ETC

96

S

A4 Exercise Book

CD0046 CD0019
96 20
L008 L003
9 47
10 CD0051
20 CD007
21
29
25
E0001

@: CQ 0044
0046
EL0008
0004
0010

EL0020

EL0021
EL0024
EL0025
RE0001

UETT DRRF004
EL0023
EL0018
CQ0007
EL0020 (measurement)

UETDRRF004 perform rescue from a Live

1.3 Live low voltage Rescue Procedures

CD0007 2.3 Electric Shock rescue Procedures

Hazards — strength of

1. No enough insulation / glove 2 electrocute D/H
   - glove to be tested and checked for currency
2. Broken insulation in rescue hook causing electrocution D/H — Insulation must be checked
3. supply still present D/H — Isolate the supply
4. Direct skin contact with casualty causing shock D/H Avoid direct skin contact with casualty
5. Electric fire, gas D/H Check electric fire & fume.

Step by step procedure to safely remove an electric Shock victim from Live electrical situation

- Acquire Low voltage rescue kit.
- Identify the points to do isolation.
- Check the glove. no hole.
- Assess the situation for danger for myself ~~or~~ and others.
- Isolate the supply.
- When isolation is not possible, use an insulated item, use rescue hook to remove the victim from contact with live parts.
- move the victim to a safe location
- Administer the first aid to the victim and contact emergency service
- Secure the area out to prevent other access by other personnel

- First step of performing low voltage rescue.
  Assess the situation for danger to yourself and others.

- In what situations might it not be possible to perform the rescue
  - The danger is present to rescuer.

why is it unsafe to touch an electric shock victim with your bare hands?

The electricity will also flow into the body of the person who does rescue and will be electrocuted

---

UEEEL0023

Table 1.1

TPI Building wire	2.5mm²	V90 0.6/1kv
TPS Double insulated	2.5mm²	V90, 250/440v
TPS 3 core and E	2.5mm²	V90 450/750v
Heavy duty	2.5mm²	250V
SWA	2.5mm²	0.6/1kV
Grey Heavy Duty flexible cord	~~2.5~~ 0.75 mm²	250/440V

Purpose of cable insulation

1.2 Cable construction

Insulate the conductors, prevent them from unintentional contact with other objects. Cable insulation must be in limits of temperature ratings.

Why is conductor insulation colour coded?

For ease of identification

Stranded conductor twisted when connecting to terminal

To properly prepare the ~~cable~~ cable ends to perform high quality termination

Poor cable termination

It can cause hot spot damage to equipment and failure of insulation.

when stripping the insulation from cable why is it important not to nick or otherwise damage the conductor.

It can reduce the current carrying capacity of conductor because it's cross sectional area has been changed resulting that overheating of conductor and damage of insulation by overheating can occur.

when terminating a conductor what steps are taken to ensure there is no stress on termination

- cable preparation (stripping off cable sheath, removing insulation)
- connector selection
- connector installation
- Insulation and sealing
- testing and verification.

Tool / Equipment

Cable lug (Crimp lug) 2.8 mm
Soldering iron
2.5mm² TPI cable
Solder 60/40 1mm²
Crimping Tool
Fastoon lug variety

3.1 Torturous path

Torturous path protects the conductor terminations from undue force when disconnecting a cord.

Continuity Testing on an extension cord after assembly

Maintain earth continuity for safe earthing integrity as well as active and neutral continuity for safe flow of reliable electrical power.

Why is it important to ensure the insulation and conductor strands are not damaged when assembling an extension cord.

If insulation is damaged, it is high risk for occurring short circuit and the damage of conductor strands also causes the over heating and damage of insulation.

4.1 Install circular TPS cable supported on cable Tray

Exposed live wire D/H All exposed conductors must be removed

Exposed rotating parts D/H All rotating parts must be covered

Accidentally switching on supply wire while the workmate is working on electrical system D/H appropriate test & tag procedure must be followed.

Inappropriate use of cable and material causing thermal stress G/M Suitable cable and materials must be ~~selected~~ selected.

Advantage of using circular TPS cable

Circular TPS cable provides double insulation thereby inherently satisfying certain safety requirement specified in AS 3000 : 2018

Why is cable trays provide sufficient support provide appropriate separating between the cable and it can also reduce the mutually induced voltage in current carrying cables.

other wiring system

casing & capping wiring, cleat wiring, batten wiring conduit wiring

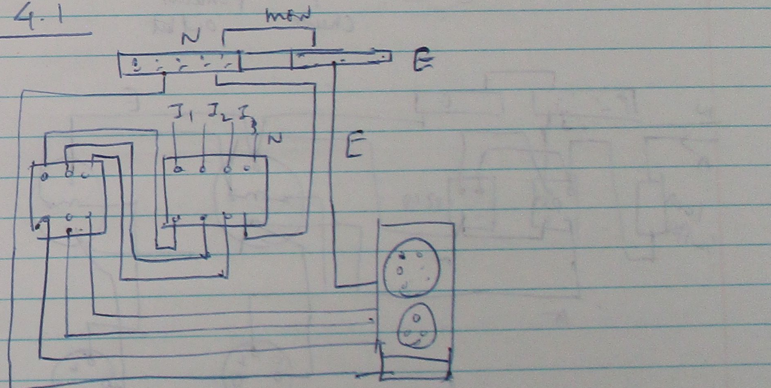
Why is it important to carry out the tests listed in this skills practice?

To assess the condition and serviceability of cable system so that maintenance procedures can be initiated

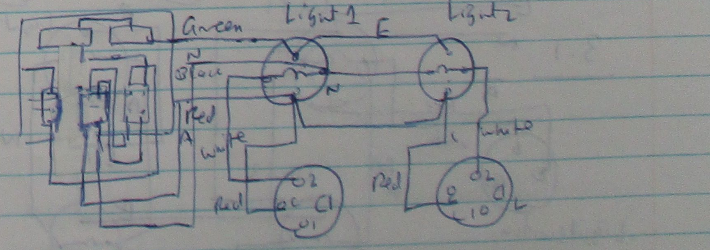
The Test reading / results should indicate the circuit is safe to connect to supply, justify reasoning

- Earth resistance is at acceptable value which can provide effective earthing to protect electrocution
- Acceptable insulation resistance between Active, Neutral and Earth wires so that electrical fault can be avoided
- polarity & continuity test — that can enable the intended operation.

