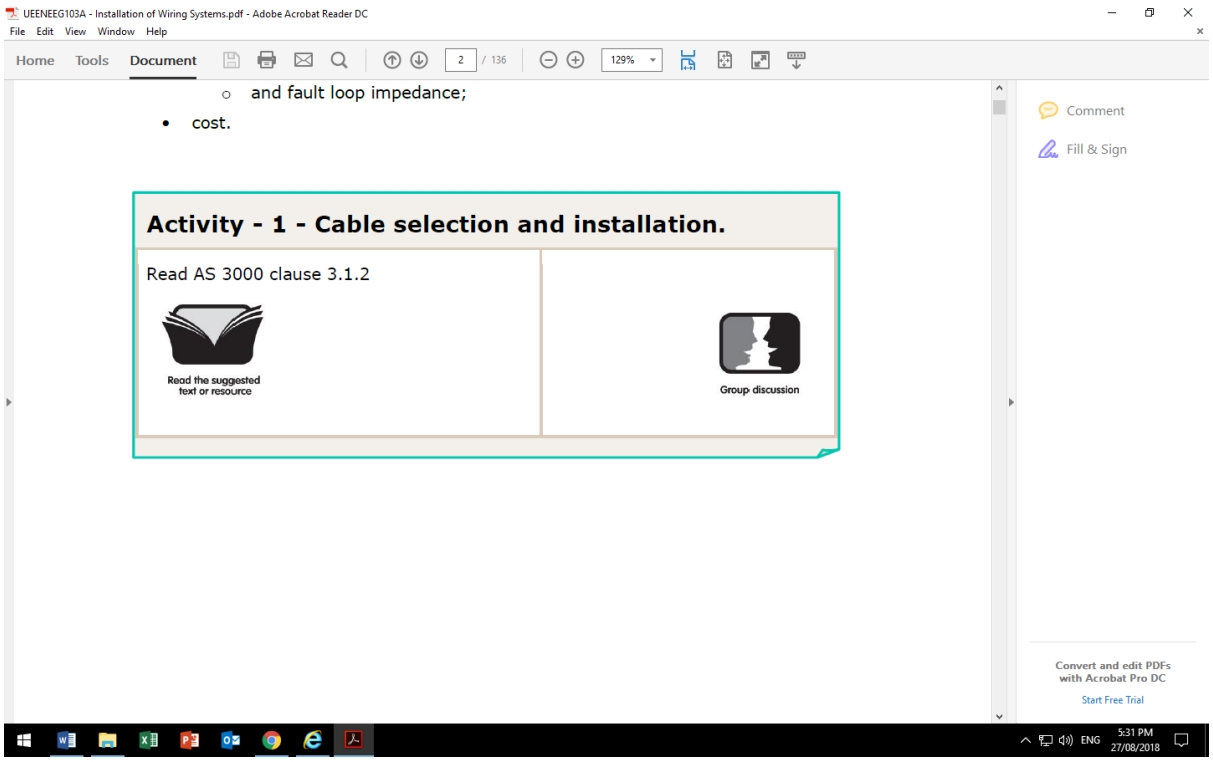



3.1.2 Selection and installation

Wiring systems shall be selected and installed to perform the following functions or have the following features:

(a) Protect against physical contact with live parts by durable insulation materials or by placing live parts out of reach.

(b) Satisfy current-carrying capacity, voltage drop and other minimum size requirements for conductors.

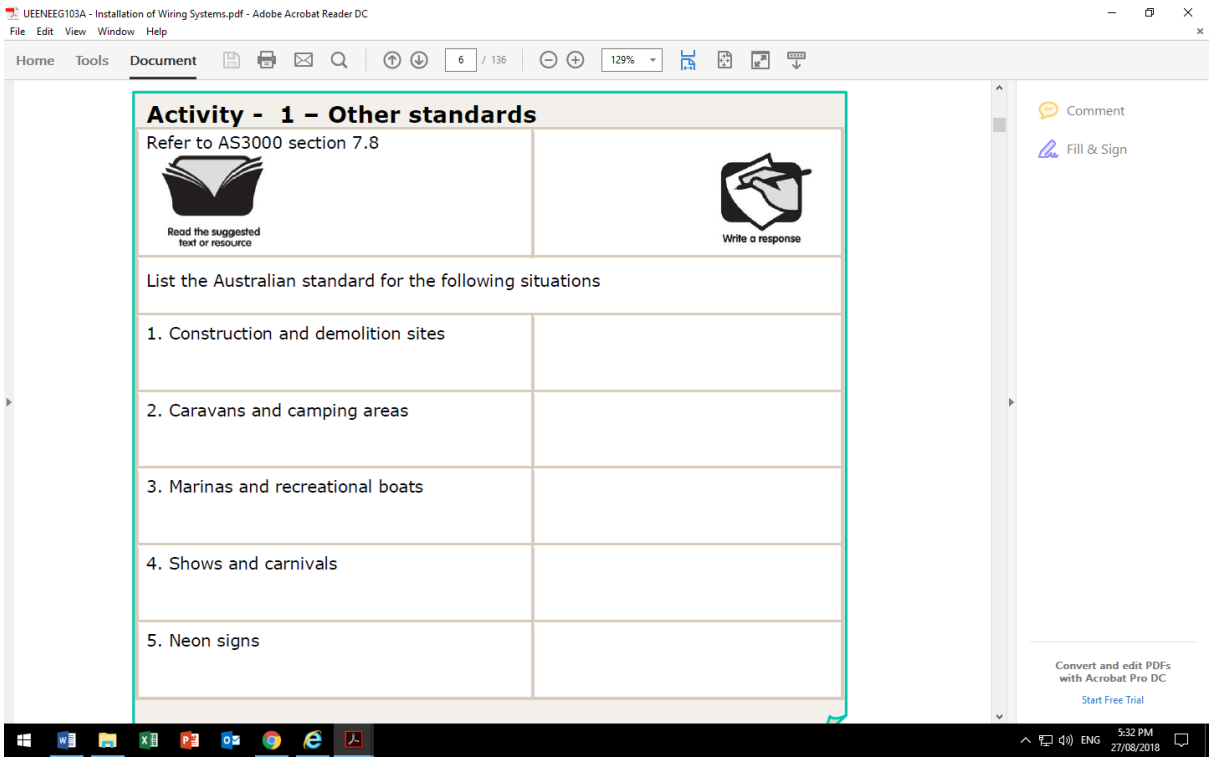
(c) Provide reliability and electrical continuity of connections, joints and terminations.

(d) Provide adequate strength of supports, suspensions and fixings.

(e) Suit intended use, including applications requiring a particular type of wiring system, e.g. fire-resistance, explosion protection, safety services.

(f) Protect against mechanical damage, environmental and other external influences by enclosure or other means.

(g) Installed in accordance with the requirements of this Section and the additional requirements as specified in the manufacturer's instructions.




These requirements include references to Standards to provide–

(a) additional requirements of this Standard listed in Clause 7.8.2;

(b) requirements that, when fully satisfied, are deemed to comply with this Standard listed in Clause 7.8.2.18; and

(c) guidance for specific electrical installations and situations, listed in Clause 7.8.3, compliance with which is not required by this Standard but may be required by relevant regulatory authorities.

The method of applying these and other Standards varies in the different jurisdictions.

7.8.2 Standards containing additional requirements

7.8.2.1 Construction and demolition sites

Electrical installations for construction and demolition sites shall comply with AS/NZS 3012.

7.8.2.2 Electromedical treatment areas

Electrical installations in electromedical treatment areas (including home patient areas) shall comply with AS/NZS 3003.

7.8.2.3 Transportable structures and vehicles including their site supplies

Electrical installations in transportable structures and vehicles including their site supplies shall comply with AS/NZS 3001.

7.8.2.4 Marinas and recreational boats

Electrical installations in marinas and recreational boats shall comply with AS/NZS 3004.

NOTES:

1 AS/NZS 3004 is a two-part Standard as follows:

(a) AS/NZS 3004.1 provides requirements for electrical installations on marinas.

(b) AS/NZS 3004.2 provides requirements for electrical installations in

recreational boats.
2 In Australia, for electrical installations on commercial vessels, refer to the Australian Maritime Safety Authority, National Marine Safety Committee's National Standard for Commercial Vessels, Part C: Design and construction-Section 5: Engineering-Subsection 5B: Electrical (NSCV C 5B).

7.8.2.5 Shows and carnivals

Electrical installations in shows and carnivals shall comply with AS/NZS 3002.

7.8.2.6 Telecommunication network power supplies

Extra-low voltage (d.c.) power supply installations within public telecommunication networks shall comply with AS/NZS 3015.

7.8.2.7 Cranes and hoists

Electrical installations for cranes and hoists shall be in accordance with the applicable requirements of this Standard.

NOTE: Such electrical installations may be subject to the requirements of the AS 1418 series or other requirements of the relevant regulatory authorities.

7.8.2.8 Lifts

Electrical installations for lifts shall be in accordance with the applicable requirements of this Standard.

NOTES:
1 See Clause 7.2.3.4 for requirements affecting the control and arrangement of special lift installations.
2 Such electrical installations are within the scope of the AS 1735 series and compliance therewith may be required by the relevant regulatory authorities.

Neon

7.8.2.9 High voltage installations

* In Australia, high voltage electrical installations shall comply with AS 2067.

In New Zealand, high voltage installation shall comply with the New Zealand Electricity (Safety) Regulations

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## Activity - 2 - Calculation of sub-mains maximum demand (construction sites)

Use AS3000 to calculate the maximum demand in the consumer's mains in a construction site with the flowing load;

Write a response

30 – 500W Halogen flood lights rated at 2.0A each (3 circuits)

20 - twin 36W fluorescent lights 0.333A each (1 circuit)

12 - 10A double single phase socket outlets (3 circuits 4 points per)

4 - 20A three phase socket outlets

2 – 32A 3 phase outlets.

| Load Group | Load | Calculation | A | B | C |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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WELCOME TO THE JUNGLE GOAT FUCKERS

TABLE C1 (*continued*)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Load group | Single domestic electrical installation or individual living unit per phase[1] | Blocks of living units[1, 2, 3] 2 to 5 living units per phase | 6 to 20 living units per phase | 21 or more living units per phase |
| | | Loading associated with individual units | | |
| (c) Ranges, cooking appliances, laundry equipment or socket-outlets rated at more than 10 A for the connection thereof[8] | 50% connected load | 15 A | 2.8 A per living unit | |
| (d) Fixed space heating or airconditioning equipment, saunas or socket-outlets rated at more than 10 A for the connection thereof[8, 11] | 75% connected load | 75% connected load | 75% connected load | |
| (e) Instantaneous water heaters:[12] | 33.3% connected load | 6 A per living unit | | 100 A + 0.8 A per living unit |
| (f) Storage water heaters[13] | Full-load current | 6 A per living unit | | 100 A + 0.8 A per living unit |
| (g) Spa and swimming pool heaters | 75% of the largest spa, plus 75% of the largest swimming pool, plus 25% of the remainder | | | |
| (h) Communal lighting[6, 7] | Not applicable | Full connected load | | |
| (i) Socket-outlets not included in load groups (j) and (m) below[8, 10, 14] Permanently connected electrical equipment not exceeding 10 A | Not applicable | 2 A per point, up to a maximum of 15 A | | |

