ETC

96

4

A4 Exercise Book

EL0014

EL0018 (10.1→10.11)

EL0005

AS0007

ELOO14 ~~Isolate, Test and Trouble Shoot Low voltage~~
Electrical circuits

1.3 Complete a certificate of Electrical safety/compliance

1 List the legislation & regulations for safety
NSW Electrical service Rule clause 1.16.4 Safe Installation

2 Electrical Regulatory body in NSW
NSW office of Fair Trading

3 Requirements for submission of Certificate of Electrical safety/compliance.
CCEW must be submitted within 7 days of completing any safety and compliance test on electrical installations
- customer, New electrical installation, Any alteration or additio to existing electrical installation, work on switchboard & associated equipment, Electrical installation on stand alone power system, installation or replacement of electricity meters

4 Checks to verify compliance & functionality 8.3.3
- continuity of earthing system 8.3.5
- Insulation resistance 8.3.6
- Polarity 8.3.7
- correct circuit connections 8.3.8
- verification of impedance required for automatic disconnection of supply 8.3.9
- operation of RCDs. 8.3.10

5 Required Test Result for Insulation resistance of electrical installation
The insulation resistance between
(a) The conductors of consumer mains and submains and
(b) Live and earthed part of electrical installation or parts there of including consumer mains and submains
Shall be not less than 1 mΩ.

6 Resistance of earthing system for electrical installation

8.3.5.2 (b)

The resistance of the main earthing conductor or any equipotential bonding conductor shall be not more than 0.5Ω

7 Types of records to keep period inspection & testing of in-service electrical equipment

2.3.3.1 Earth ~~contact~~ Continuity

2.3.3.2 Testing of insulation resistance

2.3.3.3 Testing of portable ~~is inst~~ isolation ~~carry~~ transformers & power supplies.

2.3.3.4 TEST for ~~and~~ operation of RCD.

2.3.3.5 Testing of CLASS I equipment

2.1 Develop a JSA / SWMS to carry out work on L.V Electrical equipment

Job Task - Lighting and electric Bell Installation

Type of work site - ETC college

Location - 9 MAUIS ST. REVESBY

Type of Hazards	Work at Height		Explosive gases
H.V	Hot work	✓ Foreign bodies	Toxic gases
✓ L.V	confined space	asbestos	Explosive chemical
✓ E.L.V	U.V radiation	dust	corrosive chemical
High current	mobile plant	✓ noise	~~Toxic~~ Chemicals
working LIVE	✓ Traffic	✓ manual Handling	flora / fauna
✓ House keeping	✓ Power Tools	mechanical Handling	

LIKELIHOOD / SEVERITY	LIKELY	POSSIBLE	UNLIKELY	
Death or permanent disability	1	1	2	1 - Extreme risk
Serious injury or chronic illness	1	2	3	2 - High risk
Minor injury / Need first aid	2	3	4	3 - medium risk
				4 Low risk

Job Tasks Steps	Potential Hazard	Associate Risk	Risk Level	control measure	Person responsible
Lighting and Bell Installation	Exposed Terminal,	Electrocution	1	Isolation	Supervisor
	Sharp edge Tools equipment	Harsh Eye injury	3	safety glove	Supervisor
	Flying debris Dust	Eye injury	3	Safety Glasses	Supervisor
	materials & equipment on floor	slip, Trip Fall	3-4	House keeping	supervisor

Prework checklist

- ✓ JSA / SWMS approved by ~~the~~ work manager
- ✓ JSA / SWMS has been communicated to all workers
- ✓ All required control measures have been implemented
- ✓ Required work permits have been obtained
- ✓ First facilities are in place
- ✓ All required tools & materials have been obtained.

~~Any~~ Any Accident - NO

New Hazards - NO

Risk Associated with new Hazards - NO

control measure & risk - Appropriate

To Improve JSA / SWMS

- Choose a job to be analyzed
- Break the job into specific tasks
- Determine hazards and risks present in each task
- ~~Id~~ Identify preventive control and the residual task

2.3 Demonstrate safe Isolation (LOTO) Procedures

	Hazards Identified	Supervision Level (D, A, B	Risk Classification H M L	control measure
1	Exposed Terminal	D	H	check terminal before touching
2	Live Terminal,	D	H	Identify the Source, Tag Switch off Locking Tagging
3	Electrocution due to accidentially Switching on	D	H	Locking of Tag out

2.1 Locate circuit Protection

Circuit Device NO	Device Location	protective Device Type	Nominal current Rating
DB1	main board	Circuit Breaker	20A
2 RCD (CB1, CB2 CB3 CB4 CB5	DB1	C.B	20A

2.1.2 Personnel Notified

All students & Teachers working in the workshop

2.1.3 Isolate, Lock, Tag

2.1.4 Test equipt functionality

Functional ✓

2.1.5 Test voltage between Frame to known earth

prove To earth 0

2 Re-energize Test

L1 – E 0	L1 – N – 0	L1 – L3 0
L2 – E 0	L2 – N – 0	L2 – L3 – 0
L3 – E 0	L3 – N 0	L1 – L2 – 0
		E – N – 0

2.1.6 Equipment functionality

Functional ✓

1 Additional Information on danger tag

Clearly state the warning, any warning about the specific hazards date & signed by the person who are involved in carrying out of the work.

2 who is permitted to re-energize after LoTo only the authorized individual who placed the Lock and Tag on to the system is permitted to remove them

3 3 work scenario requiring safe isolation

1/ Disconnecting 3ϕ motor in factory for maintenance

2/ maintain the aircon to be taken out from the System Heating

3/ Fix the Electric stove to replace the element.