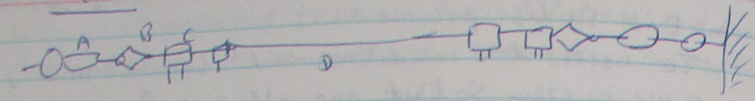
4.1



5.1

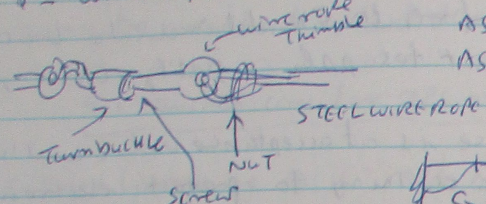


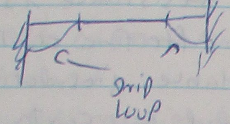
9.1

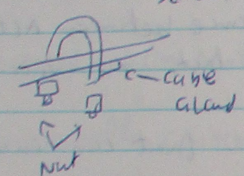


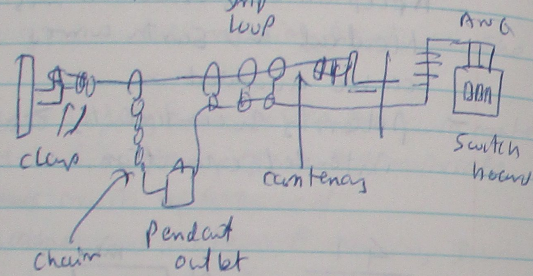
A – Turnbuckle
B – wire rope Thimble
C – cable clamp
D – Steel wire rope

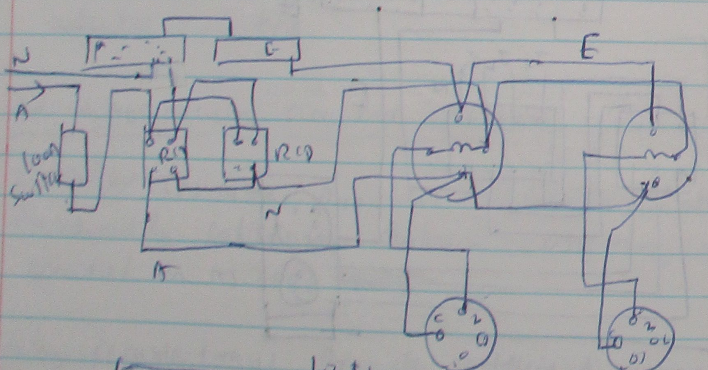
AS3000 clause 1.4.129
AS3000 Table 3.6
Table 3.10

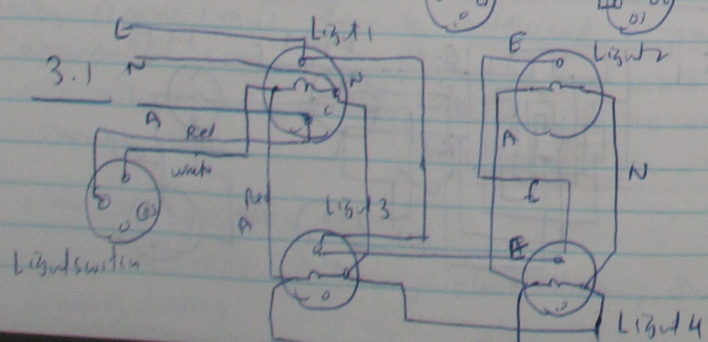


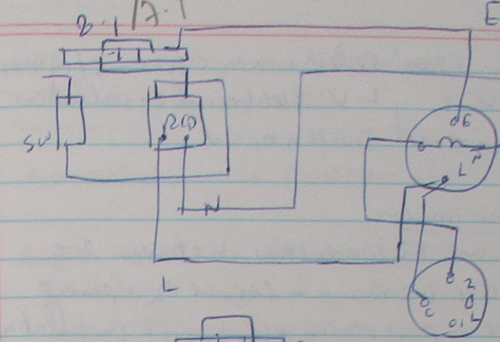


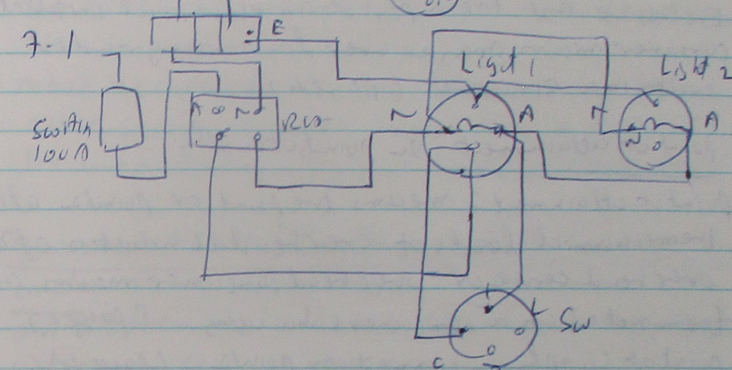












ELO013

NAT10202005 | Select wiring systems/cables for
7.1 Local service & | L.V Electrical Installations
Installation Requirement | Switchboard

Definition of consumer main

- consumer mains are the conductors between the connection point and the main - service equipment Enclosure and from part of an electrical installation. consumer mains may be ~~over hea~~ underground or within a structure (page 4)

point of attachment & point of supply

point of attachment - means the point or points at which the mechanical loads of overhead conductors of an overhead service or overhead consumer mains are terminated on a consumer's building (page 6)
point of supply - connection points (page 4, 6)

Minimum insulation resistance to be measured between the conductors of a new service and earth

(Local Rule)

Shall not be less than 50 MΩ using 500V DC IR tester
Clause 1.12.2.1 page 15)

(Local Rule)

maximum voltage drop permitted in an overhead / UG service

Should not exceed 3% of the nominal voltage
(Clause 1.12.3.4)

When an electrical installation requires CT metering

When maximum demand of the installation exceeds ~~at~~ 100A / phase (Clause 1.12.10.1)

~~Who~~ can connect and disconnect electrical installations - to supply network

Accredited Service Provider (ASP) (clause 1.9 page 4)

~~Regu~~ describe the requirements in your state or territory regarding the balancing of loads in multiphase electrical installations and explain why this is necessary

- must be arranged so that the maximum demand in an active service conductor is not more than 25A above the current in any other active service conductor.