(*continued*)







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TABLE C1 (*continued*)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **Load group** | **Single domestic electrical installation or individual living unit per phase[1]** | **Blocks of living units[1, 2, 3]** | | |
| | | **2 to 5 living units per phase** | **6 to 20 living units per phase** | **21 or more living units per phase** |
| | | **Loading associated with individual units** | | |
| (j) Appliances rated at more than 10 A and socket-outlets for the connection thereof— | | | | |
| (i) Clothes dryers, water heaters, self-heating washing machines, wash boilers[8] | Not applicable | 50% connected load | | |
| (ii) Fixed space heating, airconditioning equipment, saunas[11] | Not applicable | 75% connected load | | |
| (iii) Spa and swimming pool heaters | Not applicable | 75% of the largest spa plus 75% of the largest swimming pool, plus 25% of the remainder | | |
| * (iv) Charging equipment associated with electric vehicles | Fully connected load | 100% connected load | 90% connected load | 75% connected load |
| (k) Lifts | In accordance with Paragraph C2.4.1 and Table C2 | In accordance with Paragraph C2.4.1 and Table C2 | | |
| (l) Motors | In accordance with Paragraph C2.4.1,and Table C2, Column 2 | In accordance with Paragraph C2.4.1 and Table C2, Column 2 | | |
| (m) Appliances, including socket-outlets other than those set out in load groups (a) to (l) above, e.g. pottery kilns, welding machines, radio transmitters, X-ray equipment and the like | Connected load 5 A or less—no assessment for purpose of maximum demand | Connected load 10 A or less—no assessment for purpose of maximum demand | | |
| | Connected load over 5 A—by assessment | Connected load over 10 A—by assessment | | |

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## Activity - 3 – Maximum demand / cable selection

| Refer to AS3001 clause 2.2.5 | |
|---|---|
| Read the suggested text or resource | Write a response |
| 1. Determine the maximum demand of a single phase sub-main supplying 12 x 15A socket outlets in service pillars suitable for light duty load. | |
| 2. Select the minimum rating of a circuit breaker to protect the sub-main | |
| 3. The sub-main is to be wired in V75 TPI cable in H.D. PVC U.G. conduit at a depth of 1.0m. Determine the minimum required cable size? | |
| Table Number 3(?) / Item Number | |
| Table Numbers / Column Numbers | |
| De-rating factors | |
| Table Numbers / Column Numbers | |
| Required Current Carrying Capacity | |
| Required Cable size | |
| **Coordination between conductors and protective devices (AS3000 2.5.3.1)** | |
| $I_B$ = Maximum demand current | |
| $I_N$ = Nominal current rating of the selected protective device | |
| $I_z$ = Current Carrying Capacity of cable after any de-rating has been applied. | |
| Is $I_B \leq I_N \leq I_z$? | |

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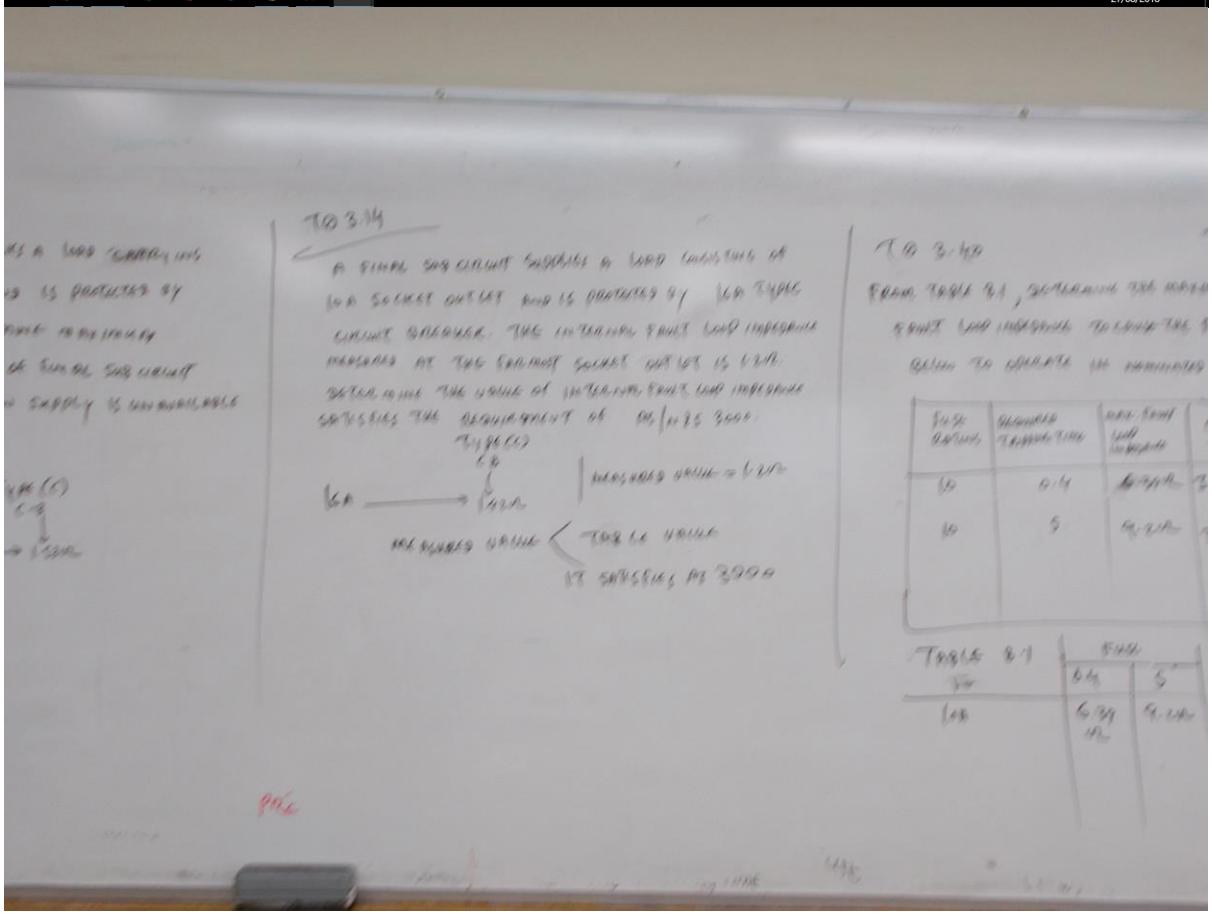
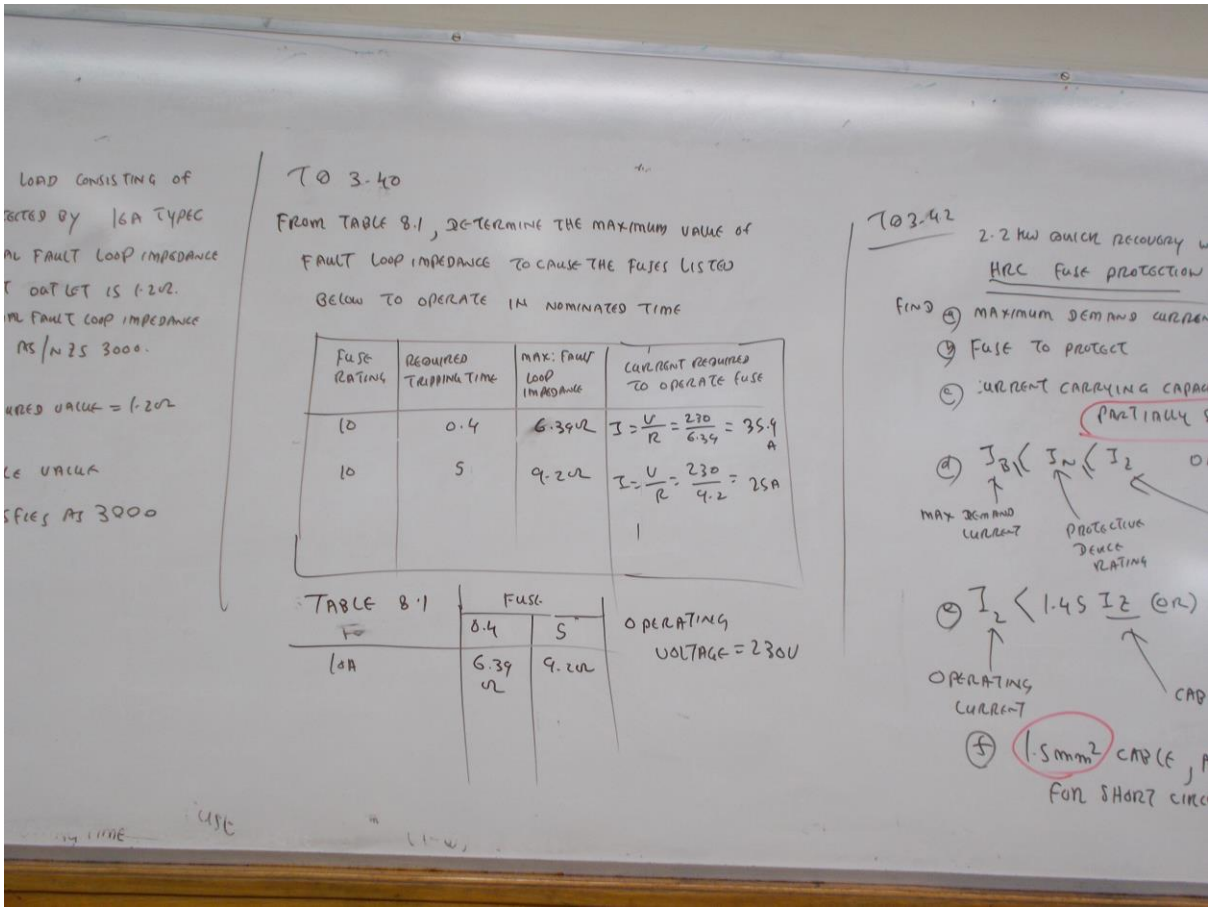
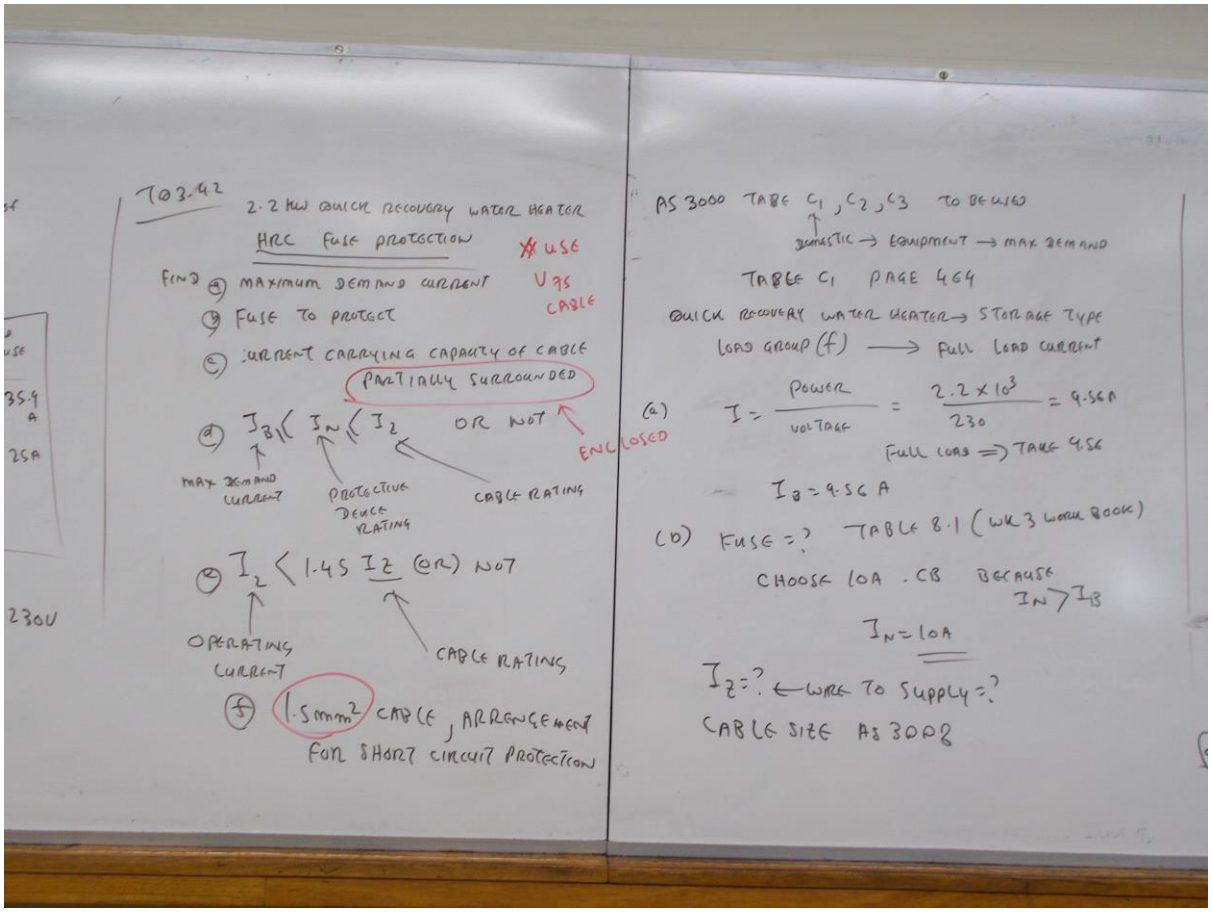
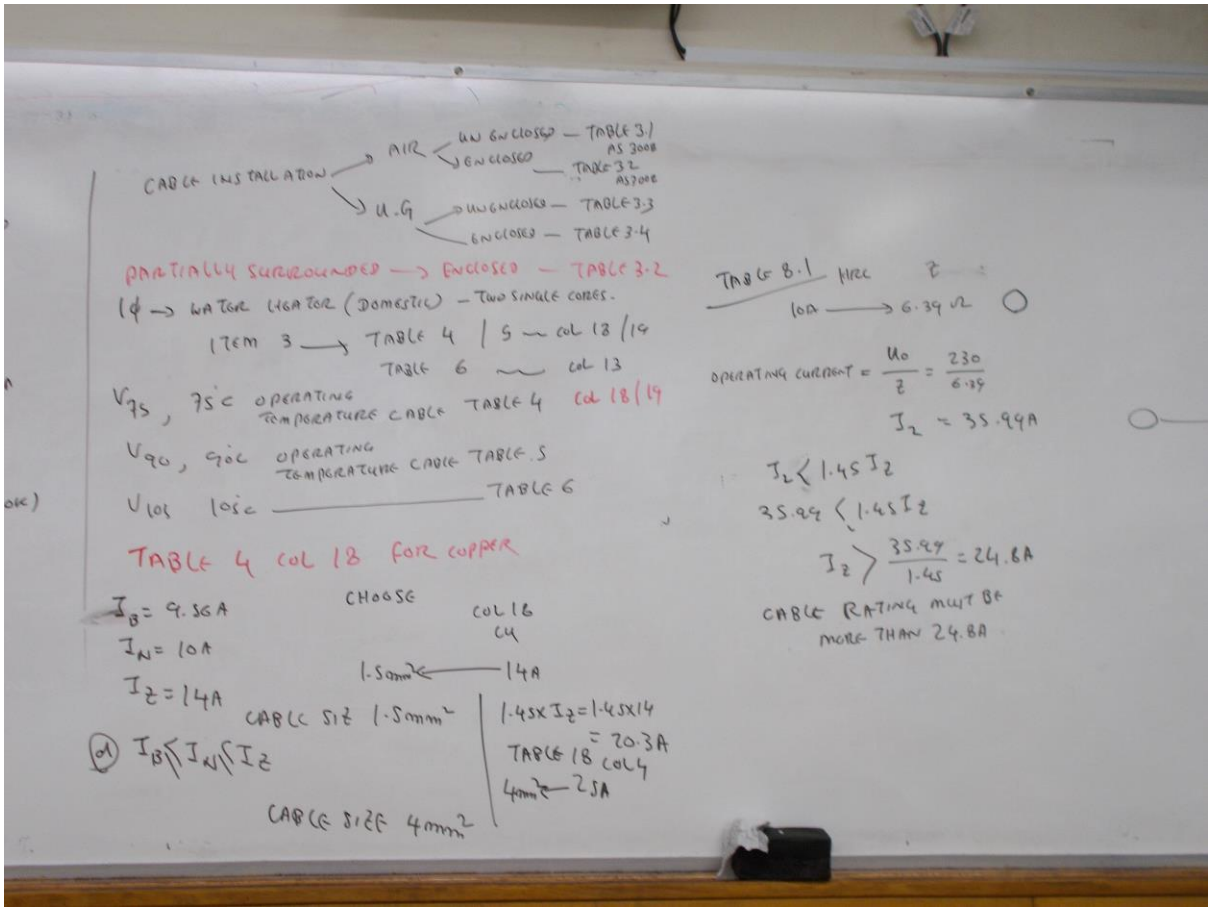