3.1 visually Inspect an Electrical Installation

Hazards	Supervision Level	Risk classification	control measure
240V Exposed conductor	D	H	Test Terminal Enclose
un tagged / un Locked switch	D	H	Properly Perform Locking / Tagging
Insulation Resistance Failure	D	H	Perform IR Test
Reverse polarity (N-E)	D	H	Perform Polarity Test

5.3.6, 5.5.1.2 2.10.4.1 3.1 unit

Electrical Installation details

Location – EIC ownership
Type of wiring – wiring Practice Board
Types & No. of Switch boards
main Switch board 1
Distribution Board NO 1 – 2
control Panel 1
metering Panel 1

Types & Number of circuit
Socket outlets NO 3
Lighting NO 2
HVAC NO –
motors NO –
Auxiliary service – NO –
Safety Service NO –

Consumer mains

1 Consumer mains have sufficient current carrying capacity and meet Voltage drop requirement Y
2 consumer mains are adequately supported Y
3 Consumer's mains are provided with adequate mechanical protection and external influences Y
4 Aerial / underground installations complies with relevant Sections of AS/NZS 3000 Y
5 Terminations are tight with all strands are ~~retired~~ retained in contact with the terminal Y

Switchboard

6 All Switch boards are adequately protected against external influences NO
7 All switch boards are located in accordance with AS/NZS 3000 having sufficient ventilation & spaces are clearance Y
8 Protection against internal arcing is ~~prote~~ Provided where required NO { current is not too much, it does not need arcing suppressing
9 Protection devices are correctly selected to Provide protection against overload Y
10 protection devices are correctly selected to Provide protection against short circuit Y
11 Protection devices Provide suitable discrimination and co-ordination Y
12 circuit breakers are oriented in accordance with AS/NZS 3000 requirement.
13 Isolation devices are suitable for their intended use Y
14 Bars and links have adequate current carrying capacity Y
15 Terminations are tight with all strands are retained in contact with the terminal Y
16 Each of the following item is clearly identified in accordance with the relevant Sections of AS/NZS 3000

Switchboards	Bars and Links
main switches	Terminals Y
protection devices	common neutrals

Earthing system

17 The MEN connection is of a suitable colour and cross sectional area Y
18 MEN Terminations are tight with all strands retained in contact with the terminals Y
19 The main earthing conductor is of a suitable colour and cross sectional Area Y
20 main earthing conductor terminations are tight with all strands retained in contact with the terminals Y
21 The connection between the main earthing conductor and the earth electrode is correctly labelled Y
22 The earth electrode is of an acceptable type as specified in AS/NZS 3000. Y
23 The earth electrode is suitably located and installed Y
24 The connection to the earth electrode is adequately protected against ☐ corrosion ☐ Mechanical damage
25 All accessible conductive piping in contact with the general mass of earth is bonded to the earthing system Y
26 All conductive sheaths, armouring and enclosures are bonded to the earthing system Y
27 Equipotential bonding conductors are of a suitable colour and cross sectional area Y

28 Bonding terminations are tight with all strands retained in contact with the terminals Y

29 All parts of the earthing system are adequately protected against external influences Y

Submains and Final subcircuits

30 All cables have sufficient current carrying capacity and ~~meet~~ meet voltage drop requirements Y

31 Cable cores are identified in accordance with AS/NZS 3000 requirements Y

32 All wiring systems are adequately protected against mechanical damage and external influences NO (Training wiring boards not all are enclosed)

33 All wiring systems are suitably segregated — NOT applicable

34 Terminations are tight with all strands are retained in contact with the terminal Y

35 Protective earthing conductors are of a suitable colour and cross sectional area Y

36 Protective earthing terminations are of a suitable colour and cross sectional area Y

37 Equipment is earthed where required due to the creation of an earthed situation Y

38 Adequate control of electrical appliances and equipment is provided including
☐ Isolation ☐ Emergency switching Y
☐ Functional ☐ Shut-down devices

39 Appliances and accessories are adequately fixed/secured in position Y

40 Appliances and accessories are suitably protected against mechanical damage and external influences NO
— Training boards are not required protection

41 ~~Dbb~~ Appliances are installed in accordance with manufacturer's instructions

42 Appliances and accessories are suitably selected and installed for the classified zones of all damp situation N (N/A lab work shop is NOT in damp zone)

1 Purpose of visually inspecting electrical installation
— To ensure that there are no ~~land~~ local hazards prior to completing the remainder of the test
All visual inspections shall be conducted in accordance with section 2 of AS3017

2 6 defects could only be identified by visual inspection
— Sign of burning
— Signs of damage to the plugs
— Incorrect wiring
— Damage to cables
— Cracks
— corrosion
— Chemical damage
— Obstructions
— Sign of over heating
— Damaged switches

3 main areas with electrical installation that are required to be visually inspected
— consumer mains (single phase, three phase
— Switch boards
— Fuses
— Exposed earth electrode
— metallic water pipe Bonds
— RCD / safety switches
— circuit Protection
— sockets

4 Four external influences against which electrical installation equipment must be protected.
4.1.3 — mechanical damage, weather, water, Flora, Fauna

5 minimum size of bonding conductor used to connect the conductive reinforcements ~~of~~ forming part of a shower or bathroom to the earthing system
5.6.3.2 [a] 4mm²

6 The requirements for ~~the~~ labelling the point of connection between the main earthing conductor and the earth electrode
5.5.1.3 The main earthing conductor shall have a permanent label attached at the connection to the earth electrode with a legible warning against disconnection " WARNING - MAIN ELECTRICAL EARTHING CONDUCTOR - DO NOT DISCONNECT