Requirement of State / Territory, installation of a consumer main

On the premises 2.4.4.1 clearly marked, sketch of the premises Fig 2.6 (a) to (m)
conductor size 2.5, Fig 2.1, 2.2, 2.3
cable size 2.6, (Clause 2.4.4, 2.4.4.1, 2.4.4.2, 2.5.1 2.6.2) Fig 2.1, 2.2

Maximum permissible span for overhead service?

up to 100A is 50m
>100A is 30m
Clause 3.5

minimum height for overhead service lines at the point of attachment on a house?
Bottom of drip loop is 2.7m
POA is 3m
Page 55

What is the minimum size for copper consumer's mains in your state or territory?
Table 2.1
$16mm^2$ Cu

Local requirements for location and accessibility of metering equipment

- must be easily accessible, not located adjacent to the service protection device, location must be labelled on the main switch board and must comply to 4.17 (clause 4.2)

minimum and maximum heights for mounting service protection devices.

Service protection device no higher than 2m to the top of the device and no lower than 500mm to the line side terminals. (clause 4.7.2 (a))

Requirements for the installation of service and metering neutral links types, location, current carrying capacity identification

Location (4.15.4) (1.12.11) (4.10) (g)

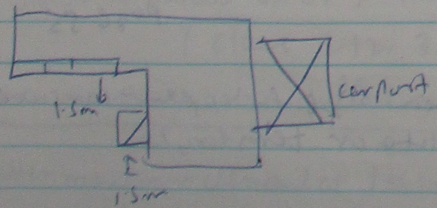
All insulated type (4.10) (a) Identification (4.15.4) (4.10) (e)

current carrying capacity (4.10)(d)

Describe local requirement for sealing of whole current energy meter

(Sealing) (4.12.1) (a) sealable to open position nylon isolation sealing wire, not less than 1.4mm in diameter

Suitable ~~locati~~ location for main switch board



Clause 4.2

2.2.1 Calculate maximum demand single domestic installation

AS/NZS 3000:2018 Table C1 column 2

Load	Load group	Calculation	Demand
26 lighting point	a(i)	3 + 2 = 5A	5A
28 double 10A socket outlet	b(i)	28 × 2 = 56 point 10 + 5 + 5 = 20A	20A
single 15A socket outlet	b(ii)	10A	10A
6.4kw electric cooktop	(c)	$\frac{6400}{230} \times 0.5 = 13.9A$	13.9A
3.5kw electric wall oven	(c)	$\frac{3500}{230} \times 0.5 = 7.61A$	7.61A
24.5A (max) reverse cycle ducted aircon	d	24.5 × 0.75 = 18.4A	18.4A
4.8kw storage hotwater heater	f	$\frac{4800}{230} = 20.9A$	20.9A
		maximum demand on consumer main	95.8A

2.2 Calculate maximum demand – Non domestic installation

AS/NZS 3000:2018 Table C2 column 3

Load	Load Group	Calculation	A	B	C
12x Fluorescent lights (0.37A)	(a)	6 × 0.37 = 2.22A	2.22A	–	2.22A
16x metal halide lights (1.6A)	(a)	8 × 1.6 = 12.8A	12.8A		12.8A
28 × 230V double 10A socket outlets	b(ii)	10 × 2 = 20 points 1000 + (19 × 100) = 2900 w 2900/230 = 12.6A 9 × 2 = 18 points 1000 + (17 × 100) = 2700 w 2700/230 = 11.7A	11.7A	12.6A	11.7A
4x 400V 10A socket outlet	b (ii)	1000 + (3 × 100) = 1300 w 1300/400 × √3 = 1.88A	1.88A	1.88A	1.88A

Load	Load Group	Calculation	A Ph	B Ph	
2×230V, 15A socket outlets	b(iii)	15A	—	15A	1[illegible]
3×400V, 20A socket outlets	b(iii)	20+(0.75×40) = 50A	50A	50A	5[illegible]
2.4kW, 230V Instantaneous water heater	C(i)	2400/230 = 10.4A		10.4 A	
2×4kW, 230V Aircon	C(i)	$\frac{4000}{230}$ = 17.4A 17.4+(0.75×17.4) = 30.5A	30.5A		
Lathe (11.6A/ph) milling machine (9.2A/ph) and grinder (4A/ph)	d	11.6+(0.75×4.2) +0.5×4 = 20.5A	20.5A	20.5A	20.5[illegible]
4kW, 230V storage water heater	g	4000/230 = 20A		20A	
Single phase arc welder	h	12A			12A
			130A	130 A	130A

What is meant by diversity in relation to maximum demand

- It is unlikely that every socket outlet, lighting point and appliance in an installation will be utilized at full capacity ~~at~~ all at the same time. This is known as load diversity

List 3 factors to consider when determining maximum demand

- Number and type of loads, intended use of loads and allowance for diversity, operating char

El001

1.3 Electrical Protection Arrangement

1 3 major types of risks posed by electrical installation.
- Fire, Electrocution, Electrical shock explosion

2 Fire performance standards

Basic protection, Fault protection, overcurrent protection, Abnormal voltage protection, Short circuit protection

3 6 External influence to be considered during design of electrical installation

Lightning, Nearby switching operation, weather temperature water entry, mechanical impact

4 ~~Ri~~ To reduce risk due to mechanical protection

Barriers to be placed

5 Supply characteristics to be taken into account during the design of electrical installation.

Supply voltage, frequency, harmonics, surge voltage (Abnormal voltage)

6 Permissible voltage drop

230/400V +10% to −6%

7 Purpose of dividing an electrical installation into circuits

To maintain allowable current level

to provide segregation between ~~Li~~ extra low voltage and LV circuits

To provide easier access for maintenance & fault finding.

8 Likely source of Abnormal voltage

Lighting, Switching of nearby circuits.

9 Risks posed by over current

over load, fire.

10 Acceptable method of providing protection against over current
- Automatic disconnection of supply (ADS)
Limiting the over current to a safe value.