LOAD CONSISTING OF
TO 3.40
FROM TABLE 8.1, DETERMINE THE MAXIMUM VALUE OF FAULT LOOP IMPEDANCE TO CAUSE THE FUSES LISTED BELOW TO OPERATE IN NOMINATED TIME
FUSE RATING | REQUIRED TRIPPING TIME | MAX. FAULT LOOP IMPEDANCE | CURRENT REQUIRED TO OPERATE FUSE
10 | 0.4 | 6.39Ω | I = V/R = 230/6.39 = 35.9 A
10 | 5 | 9.2Ω | I = V/R = 230/9.2 = 25A
TABLE 8.1
FUSE
0.4
5
10A
6.39 Ω
9.2Ω
OPERATING VOLTAGE = 230V
TO 3.42
2.2 KW QUICK RECOVERY
HRC FUSE PROTECTION
FIND a) MAXIMUM DEMAND CURRENT
b) FUSE TO PROTECT
c) CURRENT CARRYING CAPAC
PARTIALLY
d) $I_B$ ( $I_N$ ( $I_Z$
MAX DEMAND CURRENT
PROTECTIVE DEVICE RATING
e) $I_2$ < 1.45 $I_Z$ (OR)
OPERATING CURRENT
CAB
f) 1.5mm² CABLE
FOR SHORT CIRC


TO 3.42
2.2 KW QUICK RECOVERY WATER HEATER
HRC FUSE PROTECTION
USE
FIND a) MAXIMUM DEMAND CURRENT
b) FUSE TO PROTECT
c) CURRENT CARRYING CAPACITY OF CABLE
PARTIALLY SURROUNDED
d) $I_B$ ( $I_N$ ( $I_Z$ OR NOT
ENCLOSED
MAX DEMAND CURRENT
PROTECTIVE DEVICE RATING
CABLE RATING
e) $I_2$ < 1.45 $I_Z$ (OR) NOT
OPERATING CURRENT
CABLE RATING
f) 1.5mm² CABLE, ARRENGEMENT
FOR SHORT CIRCUIT PROTECTION
AS 3000 TABLE C1, C2, C3 TO BE USED
DOMESTIC → EQUIPMENT → MAX DEMAND
TABLE C1 PAGE 464
QUICK RECOVERY WATER HEATER → STORAGE TYPE
LOAD GROUP (f) → FULL LOAD CURRENT
(a) I = POWER / VOLTAGE = 2.2 × 10³ / 230 = 9.5A
FULL LOAD ⇒ TAKE 9.5C
$I_B$ = 9.5C A
(b) FUSE = ? TABLE 8.1 (WK 3 WORK BOOK)
CHOOSE 10A . CB BECAUSE $I_N > I_B$
$I_N$ = 10A
$I_Z$ = ? ← WIRE TO SUPPLY = ?
CABLE SIZE AS 3008






## *Tutorial 13*

1. The Australian standard specific to construction and demolition sites is;
(a) AS 3000

(b) AS 3001

(c) AS 3004

(d) AS 3012

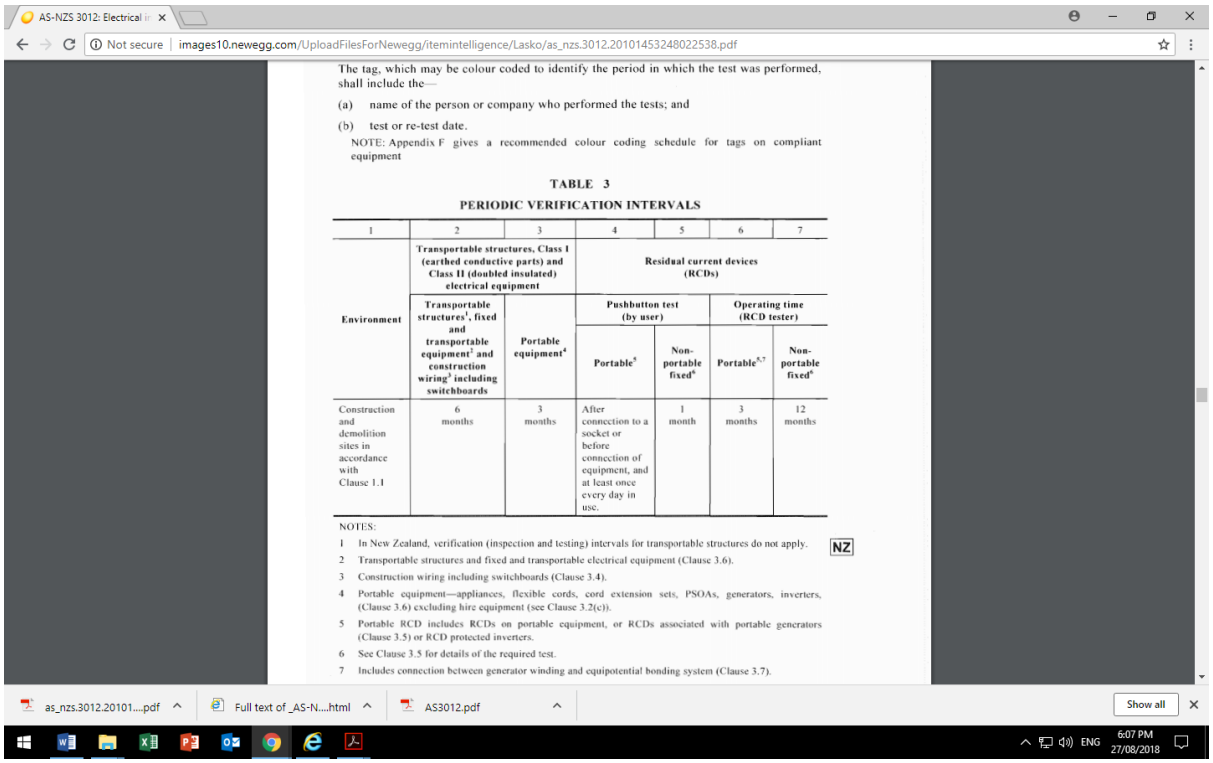
2. The Australian standard specific to camping and caravan sites is;
(a) AS 3000
(b) AS 3001
(c) AS 3004
(d) AS 3012

3. According to Australian standards extension leads used on construction sites must be tested and tagged;
(a) daily

(b) monthly

(c) every 3 months

(d) yearly



The tag, which may be colour coded to identify the period in which the test was performed, shall include the—

(a) name of the person or company who performed the tests; and

(b) test or re-test date.