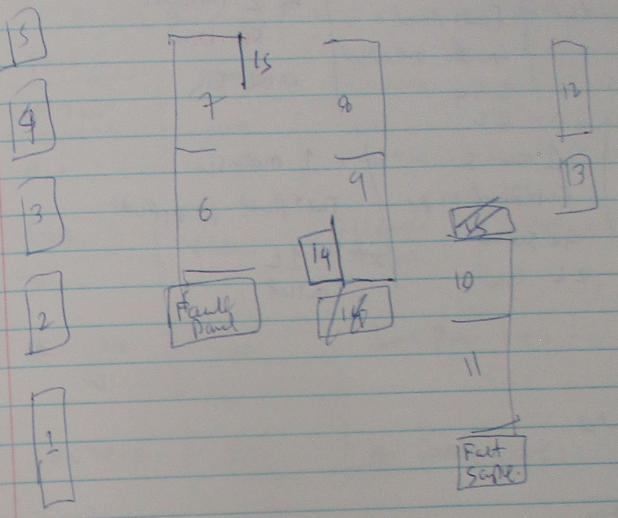
7 4 factors to be considered when inspecting ~~the~~ method, used to install electrical appliances and accessories
- Type and size of electrical system
- The number of power sockets or circuits to be installed
- Accessibility of work Area
- Presence of any hazardous materials (or) obstacles

8 Why cable entries in to switchboards must be tight fitting
2.10.4.1
Bars shall be provided with facilities for securely terminating conductors in accordance with clause 3.7

9 Non compliances Details
(2) ~~Switch board~~ Protection against internal arcing is not provided because there is no magnetic blow out system but it is not needed because the system is not a large power system
32+40 Sub main + Final sub circuit - ~~The~~ There is not mechanical protection to prevent external influence - But it is just terminating switchboard so it is not needed to be enclosed
33 There are no other services such as water, gas, telecom etc, no segregation is required
42 Appliances accessories, protection in damp area is not required because workshop is not in damp zone.

EL0014

4.5.1 conduct ~~mandatory~~ Testing



Lo

Door

(1) 3 socket outlet + 1 switch control 2 Light, Switch board, Yellow Socket
(2) 1 socket outlet + 1 Switch control 2 Light + 3A Socket
(3) 3 socket outlet + 1 Switch control 2 Light + main Socket
(4) Main switch board
(5) motor control Panel DOL STARTER | 3Ph Panel
(6) 4 double outlet + Fault Plate 1234 Stove Earth | 1 Switch hood
1 main sw | 1 sw 1 Light | 2x double outlet
3 outlet | Fine AC or
1 submain | Water sw
1 sw → 2L
(8) 1 main sw | 1 outlet
2 Sw - 2L + Tray
+ 1 main sw
Fault panel 12 3x
4 x Double outlet
2 sw + 2 L
+ to isolated Ion double outlet metallic junction
cable tray Yellow copper
(9) Underfloor Conduit Layout | Fault Panel 1234 4x2 outlet | Telecommunication

10	Switch 2 double outlet 4 Sw	1 Sw Fault Pad 4x double outlet 2 Sw LL	2 metallic Sw. box cable Tray
11	1 main Switch board	1 main Sw Fault Pad 1234 4x socket 2L 2Sw	1 main Sw Fault Panel 1234 Plate 2L 1L 1 outlet
12	3¢ Plug 1 main Sw 2 double outlet cutting 2 ft		
13	Heavy duty switch		
14	1 main Sw Fault Fault Plate 1234	4 double outlet	2Sw - 2L Earth.

Fault Saple P 1 main | Fault Sw 1234
4x double outlet
Earth 2 Sw → 2L.

Fault Pad
main Sw | Plate 1234 Pair 1 2 outlet
Pair 2 2 outlet
2 Light - Exposed wire.

16	Complete 1 main Sw Fault pad 1234 14x double outlet	2Sw 2L Earth.	

Schedule of Installation circuit

Switch Board 6, 7, 8, 9, 10, 11, 12, ~~13~~, 14, 15

Panel 6

		Demand	Cut wiring	connected load
1	40A 230V EL 2403 DA RCD	40A	All Power + Li	2 Light + 4x10A double outlet
2	CG3 CB	63A	All power + Light	2 Light + 4x10A double outlet
3	~~CB~~ x C20 CB	20A	~~2 Li~~ Power 1+2	
4	1 x C20 CB	20A	~~Hw Power~~ + Stove	
5	C 16 CB 1	~~1~~ 16A	L1	
6	C 16 CB 2	16A	L2	