11 Acceptable methods of basic protection
Insulation
Use of barriers or enclosure
Use of obstacles
Placing live parts out of reach

12 Acceptable method of fault protection
- Automatic disconnection of supply
Use of class II equipment
Electrical separation
Limitation of possible fault current to safe value.

	Scenario	Basic protection	Fault protection	30mA RCD protection	Protection against thermal effect
1	230V, 10A socket outlet final subcircuit in house			X	
2	Submain terminating onto busbars in a main switchboard		X		
3	A 2.3kW, 230V strip heater circuit installed in air		(X)		X
4	12kW, 400V water heater final subcircuit in office		(X)		X
5	Consumer main of a domestic electrical installation	X			
6	6kW 400V motor final sub circuit in factory		X		X
7	A cable ladder in the riser of a high rise building	X			
8	A final subcircuit supplying 15 lighting pt. in a house		(X)	X	
9	An electric heating cable in the slab floor of bathroom				X
10	20mm PVC conduit containing 3 TPI cables	X			

Residential Installation

Final subcircuit to double 230V 10A socket outlet in house
Basic protection
Fault protection = (CB)
RCD protection ✓ required
Thermal effect
Abnormal voltage

Final subcircuit supply of 12kW 230V stove
RCD protection - not required
Thermal effect = Thermal insulation
Fault protection - Circuit breaker

Final subcircuit to supply 12kW 400V instantaneous water heater
Fault protection - CB
RCD - not reqd
Thermal effect = Thermal Insulation.

Commercial

Sub main 200A DB Shopping Centre

Basic Protection — mech. Protection

Fault protection — C3

RCD protection not required

① Obstacles

1.4.27 A part preventing unintentional direct contact but not preventing direct contact by deliberate action

② Protecting indirect contact

Earthing

③ 30mA RCD acceptance sole as providing direct contact

no

1.5.6.1 RCDs are not recognized as a sole means of basic protection.

2.2 Arrangement of final subcircuit

①

Qty	Load
28	Lighting points
3	120W fixed exhaust fan
2	15A single socket outlet
24	10A double socket outlets
2	28A Aircon
1	11kW stove
1	8.6kW hotwater heater

C4

Cct no	Connected load	Protection device	No. of points
1	28 lighting points. 120W fixed exh. fan 3 no	16A	28 × 0.5 = 14 3 × 0.5 = 1.5 15.5A
~~2~~			
2	~~15A~~ 2 × 15A socket outlet	16A	15A
3	15A socket outlet	16A	15A
4	12 × 10A double outlet	25A	24 × 1 = 24A

Cct no	Connected load	Protective device	No. of point
5	12 × 10A double socket outlet	~25A	24 × 1 = 24A 12 × 2 = 24 double → contribution point amount
6	~~11kW~~ 11kW stove	25A	13kW
7	8.6kW hotwater heater	40A	connected load $\frac{8.6 \times 10^3}{230} = 37.3$

② + ③ Similar

① When may a socket outlet be counted as lighting point for determining circuit loading

Table C1 foot note 5.

A socket outlet installed more than 2.3m above a floor for the connection of a luminaire may be included as a lighting point in load group A(i)

② Is exhaust fan installed 2.4m above the floor

A(i) {Foot note 5 Table C1}

③ purpose of dividing electrical installation into circuit.

3.4.3

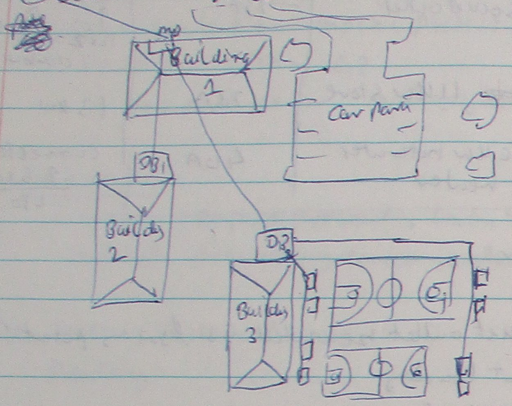
The load current sharing between each parallel cable or group shall be sufficient to prevent overheating of ~~any~~ any cable (s) group

④ Peak time. (NSW Ausgrid) ~~2pm to~~ 2pm to 8pm weekday.

⑤ Seasonal effect of energy consumption in Australia maximum operational demand occurs in summer driven by cooling loads across most of Australia's states and territories. However Tasmania's peak demand occurs in winter, driven by heavy heater use amid bitterly cold outdoor temperature.

3-2 select wiring system

Q Select wiring system for school



70mm² aerial conductor point of supply at the top of steel pole.

Consumer main — at distance of 24m to building as aerial before terminating into the main switch board

DB1 Sub main — run through sub floor of DB1, then across asphalt courtyard the DB2 mounted externally at NE of Building 3

DB2 — run through sub floor of building 1 run between Building 1 & 2 by catenary

Final sub circuit DB1.14 DB1.15 each supply 4x1000W metal halide flood lights mounted on pole 5m above the asphalt ground surface

Building 1, 2, 3 Double brick construction Timber flooring on brick piers supported by strip footing.

Consumer main

Cable Type	Cable Support Enclosure	Ext Influence
Aerial cable XLPE 0.6/1kV	Service bracket Anchor bolts Existing metallic support	corrosion wind mech. force

Installation method — Install service bracket, Anchor bolt attach continuous wire attach supply wire to catenary, termination process

DB1 Sub main

Cable Type	Cable support / Enclosure	Ext Influence
Aerial cable	Service bracket Anchor bolt catenary	corrosion wind mech force

Installation — Install bracket, anchor bolt, attach catenary wire, erect the submain.

DB2 Submain

Cable type	Cable support enclosure	Ext Influence
XLPE Insulated PVC sheathed	UG conduit	mechanical force

Installation — Put UG conduit, draw the cable. Terminate place UG Tape above it.

Final sub circuit DB1-14 / DB1-15

Cable type	Cable support / enclosure	Ext Influence
XLPE insulated PVC Sheathed	UG conduit	mech force

Installation — lay UG conduit, draw in cable, Terminate place UG Tape above it

1 minimum ground clearance for bare aerial conductor over a driveway. 5.5m (Table 3.8 AS3000)
3m Fig 3.4 NSW SIR (Service Installation Rules)

2 10mm² XLPE 4 core twisted cable max. aerial span. 50m (AS3000 Table 3.9)

- Acceptance cable used for ESR
  Not less than 2.5 mm^2 3.16 (AS3000)

- Suitable wiring system for socket outlet in brick veneer house
  & wiring in light conduit.