NOTE: Appendix F gives a recommended colour coding schedule for tags on compliant equipment

TABLE 3

PERIODIC VERIFICATION INTERVALS

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Environment | Transportable structures, Class I (earthed conductive parts) and Class II (doubled insulated) electrical equipment | | Residual current devices (RCDs) | | | |
| | Transportable structures[1], fixed and transportable equipment[2] and construction wiring[3] including switchboards | Portable equipment[4] | Pushbutton test (by user) | | Operating time (RCD tester) | |
| | | | Portable[5] | Non-portable fixed[6] | Portable[5,7] | Non-portable fixed[6] |
| Construction and demolition sites in accordance with Clause 1.1 | 6 months | 3 months | After connection to a socket or before connection of equipment, and at least once every day in use. | 1 month | 3 months | 12 months |

NOTES:

1 In New Zealand, verification (inspection and testing) intervals for transportable structures do not apply. NZ

2 Transportable structures and fixed and transportable electrical equipment (Clause 3.6).

3 Construction wiring including switchboards (Clause 3.4).

4 Portable equipment—appliances, flexible cords, cord extension sets, PSOAs, generators, inverters, (Clause 3.6) excluding hire equipment (see Clause 3.2(c)).

5 Portable RCD includes RCDs on portable equipment, or RCDs associated with portable generators (Clause 3.5) or RCD protected inverters.

6 See Clause 3.5 for details of the required test.

7 Includes connection between generator winding and equipotential bonding system (Clause 3.7).

4. According to Australian standards fixed R.C.D.s installed on construction sites must be tested using the trip button;
(a) daily

(b) monthly

(c) every 3 months

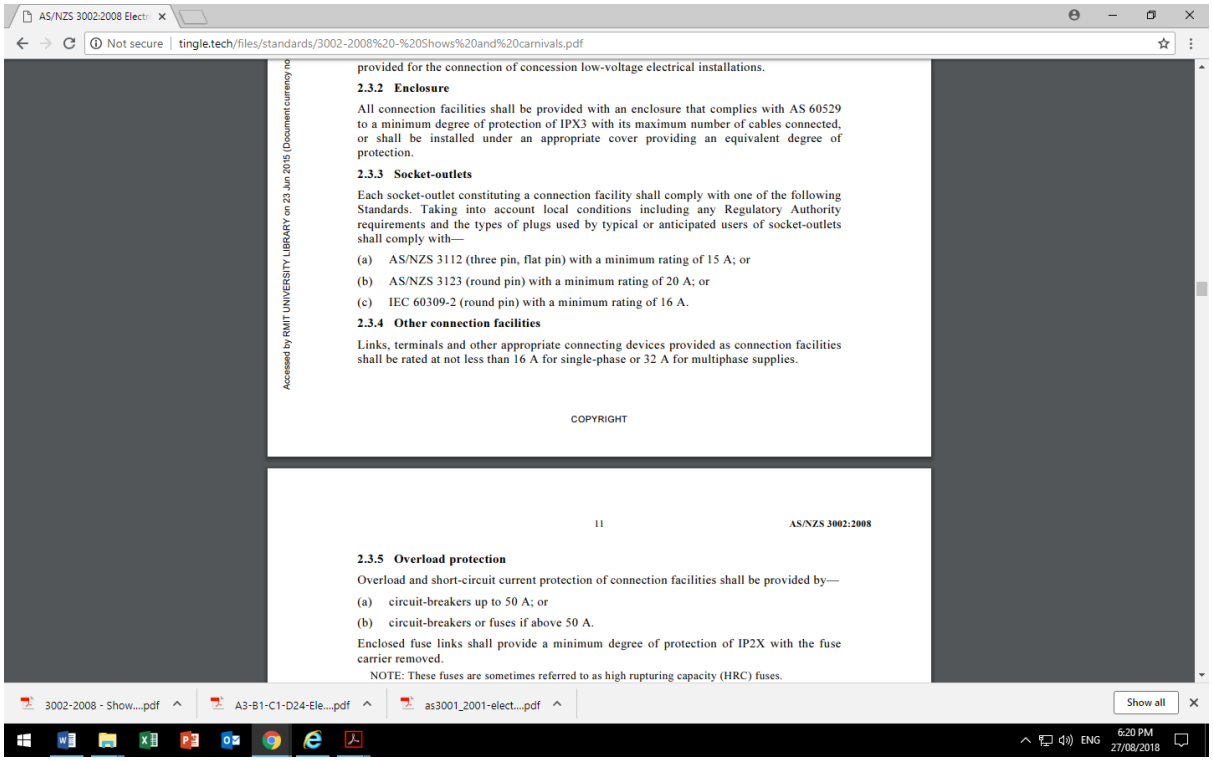
(d) yearly

5. The minimum current rating of the circuit breaker protecting a caravan site final sub-circuit is:-
(a) 8 A;

(b) 10 A;

(c) 16 A;

(d) 20 A.




6. A suitable underground wiring system for a caravan park where pegs are not likely to be driven is:-

(a) category A at a depth of 0.5m

(b) category A at a depth of 1.0m

(c) category A at a depth of 1.5m

(d) category A at a depth of 2.0m.

7. A suitable underground wiring system for a caravan park where pegs greater than 400mm are likely to be driven is:-

(a) category A at a depth of 0.5m

(b) category A at a depth of 1.0m

(c) category A at a depth of 1.5m

(d) category A at a depth of 2.0m.

**2.1.2 Underground wiring**

Underground wiring should, where possible, be installed where pegs or anchor stakes are not likely to be driven.

If installed where pegs or anchor stakes are likely to be driven, the following requirements shall apply further to those of AS/NZS 3000.

(a) The cable shall be located at a depth of not less than 1.5m.

8. A type of cable not suitable for overhead wiring in a caravan park is:-
(a) hard drawn bare copper;

(b) orange circular on a catenary cable

(c) neutral screened;

(d) parallel webbed

**3.4 WIRING SYSTEM**
**3.4.1 Size and type of cable**
Fixed wiring forming part of the electrical installation within registrable relocatable premises shall consist of multi-stranded insulated and sheathed cables or flexible cords having not less than seven strands and a conductor cross-sectional area of not less than 1 $mm^2$.
Particular care should be taken to preserve double insulation or the equivalent between the live (active and neutral) conductors of all wiring and electrical equipment not protected by an RCD and any conductive material.

9. The minimum height above ground level for overhead wiring above a caravan park roadway is:-
(a) 6.0 m;

(b) 5.5 m;

(c) 4.5 m;

(d) 4.1m.

**2.1.3 Overhead wiring**
Further to the requirements for aerial wiring specified in AS/NZS 3000, overhead wiring shall be installed so that cables are maintained at a height of not less than 6 m above the ground or relevant elevated area and located at a minimum of 2 m outside the vertical plane extending from the horizontal boundary of any site. Overhead wiring shall consist of either—

(a) insulated aerial conductors; or
(b) cable supported by a catenary.
NOTE: In the interests of safety, underground

10. The minimum mounting height of a caravan park site non lockable switch board is:-
(a) 1.6m;

(b) 1.2m;

(c) 0.9 m;

(d) 0.6m.

**2.3.2.4.7** *Height of socket-outlets and associated devices*
Each socket-outlet and each associated circuit-breaker, RCD and operating switch mounted on or in a service pillar shall be located not less than 0.8 m and not more than 1.5 m above the surface on which an operator would stand.

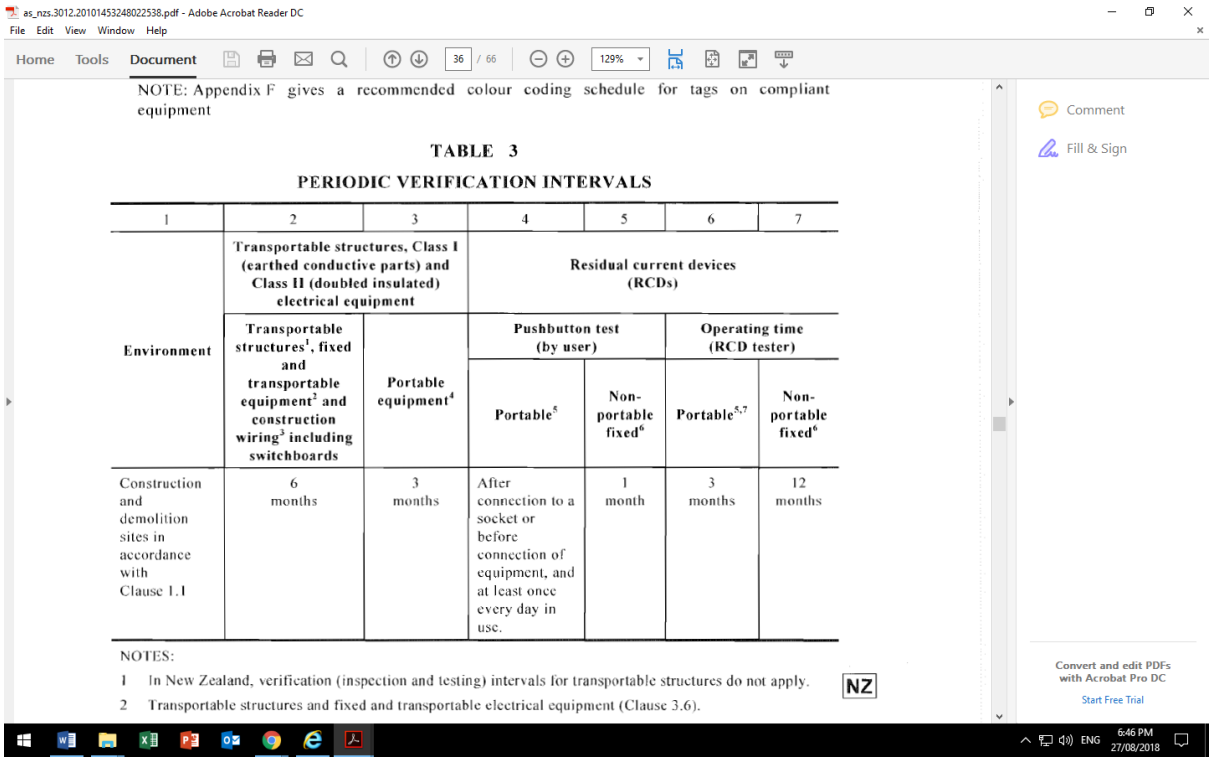
11. Describe a suitable method and frequency for testing a portable RCD on a building site by a qualified person.