Continuity of Earthing

	Circuit Earth	Looping	Reading
All outlet in Board 6	8	10	12
7	9	11	

Earthing

Insulation Resistance

A-N, A-E, N-E
~~CB~~ Board 6, 7, 8, 9, 10, 11, 12

Polarity

Switch board 12 | Hager 20C CB

A → outlet Active
N — outlet Neutral
E — Exposed outlet Earth
~~Ear~~ 30V

3¢ panel to 3¢ main sw to 3¢ Plug R - R
W - W
B - B
N - N
E - E

Short CKt — DO Fault Switch

E/N Trans Position — DO Fault Switch

Interconnection — DO Fault Switch

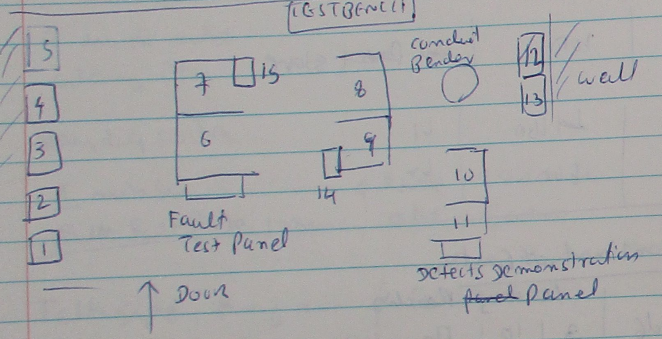
Fault Loop Impedance

Panel IS - E Points to ground	Hws E → E
Outlet 1 2 3 4 → E	Stove
Light 1/2 — E	

RCD operation — DO: RCD, Press Test Switch. ✓E

Ia = 40A; Ian 0.03A DLE 40/4/0.03

DLE7



LAYOUT OF WIRING PRACTICE WORKSHOP AND LOCATION of WIRING BOARDS ON WHICH TESTING PRACTICAL IS TO BE PERFORMED

1, 2 — 15 wiring circuit Boards

6, 7, 8, 9, 10, 11 — Small wiring compartments

BOARD 12 — 14 + 34 wiring

Hazards

— 240V exposed conductor untagged, unlocked switch D, H Test terminal / Enclosure

— untagged unlocked switch D H Properly perform Locking / Tagging

— Insulation resistance failure D H Perform IR Test

— Reverse Polarity — (N-E) D - H perform polarity Test.

Electrical Installation Details.

Location — ETC

Type of Installation — Wiring Training Boards

main switch Board	1	Lighting	2
Distribution Board	1	HVAC	—
control Panel	—	motors	—
~~metering~~ metering panel	—	Auxiliary services	—
Socket outlets	4	Safety services	—

Schedule of Installation circuits

Panel 6

NO	Protection Device	Demand	circuit wiring	connected load
1	C - 63 - CB	63A	Light + Power outlet	2 Lights 4 x 10A double circuit outlet
2	EL 240 3 RCD	40A	outlet + Light	2 Lights 4 x 10A double outlet
3	C 20 CB	20A	Power	Power 1 + 2 outlets
4	C 20 CB	20A	Stove	Stove
5	C 16 CB 1	16A	Light	Light 1
6	C 16 CB 2	16A	Light	Light 2

continuity of Earthing system

Selected meter ← multimeter, Circuit Equipment	Reading	Selected Range - ohm max. permitted value	compliance NS300.
ALL outlets in earth pin to main earth Board 6/7/8/9/10/11/12	0Ω	0.5Ω (S.6.2.6.1)	Yes

Take the ohm reading of E pin of outlet / Light to main earth bar resistance.

Selected meter / R Tester Selected Range 500V

Circuit / equipment
A-N, A-E, N-E
Resistance measurement of outlets in circuit board 6/7/8/9
10/11/12 — 2Ω | maximum permitted 1mΩ
compliance with AS 3002 4

Polarity Test

Selected meter — multimeter selected range — ohm

Switch board 12 Hager C20 C8	Correct Polarity	Active switch	Compliance AS3002
CB Active — outlet active	4	4	4
CB Neutral — outlet Neutral	4	4	4
Earth Bar — outlet Earth	4	4	4
3ϕ main switch to 3ϕ outlet			
3ϕ main switch R — outlet R	4	4	4
3ϕ main switch W — outlet W	4	4	4
3ϕ main switch B — outlet B	4	4	4
3ϕ main switch N — outlet N	4	4	4
Earth Bar — outlet Earth	4	4	4

Short circuit

Selected meter — multimeter Selected Range — ohm
other equipment - Fault switch test Panel
Switch Plate 1 (switch 1/2) Switch Plate 2 (switch 3 on at the beginning.

1 | Fault switch, Switch Plate 3 switch 2 { Initial off / Fault ON
Store | Range fault. Read — 0Ω Active — Neutral main | mΩ permit comply NO

2 | Switch Plate 1 Switch 6 Initial off | fault ON — NO
Reading 0Ω | main | mΩ | Active — Earth

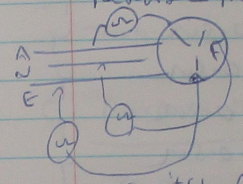
3 | Switch Plate 2, switch 4 0Ω, | mΩ. NO
Active — N (PP1)

4 | Switch Plate 3, switch 2 0Ω 1mΩ NO
Store - Range Active — N

Earth/Neutral Transposition

Selected meter — multimeter selected Range ohm
other equipment - switch plate1 | fault switch panel
Switch Plate 1 (switch 1/2) switch plate 2 switch 3 ~~Circuit equipment~~ on at the beginning.

1 circuit equipment
1 Switch Plate 4 switch 3 (Initial off / fault on
Power 2 - Neutral & Earth Reverse Polarity
— wrong polarity - compliance NO
2 switch plate 1 - Switch 3 { Int - off / Fault on }
reverse polarity Active and Neutral Light 1
Wrong Polarity - compliance AS3002 - NO
3 switch plate 2 - switch 2 Initial off - fault on
Reverse polarity - Active and Neutral Power point 1
wrong polarity - NO compliance

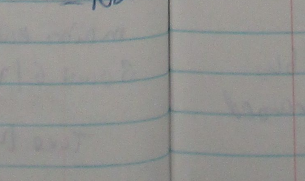


4 Switch Plate 3 Switch 5 (Initial off - Fault on
Reverse polarity - Active - Neutral - Stove
wrong polarity — NO compliance

Interconnection

Selected meter - multimeter Selected Range - ohm
other equipment - Fault switch Test Panel.
Switch Plate 1 (switch 1/2) Switch Plate 2
switch 3 - on at the beginning

1 | switch Plate 4, Switch 6 (Initial off - fault - on)
Switch Plate 2 switch 3 is now off
Power 1 & Power 2



Reading
Power 1 1 to power 2 N →
0Ω
NO compliance.

Intermix Neutral

2 Switch Plate 2, switch 6 (Initial off - fault - on)

~~Scott~~ Switch Plate 2 switch 3 is now off.