- Suitable wiring system for the supply of flourescent lighting installed in the false ceiling grid of an office building
  - Building wire in conduit, loop at light or loop at switch method

4.2 maximum Demand on consumer mains

Qty	Load
26	Lighting points
28	Double 10A socket outlet
1	Single 15A socket outlet
1	6.4kW electric cooktop
1	3.5kW electric wall oven
1	24.5A (max) reverse cycle ducted airconditioning
1	4.8kW storage hotwater heater

AS3000 Table C1 column 2

Load	Load group	calculation	Demand
26 Lighting point	a(i)	3 + 2	5A
28 x Double 10A socket outlet	b(i)	28x2=56 10 + 5x5 = 20	20A
1 x Single 15A socket outlet	b(ii)	10A	10
1x6.4kW electric cooktop	c	$0.5 \times \frac{6.4 \times 10^3}{230}$ = 13.9A	13.9A
1x3.5kW electric wall oven	c	$0.5 \times \frac{3.5 \times 10^3}{230}$ = 7.6A	7.6A
1x 24.5(A) reverse cycle ducted aircon	d	0.75x 24.5 = 18.375	18.375
1x 4.8kW storage hotwater heater	f	$\frac{4.8 \times 10^3}{240}$ = 20	20
			94.3A

---

(2)

Qty	Load — Electrical Installation in a factory unit.
12	Twin 36W T8 flourescent Lights (0.37A / fitting)
16	metal halide high bay light (1.6A per fitting)
28	Single phase double 10A socket outlet
B+A 2	Single phase 15A socket outlets
4	3 phase 20A socket outlet
1	3 phase 2.4kW hydroboil instantaneous hot water heater
B 1	Single phase 4.6kW storage hot water heater
C 2	Single phase 4kW Airconditioner
1	Three phase 6kW lathe motor (11.6A per phase)
1	Three phase 5kW milling machine motor (9.2A / phase)
1	2.2kW 3φ pedestal grinder (4A / phase)
C 1	Single phase Arc welder (18A rated primary current)

Find maximum demand of 3φ consumer's main
10A socket outlets are installed in airconditioned area of building.
Balance load across the phases

AS/NZS 3000/2018 Table C2 column 3

Qty	Load	Load Group	calculation	APh	BPh	CPh
12	Twin 36W Flourescent Light	a	cct 1 4 x 36W FL Light $4 \times 36/240$ =	0.6		
			cct 2 4 x 36W FL Light		0.6	
			cct 3 4x36W FL Light			0.6
16	metal Halide High bay Light 1.6A	a	cct 4 5 x 1.6	16 (8) 8	(8)	
			cct 5 5 x 1.6			
			cct 6 6 x 1.6			9.6
28	1φ Double 10A socket outlet 28x2=56	b(i)	cct 7 (19) $\frac{1000 + 750 \times 18}{240}$	60.4		
			cct 8 (19) $\frac{1000 + 750 \times 18}{240}$		60.4	
			cct 9 (18) $\frac{1000 + 750 \times 17}{240}$			57.29
2	15A 1φ socket outlet	b(ii)	cct 10 / cct 11 $\frac{1000W}{240}$ = 4.16	4.16	4.16	4.16 4.16
4	3φ 20A socket	b(iii)	cct 12 → (A+B) 20 + 0.75x3x20	65	65	65

	Load	Load Group	Calculation	A	B	C
1	3ϕ 2.4kW Hydro boil Instantaneous water heater	c(i)	Full connected load Cct 13 $\frac{2.4\times10^3}{\sqrt{3}\times415}$	3.33	3.33	3.33
1	1ϕ 4.6kW Storage water heater	g	Cct 14 Full load $\frac{4.6\times10^3}{230}$ =	20		
2	1ϕ 4kW Aircon	g	Cct 15 Full load $\frac{4\times10^3}{230}\times 2 = 17.39$ ×2		17.39	17.39
1	3ϕ 6kW Lathe motor 11.6A	d	Full load Cct 16 $\frac{6\times10^3}{\sqrt{3}\times E}$ = 11.6A	11.6	11.6	11.6
1	3ϕ 5kW milling machine motor	d	75% of 9.2A	6.9	6.9	6.9
1	2.2kW 3ϕ pedestal grinder	d	50% of 4A	2	2	2
1	Single phase Arc welder 18A		C 2.5.2 100%		18	
			TOTAL	185.83	185.17	182.03

Diversity related to maximum demand

C2.1 The diversity factors applicable to any given circuit in an installation will depend on a number of features of the installation including (a) condition under which the installation is expected to be used (b) operating characteristics of commercial load (c) no. of physical distribution points.

3 factors to be considered max. demand

- Physical Distribution
- Intended use of electrical equipment
- The manner in which the present requirements might vary

Different calculation

Expected uses, operating characteristics, usage manner different

main switchboard schedule

Circuit	Protective Device	Connected load
L_1	16A Type C 30mA RCBO	13x Lighting points
P1	20A Type C 30mA RCBO	9x10A double socket outlet
P2	20A Type C 30mA RCBO	9x10A double socket outlet
R	32A Type C 30mA RCBO	11kW stove
HWS	25A Type C 30mA RCBO	5.29kW storage hot water heater.