_____

Reference _____ (Clause number _____)

3.4.2 Periodic verification
Construction wiring (including switchboards and transportabLe structures) shall be visually inspected to verify the integrity of the installation at intervals not exceeding those specified in Table 3. RCDs shall be tested in accordance with Clause 3.5. Faults shall be rectified in accordance with Clause 3.8.1.

In New Zealand only, complete a construction and demolition verification certificate after INZI completion of the verification detailed in Clause 3.4.2 .



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NOTE: Appendix F gives a recommended colour coding schedule for tags on compliant equipment

**TABLE 3**

**PERIODIC VERIFICATION INTERVALS**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Environment | Transportable structures, Class I (earthed conductive parts) and Class II (doubled insulated) electrical equipment | | Residual current devices (RCDs) | | | |
| | Transportable structures[1], fixed and transportable equipment[2] and construction wiring[3] including switchboards | Portable equipment[4] | Pushbutton test (by user) | | Operating time (RCD tester) | |
| | | | Portable[5] | Non-portable fixed[6] | Portable[5,7] | Non-portable fixed[6] |
| Construction and demolition sites in accordance with Clause 1.1 | 6 months | 3 months | After connection to a socket or before connection of equipment, and at least once every day in use. | 1 month | 3 months | 12 months |

NOTES:

1 In New Zealand, verification (inspection and testing) intervals for transportable structures do not apply. NZ

2 Transportable structures and fixed and transportable electrical equipment (Clause 3.6).

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12. Describe a suitable method for fixing TPS cable to a catenary wire, to form a catenary wiring system.

_____

Reference _____ (Clause number _____)

2.5.8 Cables supported by a catenary
Cables supported by means of a catenary shall be stranded or flexible cables affording double insulation or the equivalent of double insulation.

13. Is it permitted to cable tie construction wiring to the mesh of free standing temporary fencing?

_____

Reference _____ (Clause number _____)

No

2.5.3 Protection against mechanical damage
A risk assessment should be undertaken, prior to the installation of cables or whenever a change occurs, as to the likelihood of the cables being exposed to mechanical damage.
Where the risk assessment identifies a risk of damage to cables, and the cables cannot be relocated to an alternative position. they must be protected by a suitable enclosure or barrier not less effective than-
(a) medium duty rigid or corrugated conduit of insulating material; or
(b) heavy duty rigid or corrugated conduit of insulating material; or
(c) flexible electrical hose; or
(d) armoured cable; or
(e) other means that provide equivalent protection against mechanical damage.
AS/NZS 3000 provides guidance in Appendix H.

14. Describe a method used to prevent strain on the connection plug of a connection.

Reference _____ (Clause number _____)

2.6.9 Protection of flexible cords or cables
Flexible cords and cables shall not be subject to mechanical damage, damage by liquids or damage by high temperatures.
Where flexible cords or cables supplying electrical equipment are more than 4m in length or are not in view of the person using the electrical equipment, they shall be-
(a) provided with suitable protection against, or located where they are not subjected to, mechanical damage, damage by liquids or high temperature; or
(b) supported off the floor or ground on stands or hangers covered with material that is non-conducting and will prevent mechanical damage to the cable..

15. Is RCD protection mandatory for supplies on construction site?

Reference _____ (Clause number _____)

Yes

*2.4.6.1 Final sub-circuits o/'construction wiring*
A ll final sub-circuits of construction wiring shall be protected at the switchboard where the final sub-circuits originate by residual current devices, with a maximum rated residual current of 30 mA, that operate in all live (active and neutral) conductors. The final subcircuits shall be arranged--
(a) where the number of ReDs installed exceeds one; or
(b) where more than one lighting circuit is installed,
the lighting circuits shall be distributed between RCDs.
NOTE: This arrangement is intended to minimize the impact of the operation of a single ReD.
*Exceptions: Additional protection by an ReD need not* app˜v *to any o/the .fbllowillg types offinal sub-circuit:*
*(i) Final sub-circuits supplying electrical equipment where safe mechanical operation is at risk, e.g. electric cranes or personnel lifts.*
*(ii) Final sub-circuits where all appliances, luminaires and other electrical equipment are supplied/rom a directly connected SELV or PEL V source in accordance with the requirements ofA,)iNZS 3000/or extra low-voltage supply.*

16. What is the minimum height above ground level at which festoon lighting can be installed?

_____

Reference _____ (Clause number _____)

2.7.6 Festoon lighting

(a) Festoon lampholders shall be permanently moulded to their supply cable and shall be provided with a non-conductive mechanical guard for the lamp.

(b) The maximum permitted operating voltages for festoon lighting are:

(i) In Australia, extra-low voltage (:::;50 Va.c.).

(ii) In New Zealand, low voltage (e.g. 230 V a.c.) provided the circuit is protected by 30 mA ReDs, as detailed in Clause 2.4.6.

(c) Festoon lighting shall be supported at least 2.5 m above any floor, ground, platform or working area or be installed immediately below a ceiling.

17. What is the maximum permissible supply voltage for festoon lighting?

_____

Reference _____ (Clause number _____)

2.7.6 Festoon lighting

(a) Festoon lampholders shall be permanently moulded to their supply cable and shall be provided with a non-conductive mechanical guard for the lamp.

(b) The maximum permitted operating voltages for festoon lighting are:

(i) In Australia, extra-low voltage (:::;50 Va.c.).

18. What is the maximum permissible percentage voltage drop from the point of supply to socket outlets mounted in service pillars.

_____

Reference _____ (Clause number _____)

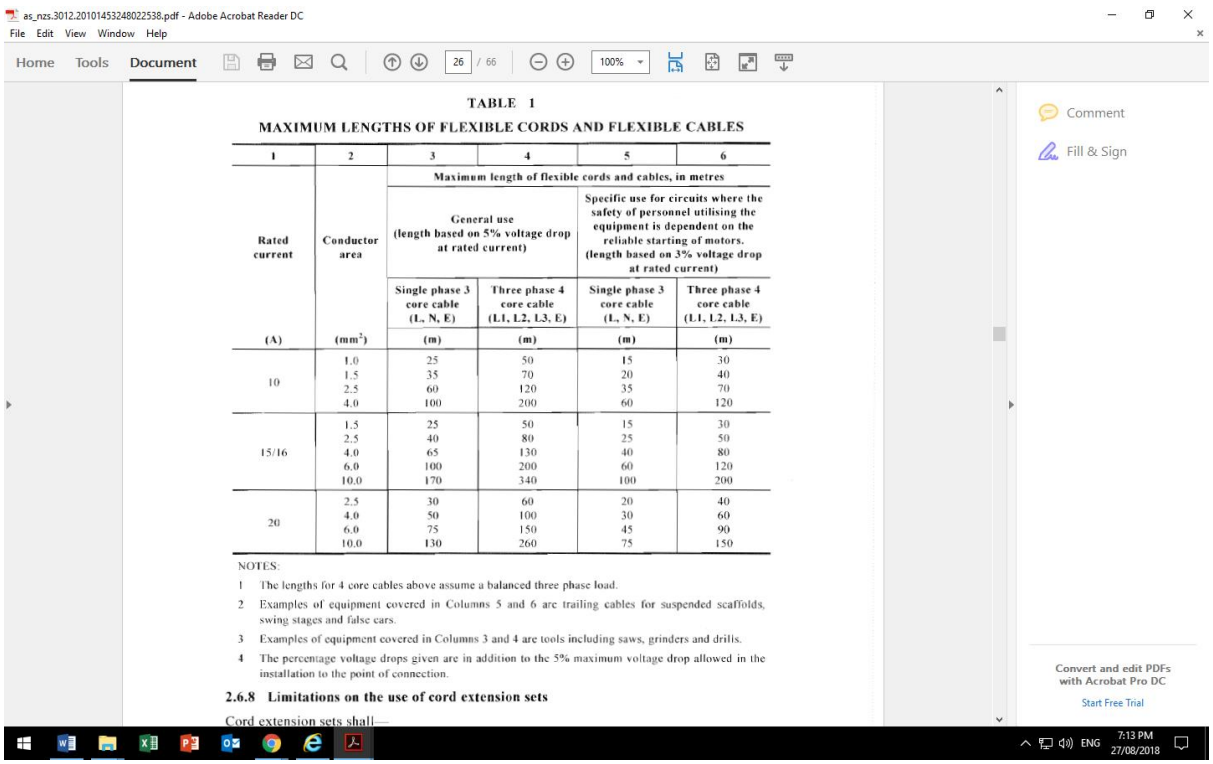



TABLE 1

MAXIMUM LENGTHS OF FLEXIBLE CORDS AND FLEXIBLE CABLES

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Rated current | Conductor area | Maximum length of flexible cords and cables, in metres | | | |
| | | General use (length based on 5% voltage drop at rated current) | | Specific use for circuits where the safety of personnel utilising the equipment is dependent on the reliable starting of motors. (length based on 3% voltage drop at rated current) | |
| | | Single phase 3 core cable (L, N, E) | Three phase 4 core cable (L1, L2, L3, E) | Single phase 3 core cable (L, N, E) | Three phase 4 core cable (L1, L2, L3, E) |
| (A) | ($mm^2$) | (m) | (m) | (m) | (m) |
| 10 | 1.0 | 25 | 50 | 15 | 30 |
| | 1.5 | 35 | 70 | 20 | 40 |
| | 2.5 | 60 | 120 | 35 | 70 |
| | 4.0 | 100 | 200 | 60 | 120 |
| 15/16 | 1.5 | 25 | 50 | 15 | 30 |
| | 2.5 | 40 | 80 | 25 | 50 |
| | 4.0 | 65 | 130 | 40 | 80 |
| | 6.0 | 100 | 200 | 60 | 120 |
| | 10.0 | 170 | 340 | 100 | 200 |
| 20 | 2.5 | 30 | 60 | 20 | 40 |
| | 4.0 | 50 | 100 | 30 | 60 |
| | 6.0 | 75 | 150 | 45 | 90 |
| | 10.0 | 130 | 260 | 75 | 150 |

NOTES:

1 The lengths for 4 core cables above assume a balanced three phase load.

2 Examples of equipment covered in Columns 5 and 6 are trailing cables for suspended scaffolds, swing stages and false cars.