Power 1 — Power 2
A — A
N — N
E — E

READING
Power 1 Active to Power 2 Active ON
No compliance

Inter mix of Active

Fault Loop Impedance

Selected meter - multimeter selected range - ohm

Panel - 1S

circuit / equipment	Reading	max permitted value	compliance with AS3000
Earth terminals to grounding Rod	on	0.5Ω	✓
outlet 1 Earth to main earth	on	0.5Ω	✓
outlet 2 Earth to main earth	on	0.5Ω	✓
outlet 3 Earth to main earth	on	0.5Ω	✓
outlet 4 Earth to main earth	on	0.5Ω	✓
Light 1 Earth to main earth	on	0.5Ω	✓
Light 2 Earth to main earth	on	0.5Ω	✓

Operation of RCDs

Selected meter — Selected range —

other equipment - DB1 RCD, Ia = 40A Ian = 0.03A

CRT / eqpt DLF 7 40 / 4 / 0.03

DB1 RCD	Rater Residual Current	correct operation	compliance AS3000
Test Switch	0.03A	✓	✓

1 Requirements for grouping / Identification of outgoing active / Neutral / conductors at Switchboard.

Each wiring terminal must be clearly and indelibly identified. The terminal assembly must be arranged so that the connecting cables can be formed in a neat format & appearance

2 Two PPE for mandatory testing

- Insulated gloves
- Safety glass / Arc flash suit / Face shield ✓

3 Three types of meters or testers commonly used in mandatory testing

- IR Tester
- multimeter
- circuit tester / clampmeter ✓

4 3 Items of equipment other than meters and testers for mandatory testing

- Lineman plier
- Screw Driver
- Tag.

5 Purpose of Polarity Testing.

- To ensure active, Neutral and earth conductors are connected in correct way.

Wrong polarity of active and neutral can cause the ground point will be LIVE through MEN connection that can cause electrical danger.

6 Purpose of testing installation circuits for interconnection.

ALL circuits are not to be mixed.

If two ~~actives~~ actives are mixed, the switch cannot effectively off the circuit in the case of emergency.

ELA014

4.S.2 Identify and Rectify Non-compliance Faults

Hazards

240V exposed conductor untagged DH Test terminal enclose

untagged/unLocked Switch DH properly perform locking and Tagging.

Insulation Resistance failure DH Perform IR Test

~~Power~~ Reverse Polarity DH Perform Polarity Test.

Location ETC

Type of installation - Wiring Training Board,

main switch Board 1
DB 1
control Panel
metering Panel

Types & Numbers of circuits

Socket outlet 4
Lighting - 2
HWAC —
Motors —
Auxiliary service —

safety ~~Service~~ service —

Panel (6)

NO	Protection Device	Demand	circuit wiring	connected Load
1	C-63-CB	63A	outlet + Lighting	2 lights + 4 x 10A double socket outlets
2	EL 240B RCD	40A	outlet + Light	2Lights + 4x10A double Socket outlet
3	C 20 CB	20A	Power	Power 1+2 outlets
4	C20 CB	20A	Stove	Stove
5	C16 CB1	16A	Light	Light 1
6	C16 CB2	16A	Light	Light 2

Installation fault 1

Identified fault - voltage is measured at metallic container

Location of fault - Earthed terminal

AS/NZS 3000 Ref - 8.3.6.1 | 8.3.6.3 (min 1 mΩ)

~~Probable causes~~ -

Testing methods - Insulation Resistance Test between Active and earth

Probable causes - Insulation breaks down between active and earth.

Suitable Solution - Trace the circuit, Locate the fault remove the contact, put insulation back

Practice Plate 1 Switch 1/2 - Plate 2 - Switch 3 is on at the beginning of the practical

Switch plate 3 Switch 2 - Test active - Earth terminals of the stove.

Installation Fault 2

Identified fault - Reverse polarity between Neutral and earth

Location of fault - Power 2
Switch plate 4 Switch 3 4

AS/NZS 3000 Ref - 8.3.7

Testing methods - Test between active of outlet and active wire
Neutral of outlet and neutral wire
Earth of outlet and earth wire.

Probable causes - Wrong connection of Neutral and earth conductors.

Suitable Solution - Wrong connection of neutral and earth conductors.
Physically reconnect each conductor to correct terminals.

Installation fault (3)

Identified fault – High resistance in main earth wire.
Location of fault – Hot water system } Switch plate 4
Switch 4

AS|NZS 3000 Ref – 8.3.5
Test method – ~~measure~~ measure the resistance of main earth wire to earth point.
probable causes – Loose connection of earth terminal
Screw tightly each conductor
Rewire the damaged cable.

Installation fault 4

Switch plate ~~1~~ Switch 1/L
Switch plate 2 Switch 3 are on at the beginning.

Identified fault – Intermix Neutral
Switch plate 4 Switch 6 on
switch plate 2 – Switch 3 off
Location of fault – Power 1 & Power 2 cables.
AS|NZS 3000 Ref – 8.3 8.2 Interconnection between different circuits.
Test methods – measure the resistance between A – A, N – N
E – E of P1 and P2 cables.
Probable causes – Two neutrals of P1 & P2 are joined at one connection.
Suitable Solution – Identify and connect the neutral to circuit.

Installation Fault 5

Identified fault – Open active
Location of fault – Light 2, NO Light is on } Switch plate 3
AS|NZS 3000 Ref – 8.2 Visual Inspection Switch 3
Probable causes – Active wire is not properly connected
Suitable Solution – ~~Test~~ Rewire and reconnect ~~the~~ the active wire

Installation Fault 6

Identified Fault – Broken Switch
Location of fault – At fault sample Board
AS|NZS 3000 Ref – 8.2 visual inspection
Test method – visual inspection.
Probable causes – Mechanical force impacted on switch
Suitable Solution – Replace the switch

Installation Fault 7

Identified fault – NO cover of switch | outlet
Location of fault – At fault sample board
~~AS|NZS 3000 Ref~~ Probable cause – Loss of screw causing ~~the~~ that cover was removed.
Suitable solution – put back the
AS 3000 Ref – 8.2 visual Inspection
Test method – visual inspection.