Table C1

Cct	Load	Load Group	Calculation	Max Demand
L_1	16A Type C 30mA RCBO 13x Lighting point	a	3A	3
P_1	20A Type C 30mA RCBO 9x10A double socket outlet 9x2=18	b(i)	~~10A~~ 15 ~~for up to~~ 20	~~10~~ 15
P_2	20A Type C 30mA RCBO 9x10A double socket outlet 9x2=18	b(i)	15A	15
R	32A Type B 30mA RCBO 11kW stove	c	50% → $\frac{11\times10^3\times0.5}{240}$	22.9
HWS	25A Type C 30mA RCBO 5.29kW storage hot water heater	f	full load $\frac{5.29\times10^3}{240}$ = 22.04	22.04
			TOTAL	77.94 Amp

4.3 Maximum Demand - multiple Domestic Installation

12 units block - consisting of
12x two bed room units
6x three bed room units

Communal load
- 12x single phase 10A double socket outlet
- 1x Three phase 5.4kW Lift motor (14.6A/Ph)
- 1x 3Phase 5.9kW pool heater (13.3A/Ph)
- 1x 3Phase 4.1kW pool pump (8.3A/Ph)

Two bedroom units 12

Qty	Load
14	Lighting point
16	10A double socket outlet
1	120W, 230V Bathroom exhaust fan
1	12kW instantaneous water heater
1	9.2kW 230V electric stove
1	4.4kW, 230V split System AC

6 Three bedrooms unit.

Qty	Load
19	Lighting points.
18	10A double socket outlet
2	120W, 230V bathroom exhaust fan
1	6.2kW, 230V electric cooktop
1	12kW, 230V Instantaneous waterheater
1	5.2kW x 230V split System AC
1	3.6kW, 230V electric wall oven

Table C1 col 4

	Load	Load group	Calculation	Max Demand
1	Lighting point + Bp fan 1 = 19	a(i)	18 units 5 + 0.25 x 19	~~9.5~~ 9.75
2	10A Double socket outlet	b(i)	15 + 3.75 x ~~19~~ 18	82.5
3	12kW Instantaneous waterheater	e	6 x 18 = 108	108
4	9.2kW, 230V electric stove	c	2.8 x 18 = 50.4	50.4
5	4.4kW, 230V split syst. AC	d		

Two bed rooms unit x 12

Table C1 col 4

	Load	Load group	Calculation	max demand
1	Lighting point + 120W Bathroom exhaust fan	a(i)	5 + 0.25 x 12	8
2	10A double socket outlet	b(i)	15 + 3.75 x 12	60
3	12kW instantaneous water heater	e	6 x 12 =	72
4	9.2kW 230V electric stove.	c	2.8 x 12	33.6
5	4.4kW 230V split syst AC	d	75% connected load $\frac{0.75 \times 4.4 \times 10^3}{230}$	14.34
			(a) I total	187.94

THREE BEDROOMS UNITS x 6

	Load	Load group	cal	max. D
1	Lighting point + exh fan	a(i)	5 + 0.25 x 6	6.5
2	10A double socket outlet	b(i)	15 + 3.75 x 6	37.5
3	6.2kW 230V electric cooktop	c	2.8 x 6 =	16.8
4	12kW, 230V Instantaneous waterheater	e	6 x 6	36
5	5.2kW 230V split System	d	75% connected load $\frac{0.75 \times 5.2 \times 10^3}{230}$	16.95
6	3.6kW, 230V electric wall oven	c	~~2.8~~ 2.8 x 6	16.8
			(b)	130.55

COMMUNAL LOAD

Load	Load group	Calculation	Max D
12 x 1φ 10A double socket outlet 12 x 2 = 24 At	f	2A/Pt 2 x 12 = 24 Take	15
3φ Lift motor 5.4kW + ~~3φ pool pump 4.1kW~~	2.41 Table C2 (e) / col 2	Full load = $\frac{5.4 \times 10^3}{\sqrt{3} \times 415} \times 1.25$ x1.25	~~8.2~~ 10.25
3φ pool pump motor 4.1kW	d	Full load = $\frac{4.1 \times 10^3}{\sqrt{3} \times 415}$	5.7
5.9kW 3φ pool heater	g Full	$\frac{5.9 \times 10^3}{\sqrt{3} \times 415}$	8.2

(c) 39.95

TOTAL
(a+b+c)
357.44 A

3φ Consumer main

AS/NZS 3000: 2018 Table C1 col 3

Two bedrooms units x12 — 4 units/ph.

Load	Load Group	Calculation	A	B	C
1 Lighting point + Bathroom exh fan	a(i)	2-5 → 6A	6	6	6
2 10A double socket outlet	b(i)	10 + 5x4	30	30	30
3 12kW Inst water heater	e	6x4 =	24	24	24
4 9.24kW, 230V electric stove	c	15A	15	15	15
5 4.4kW, 230V split syst AC	d	75% $\frac{4.4\times10^3}{230}$	19.13	19.13	19.13
3 bedrooms unit x6		2 units/ph	94.13	94.13	94.13
1 Lighting pt + Exh fan	a(i)	2-5 6A	6	6	6
2 10A double socket outlet	b(i)	10+5x2 =	20	20	20
3 6.1kW 230V electric cooktop	c	15A	15	15	15
4 12kW 230V Inst waterheater	e	6x2	12	12	12
5 5.2kW, 230V split syst AC	d	75% $\frac{0.75\times5.2\times10^3}{230}$	16.95	16.95	16.95
6 3.6kW 230V elect. wall oven	c	15A	15	15	15
			84.95	84.95	84.95

COMMUNAL LOAD

Load	Calculation	A	B	C
3φ Lift motor 5.9kW	→ Full load x1.25 = $\frac{1.25\times5.9\times10^3}{\sqrt{3}\times415}$	10.25	10.25	10.25
3φ pool pump motor 4.1kW	= $\frac{4.1\times10^3}{\sqrt{3}\times415}$	5.7	5.7	5.7
3φ pool heater 5.9kW	= $\frac{5.9\times10^3}{\sqrt{3}\times415}$	8.2	8.2	8.2
Socket outlet 2 wire = 24; per phase 8 = 8 x 2A = 16A → 15A		15	15	15
		39.15	39.15	39.15

Total = 94.13 + 84.95 + 39.15 = 218.13 A

max demand on unit block consumer main = 218.13A

max demand on two bedrooms submain = 94.13A

max demand on 3 bedrooms unit submain = 84.95A

Table C1 foot note 5

Socket outlet installed more than 2.3m above floor for luminaire can be counted as lighting point.

5.2 Select cables based on current carrying capacity

$I_B \leq I_N \leq I_Z$

I_B = maximum demand for circuit

I_N = Nominal current of protective device

I_Z = continuous current carrying capacity

Scenario 1 — Ckt demand 20A | Two cores + Earth V90 TPS copper cable, clipped directly to timber floor joists crawl space under a house.

Protective device: QB 20A

Table 3.1 Item 12   Table 10/11 → col 5-7; 12 col 4-5

Derate Table 22   derate = 1

20A/1 = 20A   V90 Table 11 col 5

1.5mm² ← 28A   1.5mm² cable size.