3 Examples of equipment covered in Columns 3 and 4 are tools including saws, grinders and drills.

4 The percentage voltage drops given are in addition to the 5% maximum voltage drop allowed in the installation to the point of connection.

**2.6.8 Limitations on the use of cord extension sets**

Cord extension sets shall—

19. What is the minimum mounting height for socket outlets and associated devices mounted on service pillars in a caravan park?

_____

**2.3.2.6.2** *Height*

The maximum and minimum height of a service pillar shall be dictated by Clauses 2.3.2.4.7 and the requirements of AS/NZS 3000. Where a service pillar would otherwise be less than 1.5 m high, consideration should be given to attaching a device to increase the effective clearly visible height to 1.5 m. Such devices would include flags or wands, coloured to be appropriately visible to drivers manoeuvring vehicles

**4.4.2 Construction**

The outlet box shall be constructed from durable, impact-resistant, non-hygroscopic materials and shall provide mechanical protection for the socket-outlets, switches and electrical equipment mounted on or contained therein. It may also incorporate lighting equipment complying with Clause 4.5. The outlet box shall be provided with facilities to maintain the socket-outlets, switches, and other electrical equipment mounted on or contained therein a minimum of 300 mm above the ground.

20. Is a caravan treated as a separate MEN installation

_____

Reference _____ (Clause number _____)

No

**3.5 EARTHING**

**3.5.1 Detachable connection**

**3.5.1.1** *General*

Where either or both ends of a supply lead to the relocatable premises will be detachable, the protective earthing conductor within the relocatable premises shall be—

(a) run as directly as practicable to; and

(b) effectively connected;

to the earth contact of the appliance inlet or the earth terminal of the direct connection point on the premises.

Where there is more than one appliance inlet or direct connection point, or any combination of the two, the earth-contacts of all the inlets and the earth connection of all direct connection points shall be directly bonded together as well as to the protective earthing conductor. In addition, the following requirements shall apply:

(i) *Isolation of protective earthing conductor*

No direct connection shall be made at the relocatable premises between the protective earthing conductor of the relocatable premises electrical installation and the general mass of earth, e.g. by means of a driven electrode.

No connection shall be made at the relocatable premises between any live (active or neutral) conductor and the protective earthing conductor of the relocatable premises electrical installation.

21. List the items of equipment in a caravan that need to be earthed.

_____

_____

_____

_____

_____

Reference _____ (Clause number _____)

**3.5.1.2** *Equipment to be earthed*

The following items of equipment shall be effectively connected to the protective earthing

conductor:
(a) The conductive material of the chassis or frame regardless of the type of material of which the outer enclosure of the relocatable premises is constructed.
(b) The outer enclosure of the relocatable premises, if constructed of conductive material, including rigid annexes attached to the relocatable premises. Where the outer enclosure of the relocatable premises comprises a number of conductive sheets, and connection to the protective earthing conductor is required to comply with this Clause, the protective earthing conductor need only be attached directly to one sheet, provided that effective electrical bonding is maintained between each sheet by riveting, screwing, or similar means.
(c) Window and door frames of conductive material where any part of the relocatable premises' electrical installation is within 100 mm of the frame.
(d) The earthing contact of all socket-outlets.
(e) The exposed conductive parts of electrical equipment required to be earthed in accordance with AS/NZS 3000.

22. Describe the precautions to be taken where wiring passes through a caravan frame.

_____
_____
_____

Reference _____ (Clause number _____)

**3.2.1 Detachable connection at the relocatable premises**

Where the supply to the relocatable premises is to be by means of a detachable connection at the premises, the premises shall be fitted with one or more appliance inlets complying with either—

(a) AS/NZS 3109.1;
(b) AS/NZS 3123; or
(c) for New Zealand, IEC 60309-2 .

The choice of the type of appliance inlet(s) should be made following consideration of conditions of use likely to apply in the areas, states or countries where it is anticipated that the premises will be used. This includes possible requirements of relevant regulatory authorities.

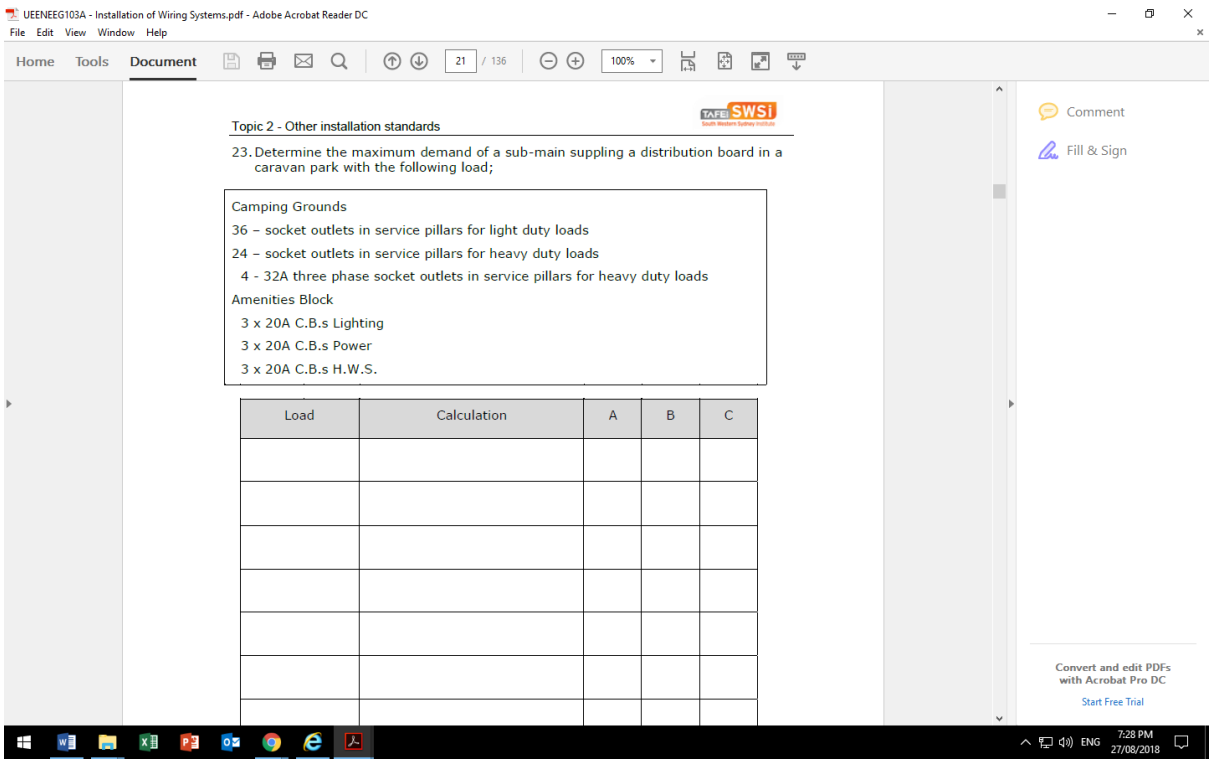
Each appliance inlet shall—

(i) be mounted with the earthing pin not in the uppermost position in relation to the other pins;
(ii) be mounted in a readily accessible position on the exterior of the relocatable premises;
(iii) be fixed to the relocatable premises in such a manner that it is mechanically protected against any risk of damage that may reasonably be anticipated;
(iv) comply with AS/NZS 1939 with a minimum degree of protection of IP24 both with and without a cord extension socket inserted; and
(v) in New Zealand, be rated at not less than the maximum demand of the relocatable premises.

If the appliance inlet is mounted on the same face of the vehicle as any entry door (including those to the driving cabin of a campervan, motor home or similar but not including loading or service hatches) the appliance inlet shall be located not less than 1.5 m from any such doors.

Further to these requirements, it is recommended that the appliance inlet be located on a separate face of the vehicle from the primary access door to the relocatable premises and not less than 150 mm from any outward opening hinged window, access hatch or similar.

NOTE: Subject to these requirements, consideration should be given to placing the appliance inlet assembly away from the areas of the relocatable premises where it would be more prone to the ingress of dirt and moisture, particularly during travel.



Topic 2 - Other installation standards

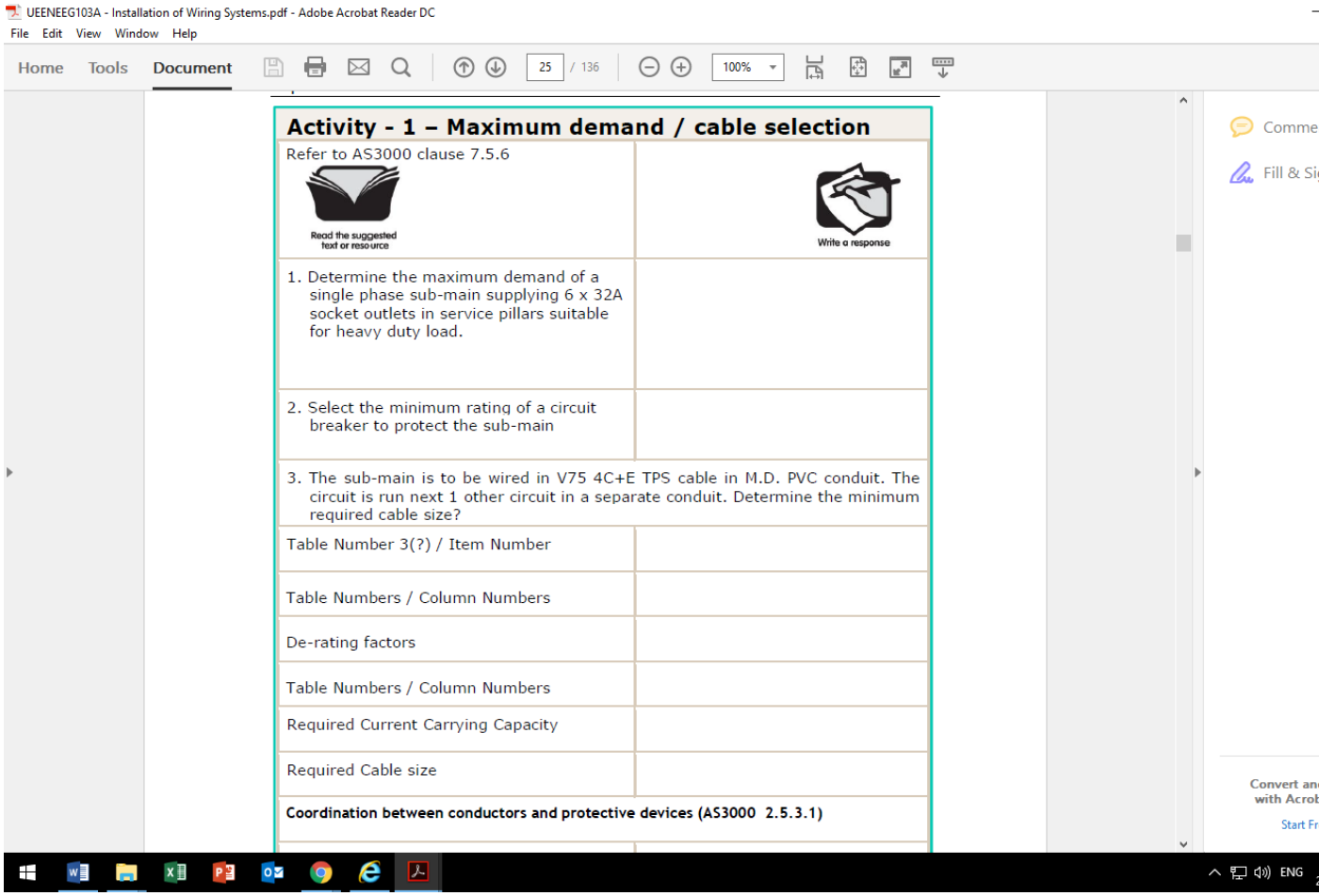
23. Determine the maximum demand of a sub-main suppling a distribution board in a caravan park with the following load;

