name and authority number of the **tester** and the date on which the test was carried out; and
- A signature by the tester and, if applicable, the electrical installation work provider (contractor).

Switchboard/Distribution Boards

- The switchboard is to be identified on the test results sheet.~~:~~
- There should be a separate sheet for each switchboard or distribution board.
- Polarity of sub-mains will be included in test sheet for the distribution board.

Circuit Design

- Where the installation / circuit has been designed by an engineer, state the designer. Include the qualification[1](s) and Australian professional membership(s) / affiliation(s) of the designer.
- Where the installation / circuit was designed, say on the job, within a design and construct arrangement, by a qualified person (e.g. electrician), insert their name and qualifications.
- Confirm that the installation / circuit complies with the design.

Components Compliance

Where appliances (motors, etc.) are connected to the circuit, there must be clear lines of responsibility between the electrician and the appliance provider to ensure that the appliance is working correctly.

- All components should comply with Australian Standards.
  This simply calls for a **YES/NO** entry.

[1] Qualification in this context, relates to a qualification issued under the Australian Qualification Framework (AQF) handbook, second edition 2013, by the Australian Qualification Framework Council, and defined as, "*An AQF qualification is the result of an accredited complete program of learning that leads to formal certification that a graduate has achieved learning outcomes as described in the AQF.*", and issued by a Registered Training Organisation (RTO)

If the **answer** to this is '**NO'**, then, provide on a separate document:

- details of the components that are not compliant, and,
- the reason why they have been installed, and,
- which standards they have deviated from, and,
- the dispensation required, and,
- the provider of dispensation.

- Some verification of compliance can be documented in the form of supplier invoice/s.
- Where designed by an electrical engineer, the engineer should provide a design certificate, listing the applicable standards referenced / used in the design.

Job Description

Typical job descriptions include:

- A new installation – i.e. a new building.
- A new circuit – which should be identified on the test result sheet including for example PVs or battery installations.
- Changes to a circuit – e.g. new sockets or lamps – record results under the relevant circuit.
- New/replacement switchboard or distribution board.
- New/replacement meter.

  Note:
  For a replacement switchboard, the tests are the same as for a new installation. For a replacement meter, the only tests are, polarity and continuity.

  Note:
  The form also provides space to tick the type of job and then add comments.

Circuit Testing Results

- For the purposes of this exercise, it is assumed that the tests will comply with Chapter 8 of the Wiring Rules and to AS/NZSA 3017 Electrical installations – Verification guidelines.
- See Chart below – a suggested expanded test result form, where actual test results can be recorded. This form could be used to copy to the customer and tester (self-recording and future defence), as OFT does not currently require collection of some of this data.

Defects in Existing Circuits

It is common for electricians working on old circuits to find defects – such as bad connections, compromised switchboards that may include asbestos, deteriorating insulation, no safety switches, etc**.** These conditions should be noted and brought to the attention of the owner.

Signatures

The form should be signed by**:**

- the licensed electrician responsible for the installation and,
- the licensed electrician who conducted the tests, and,
- The name of the organisation providing the service.

BEST PRACTICE MODEL - ELECTRICAL INSTALLATION CIRCUIT TEST RESULTS SHEET

Client _____ Date _____

Address _____

_____

_____

Identity of switchboard _____

Circuit designer _____ Date _____

Installation complies to design Comment _____

Components meet Australian Standards Yes No _____

Visual inspection _____ Date _____

_____ Date _____

_____ Date _____

Type of job	Details
New installation	
New circuit	
Change to circuit	
Switchboard	
Meter	

1	Test insulation of consumer mains	MΩ									
2	Polarity test – consumer mains	✓									
3	Resistance of earth electrode	Ω									
4	Earth continuity	MΩ									
5	Fault loop impedance (mains)	Ω									
6	Insulation resistance installation	MΩ									
7	Interconnection between circuits	MΩ									
8	Incoming neutral integrity test	Ω									
	THE TEST		Circuit 1	Circuit 2	Circuit 3	Circuit 4	Circuit 5	Circuit 6	Circuit 7	Circuit 8	
9	Note circuit breaker rating	Amps									
10	Appliance earth continuity	Ω									
11	Insulation test for individual circuits	Ω									
12	Polarity of single pole switches	✓									
13	Polarity and continuity light fittings	✓									
14	Polarity of sockets & RCD test.	✓									
15	Polarity and connection to appliances	✓									
16	Measurement of touch potential	V									
17	Phase sequence to appliance	Ω									
18	Earth fault loop impedance	Ω									
19	Verification of RCD	Secs									