Protective ~~40A~~ 32A

Scenario 2 29A, Two cores + earth V90 TPS copper. Perforated cable tray bundled with three other ckts.

Table 3.1 Item 9. Derate table 24

Table 10/11 — col 2-4 — Table 12 col 2/3.

Table 24 Touching

1 row — Item 7 — 4 cables — 0.78   ∴ $I = \frac{29}{0.78}$ = 37.17

V90 Table 11 4mm² ← 45

Current rating of CB shall not be greater than cable current carrying capacity

Scenario 3 - 50A, 2x SDI V90 copper cable.

Clipped to a surface passing into a cavity where they become partially surrounded by thermal insulation for 350mm along their length. 3(2)

2x SDI - Item 3 Derate Table 22

Table 4/5 col 17-19 Table 6 col 13

~~64A~~ Derate = 1 only 1 cct

40A Table 5 col 13

50A → 64A → 10mm²

Scenario 4

15A, 2x TPI copper cable In a pvc conduit with one other cct cast directly into concrete structure in building.

2 single core / enclosed

~~20A~~ Table 3(2) Item 2 Derate

~~16A~~ Table 7/8 col 15-17, Table 9 col 11/12 Table 22

13A single layer on wall floor Touching Item 3

2cct Derating factor = 0.85

Current = $\frac{15}{0.85}$ = 17.64 Amp.

Table 8. 17.64A → 1.5mm²

Scenario 5 22A Two cores & earth V90 TPS

Laid directly on a plastered board ceiling in open air where ambient air temperature is 50°C.

3(1) Item 12

Table 10/11 → col 5 → 7 | Table 12 col 4/5

CB 20A Derate Table 22 V90

(1.5mm²) 22A CB 20A

Scenario 6 78A, 2 cores & Earth V90 circular TPS copper cable. Suspended from a catenary in air, grouped with two other circuits where the ambient temperature is 35°C

3(1) Table 10/11 col 2 & 3

Item 9 Derating Table 22

Suspended from a catenary — Bunched in air / two other cct - 3 cct

Derating = 0.75

78/0.75 = 104A V90 - Table 11

col 2 104A → 16mm²

Scenario 7 100A Two core pvc twisted copper aerial cable / In air 1m/s wind where the ambient temperature is 40°C.

3(1) Table 11/12 col 2 → 4

Item 9 No derating.

∴ 100A → 16mm²

$I_B \leq I_N \leq I_Z$

I_B = maximum demand for the circuit

I_N = The nominal current of protective device

I_Z = continuous current carrying capacity of conductor.

Scenario 8 , Flexible.

400A, 4 x SDI x 90 copper cable

Trefoil on cable ladder, in open air where the ambient air temp is 40°C

4 x single core SDI

AS/NZS 3008 CCC Table column 3(1) Item 1

Table 4/5 col 2 - 4

Derating - Table 23

800 Table 6 col 2/3

Ladder - Item 8 - Trefoil - 1 cct/row = 0.95

90 - Table ∴ I = 400/0.95 = 421A

5 SDI - cu flexi 421A → 433 → 150mm²

Secnario 9

35A, 3cores & Earth circular V90 TPS copper cable
In the wall cavity of a house, completely surrounded by thermal insulation.

Table 3(2) 3cores. completely surrounded
Item 6
Table 4(5 col 20 → 21 | derate tables
6 → col 14.

Bunchon surface, enclose - Item 2 1 cct = 1
35A. V90 - Tables 35A → 43 A → 16 mm²

Secnairo 10 4 SDI - 4 singlecore SDI

180A; 4×SDI V90 copper cable
underground in a conduit at a depth of 500mm where ground temperature is 25°C Thermal resistivity 1.2°C per/m/watt.

Table 3(4) Item 4 → Table 13/14 col 29 - 27
Table 9 col 4/11
Derating → Table 26(1)
cct 1 - ~~Touching~~ - ~~0.74~~
I - 180/~~0.74~~ = ~~243.2~~ Amp 180A → 193A
V90 - Item(5) ~~243.2A~~ → ~~Amp~~ → 70mm²
~~col 29~~ col 25

Secnario 11

85A, 4core XLPE Aluminium cable
Buried directly in the ground at a depth of 500mm with ground temperature of 25°C.

~~85A~~, Table 3(3) 4 core Item 4 - Table 13/14 - col 23/24
Table 15 col 13
Derating Table 25(2) only one cct No derating
XLPE ? (13) - TPS, (14) - X, (15) - R
XLPE → Table 14
Aluminium - col 24. 85A → 16mm²

Secnario 12

30A 3×SDI copper cable. flexi ~~Inclosed~~
Inclosed trunking with 5 other cct ambient tep 45c
Table 3(2)
3 singlecore - (no insulation) Item 2 → Table 7/9
col 15 - 17
Table 9 col 11/12
Derating Table 22

Table 22 Enclose Item 2 - 6 cct => 0.57
∴ $\frac{30}{0.57}$ = 52.6 Amp

Table 7 - TPS. Table 8 XLPE Table 9 RAF, RC
SDI - Serial Digital Interface
RAS9 ∴ Table 9 Flexi: col 12
∴ 52.6A → 70A → 10mm²

Secnairo 13
100A 4cores twisted XLPE Aluminium cable
Still Air tep 45c

∴ Table 3(1) Item 10. derate 24. one cct derate 9
Table 13/14 col 2-4 Table 15 col 2-3
XLPE Table 14
100A - 116A - 35mm²

Secnario 14

272A 4×SDI RE1f110 Flexi Trefoil cableladder
~~It~~ Table 3(1) -
3core - Item 10 Table 13/14 - col 2-4
Table 15 col 2/3
110 → Table 15 col 3 SDI - Flexi
272A → 70mm²

(6.2) Select cables based on voltage drop limitations

1φ voltage drop

(1) 2.5mm², multicore V90 TPS Cu 20A 24m 1φ
Table 42 col 8
1.61 mV/A-m

$V_d = \frac{V_c L I}{1000} = \frac{2}{\sqrt{3}} \times \frac{1.61 \times 24 \times 20}{1000} = 0.7728V \times 1.15$
$= 0.8887V$