Installation fault 8

Identified fault – Open Neutral
Location of fault – Hws
Switch plate 4 Switch 1

AS|NZS 3000 Ref – 8.3.8
Test method – measure the resistance between supply A|N|E and Hws A|N|E
Probable causes – Neutral wire is not connected
Suitable solution – ~~Reconnect~~ Reconnect the neutral wire of Hws.

1 minimum ~~of~~ value of insulation resistance permitted between submain conductors
1 mΩ 8.3.6.3

2 maximum value of resistance permitted for an equipotential bonding conductor
0.5Ω (8.3.5.2)

3 maximum value of resistance permitted for a protective earthing conductor
0.5Ω (8.3.5.1)
The resistance of protective earthing conductors shall be
(a) low enough to permit the passage of current necessary to operate the over current protective device and
(b) consistent with length, CSA and type of conductor material
The resistance of main earthing conductor: (or)
Protective earthing conductor shall not be more than 0.5Ω

4 Possible causes of short circuit in electrical installation.
— short circuit between active to neutral at light point
— ~~can~~ contact with a lot of water
— wear and tear of electrical wire
— Faults in appliance

5 Possible cause of mechanical damage
— Damage wiring enclosure
— mechanical damage to wire insulations
— wire insulation is cut off by sharp edges
— over heating of / melting down of cable insulation
— ~~over~~

6 The dangers posed by a high impedance ~~to~~ earth fault loop.

The earth fault ~~loop~~ current will not be high enough to be ~~sensed~~ sensed by ELCB causing the failure of tripping off the supply of faulty situation.

5.1 conduct optional Testing

Hazards, as in 3.1

Type of equipment
ANENG ST180 multimeter
Function / purpose — multimeter | V | I | Hz
AC DC AC
Critical parameter AC/DC V 0-600V
Tolerance — ± 1.5%, ±5
Standard Test device comparison

Testing Procedure — Test the known voltage source / known Resistance and find out the difference

Characteristic

Test	Result 1	Result 2	Result 3
Equipment	239.5V	62.6Ω	24.4Ω
Std Test device	240V	63Ω	24Ω

calibration
required Adjustment To adjust the meter for ohm range.

2.2 carry out load current testing
Type of equipment — 42V/24V CT Transformer, 100VA
2.2.1 Function / purpose — To step down AC42V to AC24V
output power — 100VA
power factor — —
Operating voltage — 42V/24V
Pri Sec
Full load current — 2.38A / 4.16A

1 minimum ~~of~~ value of insulation resistance permitted between submain conductors
Iner 8.3.6.3

2 maximum value of resistance permitted for an equipotential bonding conductor
0.5Ω (2.3.5.2)

3 maximum value of resistance permitted for a protective earthing conductor
0.5Ω (2.3.5.1)
The resistance of protective earthing conductors shall be
as low enough to permit the passage of current necessary to operate the over current protective device and
(y) consistent with length, CSA and type of conductor material
The resistance of main earthing conductor (or)
Protective earthing conductor shall not be more than 0.5Ω

4 Possible causes of short circuit in electrical installation.
— short circuit between active to neutral at light point
— ~~rain~~ contact with a lot of water
— wear and ~~tear~~ of electrical wire
— Faults in appliance

5 Possible cause of mechanical damage
— Damage wiring enclosure
— mechanical damage to wire insulations
— wire insulation is cut off by sharp edges
— over heating of / melting down of cable insulation

~~over~~

6 The dangers poted by a high impedance ~~to~~ earth fault loop.

The earth fault ~~loop~~ current will not be high enough to be ~~sensed~~ sensed by ELCB causing the failure of tripping off the supply of faulty situation.

5.1 conduct optional Testing

Type of test — Hazards, as in 3.1
ANCNG ST120 multimeter
Function / purpose — multimeter | V (AC DC) | I (AC) | Hz
Critical parameter AC/DC V 0-600V
Tolerance — ± 1.5% ± 5
Standard Test Device comparison

Testing Procedure — Test the unown voltage source / Unown Resistance and find out the difference

Characteristic

Test	Result 1	Result 2	Result 3
Equipment	239.5 V	62.6Ω	24.4Ω
Std Test device	240 V	6.8Ω	24

calibration
required Adjustment To adjust the meter for ohm range.

2.2 carry out load current testing
Type of equipment — 42V/24V 1Φ Transformer, 100VA
2.2.1 Function / purpose — To step down AC 42V to AC 24V
output Power — 100VA
Power factor — —
Operation voltage — 42V (Pri) / 24V (Sec)
Full load current — 2.38A / 4.16A

2.2.3 Appliance operating characteristic

Refer practical 3 of EL0025

$\frac{46W}{42V} = 1.095A$

condition		Line voltage	Line current	power in	power out	effcy
Load	1	24.39	1.09	46 W	12.28 W	26.7
	2	24.29	0.6 A	26.6 W	28.05	49.5
	3	24.34	0.9	58.6 W	27.48 W	47.6
	4	24.33	0.8	54.45 W	30.34 W	50.96

① Purpose of calibrating electrical equipment

To get accurate result of measurement and to determine whether it matches the standard test equipment or not

② purpose of load current test

To determine line current drawn by appl in various condition whether it meets manufacturer's specification. or not

③ 3 method of load current testing

(a) Clampmeter

(b) Ammeter

(c) measure the voltage across a known series resistor and divide the voltage by its resistance.