Comments on existing circuits - possible faults or deterioration

_____

_____

_____

_____

Name of electrician responsible for the installation: _____ Licence No.: _____

Name of electrician testing the installation _____ Licence No.: _____

Name of contracting organisation _____ ABN: _____

Notes on Tests

No.	Title	Description	AS/NZS 3017 Ref. (Section) / Figure
1	Test insulation of consumers mains	Ensures insulation of consumer mains.	3.2 / 3.4
2	Polarity test – consumer mains	Ensures correct connection between consumer mains and the switchboard. For distribution boards, use appropriate tests.	3.3 / 3.6 Figures 3.7-9 and 3.12-3.
3	Resistance of earth electrode	Ensures that the protective devices will operate in the event of a short circuit	3.8 / 3.23
4	Earth continuity	Ensures continuity between the main earth bar and the earth electrode.	3.1 / 3.23
5	Fault loop impedance (mains)	Ensures circuit breakers operate in the event of an active-earth fault.	3.6 / 3.21-2
6	Insulation resistance – installation	Ensures that the insulation of the entire circuit is intact – if faults are found in the installation; each circuit must be tested to identify the fault.	3.2 / 3.3
7	Interconnection between circuits	Ensures correct isolation of each circuit; primarily to prevent accidental energising of a circuit via a connection to another circuit.	3.4 / 3.19
8	Incoming neutral	Detects possible faults in the incoming neutral that need to be addressed by the DNSP.	3.10 / 3.26
9	Note circuit breaker type & rating	This is needed to calculate the acceptable fault loop impedance.	
10	Appliance earth continuity	Tests the earth connection between each point of the circuit and the main earth bar.	3.1 / 3.2
11	Insulation test for individual circuits		3.2 / 3.5
12	Polarity of single pole switch	Ensures that the conductor entering the switch is connected to the load side of the circuit protective device.	3.3 / 3.10-1, 3.14

No.	Title	Description	AS/NZS 3017 Ref. (Section) / Figure
13	Polarity and continuity of light fittings	Test requires the application of resistors at the switchboard.	3.4 / 3.15
14	Polarity of sockets and RCD tests	Variety of tests to ensure continuity and correct polarity for all power sockets. May involve inherent RCD's.	3.4 / 3.16-7
15	Polarity and connection of appliance	Ensures continuity and correct polarity for connection to all appliances (stoves, water heaters, etc.).	3.4 / 3.19
16	Measurement of touch potential	Measurement of the voltage drop on the protective earth conductor between an earthed situation (e.g., a tap) and the main earth bar.	3.9 / 3.25
17	Phase sequence to appliance	If the polarity of multiphase equipment is incorrect, equipment will not function properly, e.g., motors may operate in reverse.	3.5 / 3.20
18	Earth fault loop impedance	Ensures protective devices will operate in the event of a short circuit to earth ***(See Note 1 below)***	3.6 / 3.21-2
19	Verification of RCDs	Note that in medical environments RCD testing must comply with AS/NZS 3003	3.7

Note 1 – Fault Loop Impedance
There are three types of circuit breaker in use:

Type B – mainly for domestic or light commercial applications where no significant inrush currents are expected. They trip at 3-5 times the rated current (*not very common and not typically stocked by wholesalers*)

Type C – mainly for commercial/industrial applications where low inrush currents are expected. They trip at 5-10 times the rated current (*most common)*.

Type D – for industrial applications where high inrush currents are expected, e.g. on starting a motor. They trip at 10-20 times the rated current.

The maximum value of the required fault loop impedance is given by:

$$Z_s = U_o / I_a$$

Where
Z_s: fault loop- impdance
U_o: nominal phase voltage
I_a: rated current