(2) 6mm², multicore V90 TPS Cu 38A 34m
as above

(3) 16mm², SDI V90 Cu in conduit 86A, 38m
wiring Enclosure, flexible — SDI
Table 47, 90°C — column 8

SDI
Table 41, col 8
$16mm^2 = 2.53 \times 1.15$ 16mm² — 2.68
$= 2.907$
$V_d = \frac{2.907 \times 38 \times 86}{1000} = 9.49$ | $\therefore V_d = \frac{V_c L I}{1000} = \frac{2}{\sqrt{3}} \frac{2.68 \times 38 \times 86}{1000} = 8.75V \times 1.15$
$= 10.06V$

(4) 4mm², SDI V90 Cu Trunking 32A, 12m
Table 41 col 8
$10.9 \times 1.155 = 12.58$
Table 47 col 8
4mm² — 10.9
$V_d = \frac{12.58 \times 32 \times 18}{1000} = 7.25V$
$V_d = \frac{V_c L I}{1000} = \frac{10.9 \times 32 \times 18}{1000} \times \frac{2}{\sqrt{3}} = 6.27V \times 1.15$
$= 7.21V$

(5) 1.5mm², multicore V90 TPS Cu 10A 27m
Table 42 col 8
1.5mm² → 30.0

$V_d = \frac{V_c L I}{1000} = \frac{30 \times 27 \times 10}{1000} = 8.1V \times \frac{2}{\sqrt{3}} = 9.35V$

(1) 3φ voltage drop

120mm², four X90 single Laid Trefoil, 350A/Ph
Table 40 62m
X90 – 90°C – col 8

$V_c =$ 120mm² → 0.373

$V_d = \frac{V_c L I}{1000} = \frac{0.373 \times 62 \times 350}{1000} = 8.09V$

(2) 6mm², multicore V90 TPS Cu 38A 34m
Table 42 col 8 6mm² → 6.8 $V_d = \frac{6.8 \times 34 \times 38}{1000} = 8.78V$

(5.2)

= 3 conditions affecting current carrying capacity of cable.
3.3.2.1 Ambient temperature
3.3.2.2 External heat source
3.3.2.3 Thermal insulation

— MIMS cable Normal operating Temperature
Table 3.2 100°C

— X90 Normal operating Temperature 90°C

— 4 conditions applied for derating of cable
- Groups
- Uniform group (load) not equally loaded — AS3008 Table 23 footnote
- Layers
- Spacing

— What installation condition should be assumed when selecting cables to be installed in the wall cavity of a house? why?
- minimum cable separation in air
- Supporting
- Touching
ventilated trench or open trunking, buried directly in plaster render or in the switchboard.

AS3008 Table 3(1) col 5.

3 $16mm^2$, SDI flex V90 Cu in conduit, 86A, 38m.
wiring enclosure

for SDI Table 41 col 8 — Table 47 col 8

$16mm^2 \rightarrow 2.55$ — $16mm^2 \longrightarrow 2.68$

$\frac{2.55 \times 38 \times 86}{1000} = 8.17V$

$Vd = \frac{Vc L I}{1000} = \frac{2.68 \times 38 \times 86}{1000} = 8.75V$

4 $4mm^2$, SDI flex V90 Cu in Trunking, 32A, 18m.

Table 41 col 8 — Table 47 col 8

$4mm^2 - 10.2$ — $4mm^2 \longrightarrow 10.9$

$Vd = \frac{10.2 \times 32 \times 18}{1000} = 5.87V$

$Vd = \frac{10.9 \times 32 \times 18}{1000} = 6.278V$

5 $1.5mm^2$ multicore V90 TPS Cu 10A, 27m

Table 42 col 8

$1.5mm^2 \longrightarrow 30$ mV/A-m $Vd = \frac{30 \times 10 \times 27}{1000} = 8.1V$

6 $120mm^2$ four X-90 singles laid in trefoil, 350A/Ph 62m

Table 40 col 8

$120mm^2 \longrightarrow 0.373$ $Vd = \frac{0.373 \times 350 \times 62}{1000}$

$= 8.09V$

7 $10mm^2$, multiple core V90 TPS Cu 40A/Ph 50m

As above Table 40 col 8

$10mm^2 \longrightarrow 4.05$ $Vd = \frac{4.05 \times 40 \times 50}{1000} = 8.1V$

8 $50mm^2$, single core MIMS on cable Tray, 200A/Ph 56m

Table 49 90c → col 8

$50mm^2 \longrightarrow 0.775$ mV/A-m $Vd = \frac{Vc L I}{1000}$

$= \frac{0.775 \times 200 \times 56}{1000}$

$= 8.68V$

9 $16mm^2$, ~~four~~ four core twisted Cu XLPE aerial 80A/Ph, 22m

Table 50, at 90 C

2.59 mV/A-m

$Vd = \frac{Vc L I}{1000} = \frac{2.59 \times 22 \times 80}{1000} = 4.55V$

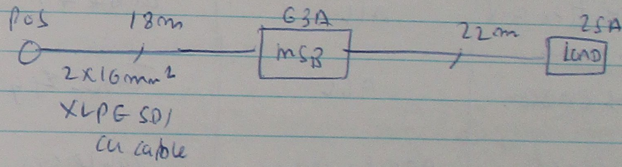
10 $4mm^2$, multicore V90 TPS Cu 25A/Ph 78m

Table 42 col 8

$4mm^2 \longrightarrow$ 90°c 10.2 mV/A-m

$Vd = \frac{Vc L I}{1000} = \frac{10.2 \times 25 \times 78}{1000} = 19.89V$

Pb Select 1φ cable based on current carrying capacity and voltage drop.



Two cores V90 TPS Cu cable clipped directly to timber frame of the building

Consumer mains $16mm^2$, Final subcircuit 25A V90 TPS Cu cable clipped to timber frame.

Table 3(7) Two cores clipped directly to timber frame

Item 12 — Table 10/11 col 5-7, Table 12 col 4/5

Derating Table 22 — only one circuit Derate = 1

V90 — Table 11 column 8

$25A - 27A \longrightarrow 2.5mm^2$

Table 42. Two cores col 8

$2.5mm^2 \rightarrow 16.4 \times 1.155$ 1φ

$Vd = \frac{Vc L I}{1000} = \frac{16.4 \times 1.155 \times 22 \times 25}{1000}$

$= 10.4V$