④ performance Testing

The performance characteristics of equipment are tested under various operating conditions whether they match the manufacturer's specification or not.

⑤ Items required regular calibration.

meters (flux meter, ohmmeter, tachometer IR Testers, ELCBs, energy meters

Instrument transformers (CT, VT)

⑥ at 50% load the current reading should be

$2.38/2 = 1.19A$

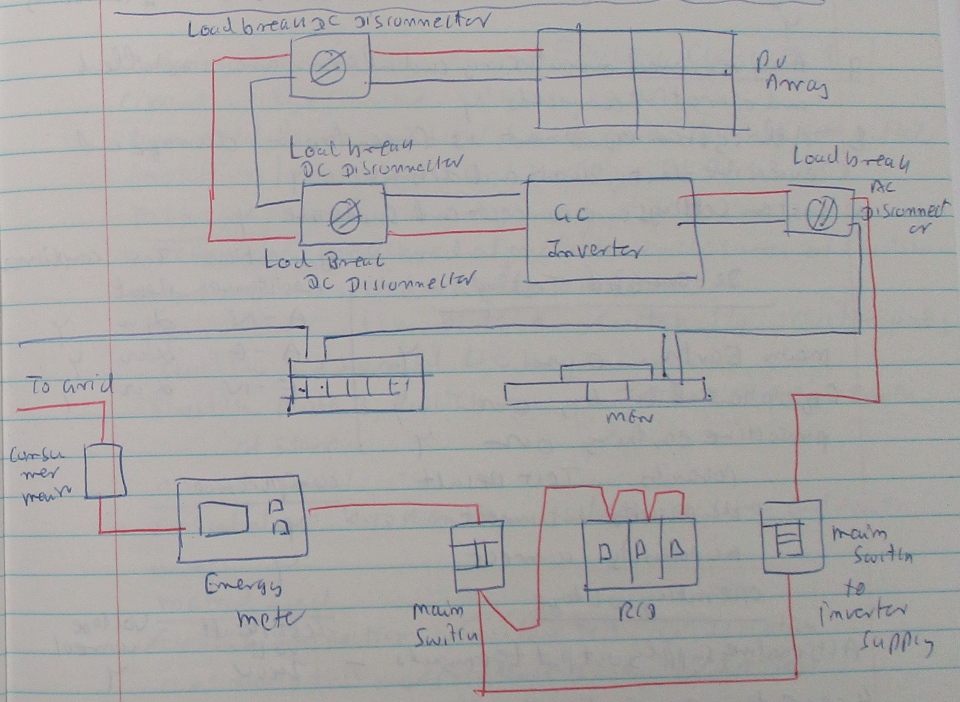
according to test result $P_{IN} = 54.45W$

voltage = 42V

$I = \frac{54.45}{42} = 1.296A$

It is not too different from specification value.

5.2 Inspect and Test an alternative supply system



Hazards

Falling from Height DH use fall Protection gears

PV wiring Short circuited DH Test insulation resistance

output circuit electrical Short circuit DH Test insulation resistance

Battery acid injury DH use glove, eye Protection

Exposed conductor DH Test, Enclose

Inspection check list

1 Equipment is suitably ventilated Y
2 Equipment is suitably rated for ambient temperature and humidity Y
3 NO External heat sources are present that may cause hazardous temperature rise Y
4 Access and egress from the area is unobstructed Y
5 All required singnage, labelling and markings are installed Y
6 Required Switchgear is installed and operating correctly Y
7 Any required monitoring and alarms are installed and operating correctly Y
8 All system equipment is free from damage and excessive dust, dirt and debris Y
9 System setings are correct and suitable Y

De-energised Testing

main Earth	0 Ω	Y
Equipotential Bonding	0 Ω	Y
protective earthing	0 Ω	Y

Insulation Resistance	Test Result	compliance
A-N	∞ Ω	Y
A-E	∞ Ω	Y
E-N	∞ Ω	Y

Polarity	Test Result	compliance
dc polarity	correct	Y
AC polarity	correct	Y

operating voltage

	Test Result volt	Voltage correct
Alternative supply out put terminals	240V	Y

4 operating Parameters to be tested at inverter alternative supply system
1. DC Input / AC out put voltage
2. Input / out put currents
3. operation of Protection & Alarms
4. ~~Frequency~~ Frequency.

6.2 Trouble Shoot Electrical circuits & equipment.

Ha 2 cards
240V exposed conductor untagged ∴ H Test terminal enclose
un tagged un Locked switch ∴ H properly Perform Locking & tagging
Insulation Resistance failure - ∴ H perform IR Test
Reverse polarity ∴ H perform polarity test

Wiring Training Boards **FAULTY CIRCUIT 1**
Circuit voltage/current - 240V, 63A
connected loads - 2 Light, 4 x 10A Double ~~Soft~~ outlet,
Protection/control - C-63-CB, EL 2403 RCD
Fault symptoms
voltage is measured at metallic enclosures of switch board and connected metallic accessories.
§ practice - Switch Plate 1, Switch 1/2, Switch Plate 2 Switch 3 is on at the beginning
Switch Plate 3, switch 2 - Test Active - Earth of stove.
circuit fault
Insulation breakdown between active and earth wires.
method used
✓ visual Inspection ✓ voltage Test, ✓ Isolation continuity test. ✓ Resistance test, ✓ IR Test Seltiomd Tests, split halt Test
Test equipment used
multimeter, IR Tester.
circuit fault
ELCB failed to operate continue fault symptom 2

visual Inspection ✓

FAULTY CIRCUIT 2

Circuit voltage/current - 240V, 63A
connected load 2 Lights, 4x10A Double socket outlets
protection/control - C63 CB, EL2403 RCD.