Camping Grounds
36 – socket outlets in service pillars for light duty loads
24 – socket outlets in service pillars for heavy duty loads
4 - 32A three phase socket outlets in service pillars for heavy duty loads
Amenities Block
3 x 20A C.B.s Lighting
3 x 20A C.B.s Power
3 x 20A C.B.s H.W.S.

| Load | Calculation | A | B | C |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

See C1 of AS3000 and do it yourself

Page 25



**Activity - 1 – Maximum demand / cable selection**

Refer to AS3000 clause 7.5.6

Read the suggested text or resource

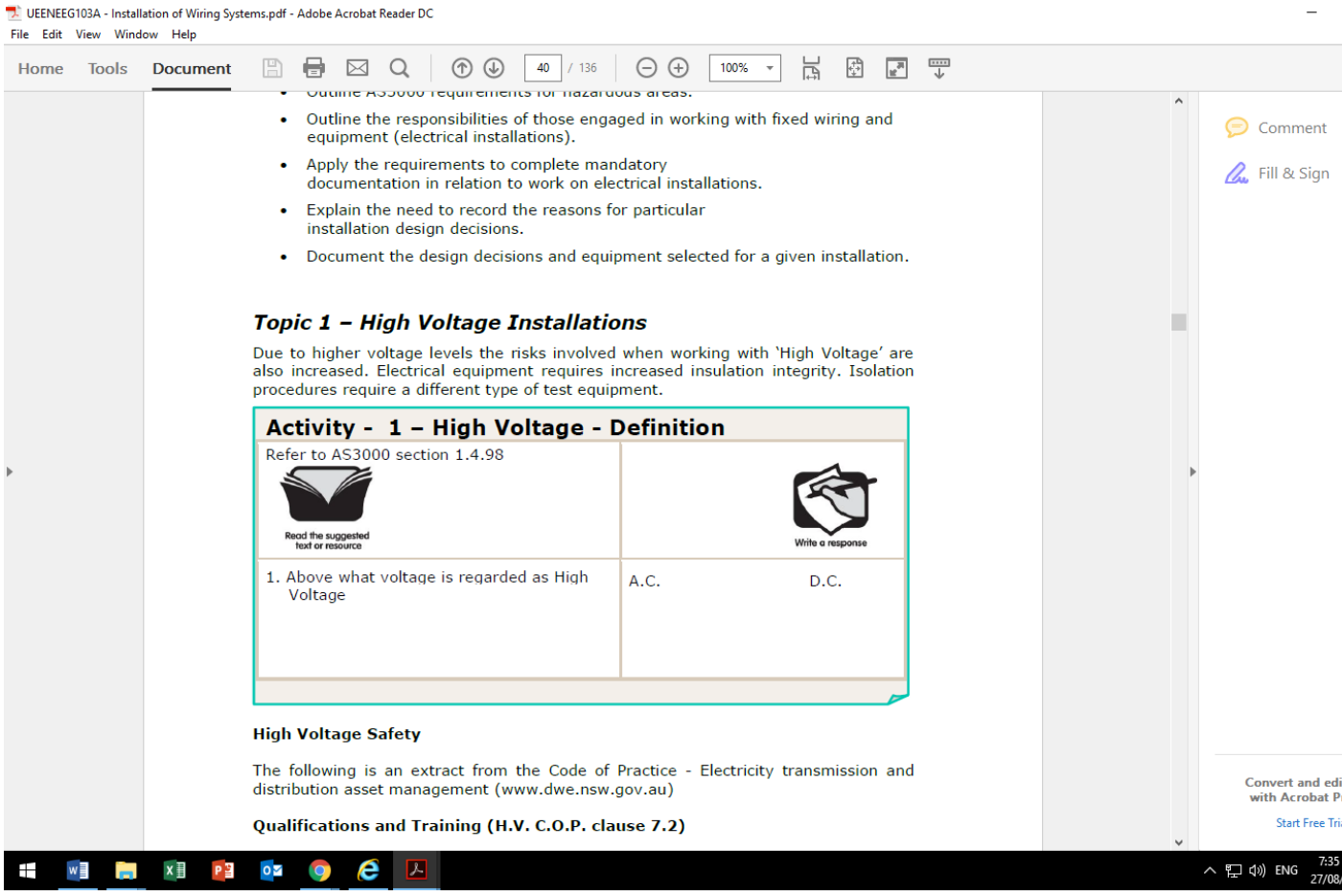
Write a response

| | |
|---|---|
| 1. Determine the maximum demand of a single phase sub-main supplying 6 x 32A socket outlets in service pillars suitable for heavy duty load. | |
| 2. Select the minimum rating of a circuit breaker to protect the sub-main | |
| 3. The sub-main is to be wired in V75 4C+E TPS cable in M.D. PVC conduit. The circuit is run next 1 other circuit in a separate conduit. Determine the minimum required cable size? | |
| Table Number 3(?) / Item Number | |
| Table Numbers / Column Numbers | |
| De-rating factors | |
| Table Numbers / Column Numbers | |
| Required Current Carrying Capacity | |
| Required Cable size | |
| **Coordination between conductors and protective devices (AS3000 2.5.3.1)** | |

7.5.6 Arrangement of PELV circuits

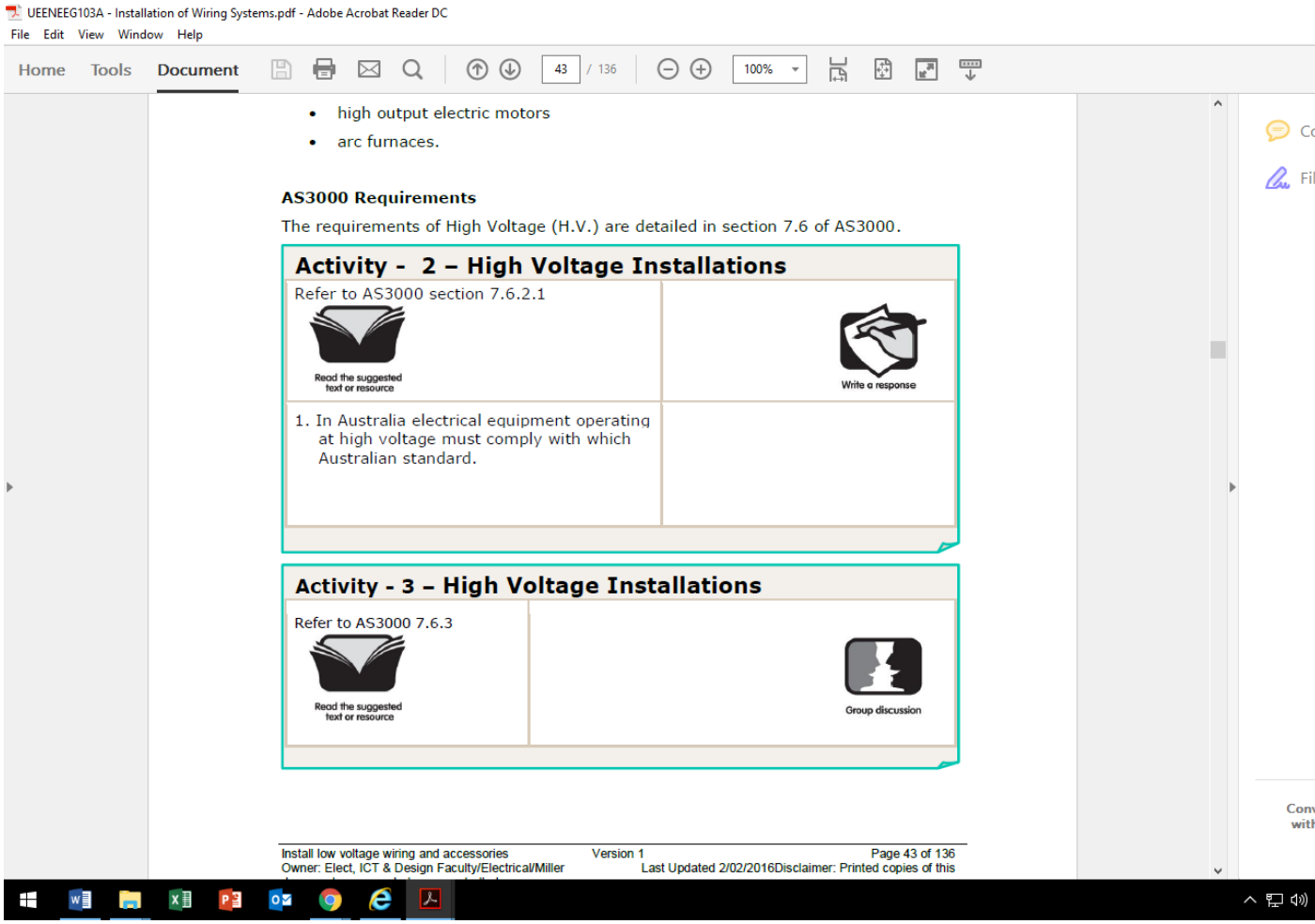
The following applies for PELV circuits, where one conductor of the output

circuit is earthed.
Basic protection shall be provided by—
(a) barriers or enclosures affording a degree of protection of at least IPXXB or IP2X; or
(b) insulation capable of withstanding a test voltage of 500 V a.c. for 1 min.
Exception: Basic protection shall be deemed unnecessary if electrical equipment is within the zone of influence of equipotential bonding and the nominal voltage does not exceed—
1 25 V a.c. or 60 V ripple-free d.c., when electrical equipment is normally used in a dry location only and large-area contact with the human body is not to be expected; or
2 6 V a.c. or 15 V ripple-free d.c., in all other cases.
NOTES:
1 The earthing of circuits may be achieved by an appropriate connection to earth within the source itself.
2 AS/NZS 60479 indicates that large-area contact is approximately 8000 $mm^2$.
3 Insulation is capable of withstanding the test voltage for the required period when the insulation resistance, after the test voltage has been applied for the specified period, remains above the required minimum value.