Faults symptoms

Earth leakage circuit breaker failed to operate
{ switch plate 1, switch 1/2, switch plate 2
switch 3 is on at the begining.
switch plate 4, switch 4, measure the resistance of main earth wire to earth point.

circuit fault

High resistance in main earth wire.

methods used

visual Inspection
voltage Test
✓ Isolation
✓ continuity test
✓ Resistance Test
IR Test
sectional test
split half test

Test equipment used

multimeter
IR Tester

circuit fault

Loose connection of earthed terminal

✓ visual Inspection
✓ continuity Test
✓ Resistance Test
✓ IR Test

Test equipment

multimeter
IR Tester

FAULTY CIRCUIT 3

circuit voltage/current - 240V, 63A
connected Load - 2 Lights, 4x10A Double outlet.
Protection/control - C-63-CB, EL2403 RCD.

Fault symptoms

no light was on when the switch is closed
{ switch plate 1, switch 1/2, switch plate 2,
switch 3 is on at the beginning. switch plate 3, switch 3 measure the resistance between active to light 2 active

circuit fault

Active wire is not properly contacted.

✓ visual Inspection.

Faulty circuit 3

circuit voltage/current 240V, 63A
connected load - 2 Lights, 4x10A Double outlet
protection/control - C-63-CB, EL2403 RCD.

Fault symptoms

no light was on when the switch is closed
{ switch plate 1, switch 1/2, switch plate 2, switch 3 is on at the beginning.
switch plate 3, switch 3, measure the resistance between supply active to light 2 active.

circuit fault

open active.

methods used

✓ visual Inspection
voltage tests
Isolation
continuity Test
Resistance Test
IR Test
sectional Tests
split half Test

multimeter
IR Tester

circuit fault

Active wire is not properly contacted.

methods used

✓ visual Inspection.

FAULTY CIRCUIT 4

circuit voltage/current - 240V, 63A
connected load - 2 Lights, 4x10A Double socket outlets
protection/control - C-63-CB, EL2403 RCD

Fault Symptoms

No Heat in Ltws when the switch is closed.
Switch Plate 1, Switch 1/2, switch Plate 2, Switch 3 is on at the beginning.
Switch Plate 4, Switch 1, measure the resistance between supply A1N/E and ltws A1N/E.

circuit fault

ltws neutral wire is not Properly connected
✓ visual inspection.

Circuit fault	Resistance Test
open neutral	IR Tests
~~visual inspection~~	Sectional Test
~~voltage Test~~	half split Test
✓ Isolation	
✓ continuity Test	

(1) Benefit of split Testing

It can reduce the substantially the number of tests, necessary to locate a fault when the number of components or blows in series is large.

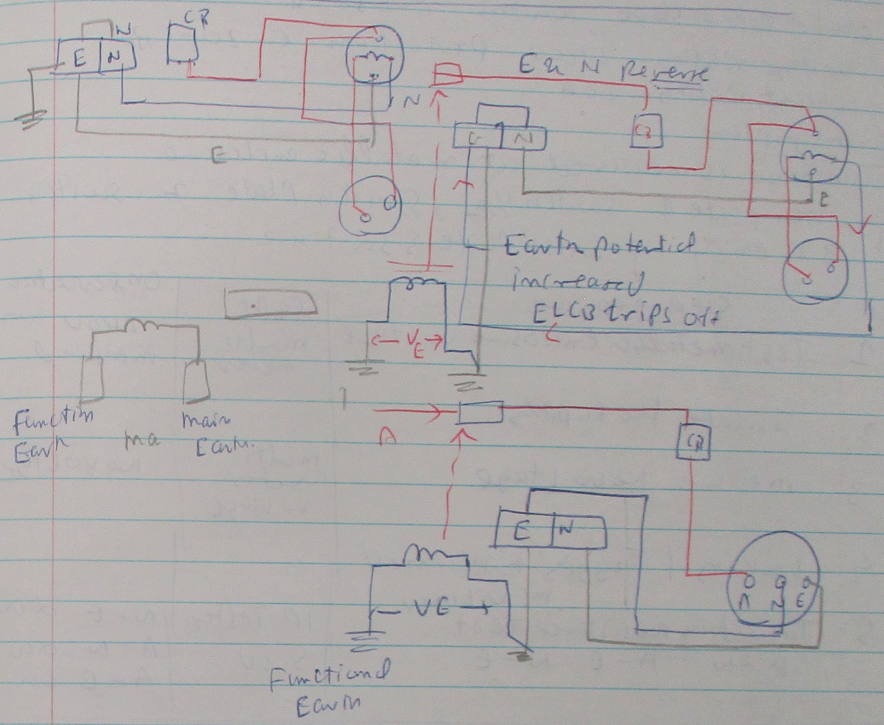
(2) Electrical equipt fault, only be ~~seen~~ located by visual inspection

- Blocked vents	- over heating
- Bearing failure	- Broken component wire
Burnt insulation	

(3) 2 Safety Procedure

✓ Isolate electrical supply, locking, Tagging
✓ Test the electricity at all exposed terminals before both touching and working.

7.2.1 Fault find Electrical circuits & Equipment



Note- When Neutral and Earth are wrongly connected, the earth potential will increase because the current flows in to earth.
The potential between main earth and functional earth ~~or~~ electrodes will increase causing ELCB to trip off the supply

Hazards

240V exposed conductor	D/H	Test terminal/enclose
Untagged, unlocked Switch	D/H	Properly perform Locking Tagging
Insulation resistance failure	D/H	perform IR Test
Reverse polarity	D/H	perform polarity Test.