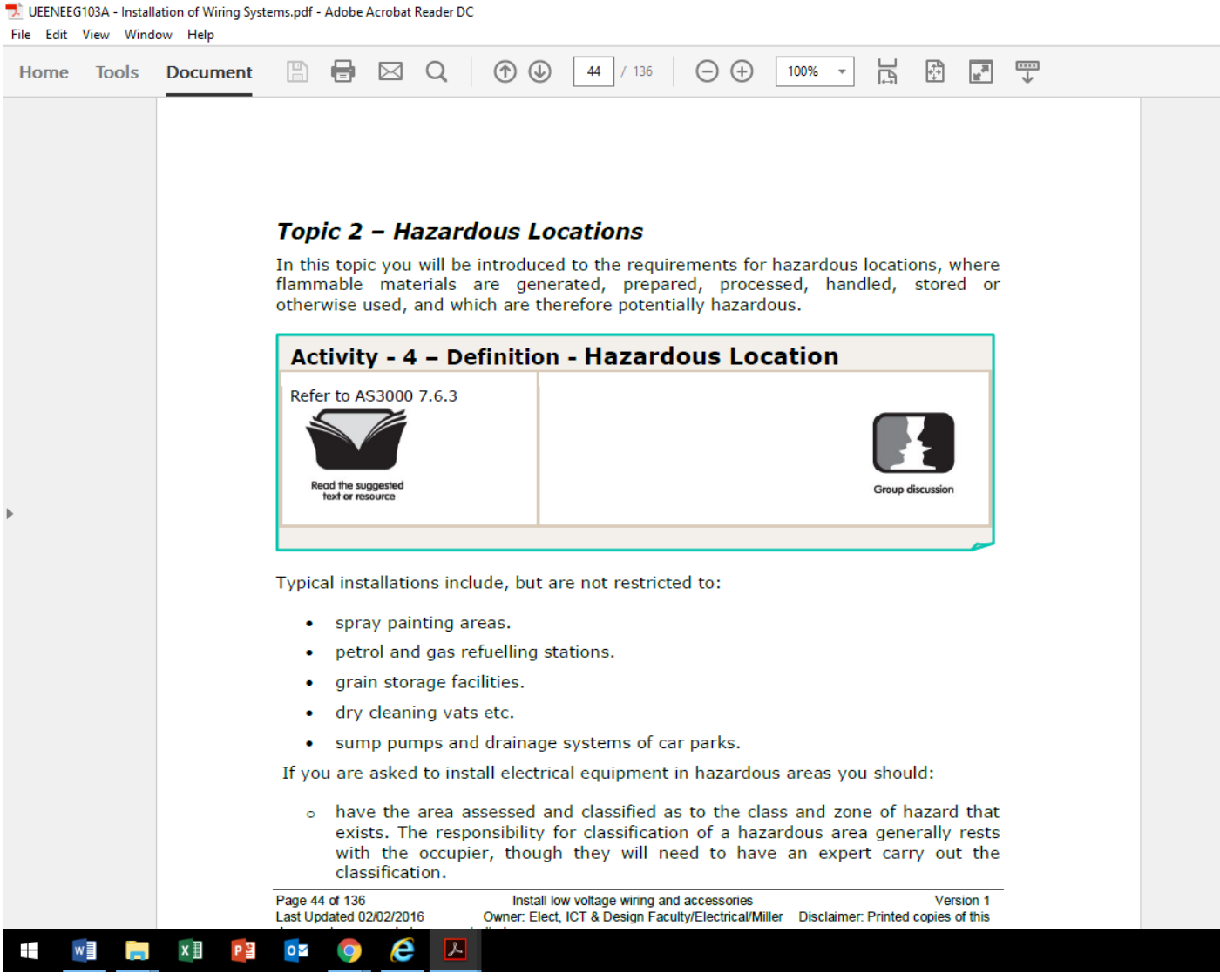

1.4.128 Voltage
Differences of potential normally existing between conductors or between conductors and earth as follows:

(a) Extra-low voltage Not exceeding 50 V a.c. or 120 V ripple-free d.c.
(b) Low voltage Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.
(c) High voltage Exceeding low voltage.




7.6.2 Application
7.6.2.1 In Australia
In Australia, electrical installations and those portions of electrical installations operating at high voltage shall be installed in accordance with AS 2067.
7.6.3 Issues relevant to high voltage installations
For the design of electrical installations with voltage 1 kV or more, the issued that shall be taken into account include the following:
(a) Insulation levels to withstand highest voltage and/or impulse withstand voltages.
(b) Minimum clearances to live parts taking into account electrode configurations and impulse withstand voltages.
(c) Minimum clearances under special conditions.
(d) The application of various devices connected to the system.
(e) The methods of installation of equipment, cables and accessories.
(f) General requirements of installations regarding choice of circuit

arrangement, documentation, transport routes, lighting, operational safety and labelling.
(g) Special requirements with respect to buildings.
(h) Protection measures with respect to access.
(i) Protection measures with respect to fire.
(j) Provision of earthing such that the system operates under all conditions and ensures safety of human life where there is legitimate access.
(k) Testing.




## 7.7 HAZARDOUS AREAS (EXPLOSIVE GAS OR COMBUSTIBLE DUSTS)

### 7.7.1 Scope

The particular requirements of this Clause (Clause 7.7) apply to the selection of electrical equipment and its installation to ensure safe use in areas where flammable or combustible materials are produced, prepared, processed, handled, stored or otherwise exist, and therefore may give rise to an explosive atmosphere.

7.7.2 Classification of hazardous areas

7.7.2.1 Responsibility for classification

The responsibility for classification of a hazardous area (see Clause 1.4.15) rests with the persons or parties in control of the installation. The requirements are contained in AS/NZS 60079.10.1 for gas or vapour and AS/NZS 60079.10.2 for combustible dust.

7.7.2.2 Hazardous areas (AS/NZS 60079 series)

For the purposes of classification, two types of hazardous area are as follows:

(a) Hazardous area (gas or vapour) in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus.

NOTES:

1 Hazardous areas are divided into zones based upon the frequency and duration of the occurrence of explosive gas atmospheres.

2 Explosive gas atmospheres include flammable vapours (from liquids).

(b) Hazardous area (dust) in which combustible dust in the form of a cloud is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

NOTES:

1 Hazardous areas are divided into zone based upon the frequency and duration of the occurrence of explosive dust atmospheres.

2 The potential of creating an explosive dust cloud from a dust layer.

3 Combustible dusts may include fibres and flyings.

7.7.2.3 Reduction or elimination of the hazard

Through design and operation, it is possible to reduce the degree of hazard. This is achieved by giving attention to items such as plant layout, product containment and ventilation.

**2.2**
**explosive gas atmosphere**
mixture with air, under atmospheric conditions, of flammable substances in the form of gas or vapour in which, after ignition, combustion spreads throughout the unconsumed mixture

[IEV 426-02-03, modified]

NOTE Although a mixture which has a concentration above the upper explosive limit (UEL) is not an explosive gas atmosphere, it can readily become so and, in certain cases for area classification purposes, it is advisable to consider it as an explosive gas atmosphere.

**2.3**
**hazardous area**
area in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus

[IEV 426-03-01, modified]

**2.4**
**non-hazardous area**
area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of apparatus

[IEV 426-03-02, modified]

**2.5**
**zones**
hazardous areas are classified into zones based upon the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

**2.5.1**
**zone 0**
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently

[IEV 426-03-03, modified]

**2.5.2**
**zone 1**
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally

[IEV 426-03-04, modified]

**2.5.3**
**zone 2**
place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only

[IEV 426-03-05, modified]

NOTE 1 In this definition, the word ‘persist’ means the total time for which the flammable atmosphere will exist. This will normally comprise the total of the duration of the release, plus the time taken for the flammable atmosphere to disperse after the release has stopped. (The term ‘persistence time’ as used in annex B refers specifically to only one part of the total time for which the flammable atmosphere will exist.)

NOTE 2 Indications of the frequency of the occurrence and duration may be taken from codes relating to specific industries or applications.

## Activity - 5 – Hazardous Locations - Classification

Refer to AS60079.10 (figure 1) and AS2430.1

Read the suggested text or resource

Write a response

| | |
|---|---|
| 1. What zone is the refuelling area of a petrol station classified? | |
| 2. What zone is a spray painting booth classified? | |
| 3. What zone is the sump of a underground car park be classified? | |
| 4. What zone is the area adjacent to a LPG decanting bottle? | |
| 5. What zone is the interior of a petrol storage tank | |









## Activity - 6 – Hazardous Locations - Dust

Refer to AS61241.3 (figure 2) & AS2430.1

Read the suggested text or resource

Write a response

| | |
|---|---|
| 1. What zone is the floor of a wheat silo classified? | |
| 2. What zone is the inside of a coal hopper classified? | |
| 3. What zone is the inside of a cement batching unit classified? | |
| 4. What zone is a wheat handling conveyor belt classified? | |

You should also consider:

## 6.2 Zones for dusts

Layers, deposits and heaps of combustible dust shall be considered as 'any other source' which can form an explosive atmosphere.

Zone 20

A place in which an explosive atmosphere, in the form of a cloud of combustible dust in air, is present continuously, or for long periods or frequently for short periods.

Zone 21

A place in which an explosive atmosphere, in the form of a cloud of combustible dust in air, is likely to occur occasionally in normal operation.

Zone 22

A place in which an explosive atmosphere, in the form of a cloud of combustible dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

## 6.3 Examples of zones for explosive dust atmospheres

### 6.3.1 Zone 20

Examples of locations that may give rise to zone 20:

– locations inside the dust containment;
– hoppers, silos, etc, cyclones and filters;
– dust transport systems, except some parts of belt and chain conveyors, etc;
– blenders, mills, dryers, bagging equipment, etc.

### 6.3.2 Zone 21

Examples of locations that may give rise to zone 21:

– Areas outside dust containment and in the immediate vicinity of access doors subject to frequent removal or opening for operation purposes when internal explosive dust/air mixtures are present.
– Areas outside dust containment in the proximity of filling and emptying points, feed belts, sampling points, truck dump stations, belt dump over points, etc. where no measures are employed to prevent the formation of explosive dust/air mixtures.
– Areas outside dust containment where dust accumulates and where, due to process operations, the dust layer is likely to be disturbed and form explosive dust/air mixtures.
– Areas inside dust containment where explosive dust clouds are likely to occur (but neither continuously, nor for long periods, nor frequently), e.g. silos (if filled and/or emptied only occasionally) and the dirty side of filters, if large self-cleaning intervals exist.

### 6.3.3 Zone 22

Examples of locations that may give rise to zone 22:

– Outlets from bag filter vents which, in the event of a malfunction, can emit explosive dust/air mixtures.
– Locations near equipment opened at infrequent intervals or equipment that, from experience, can easily form leaks where, due to above atmospheric pressure, dust is blown out; pneumatic equipment, flexible connections that can become damaged, etc.
– Storage of bags containing dusty products. Failure of bags can occur during handling, causing dust emission.

## *Topic 4 – Mandatory Documentations*

### Activity - 6 – Certificate of Compliance Electrical Work (CCEW)



Complete the CCEW provided for the installation below

22 - Light points
24 - Double 10A Socket Outlets
1 - 15A socket outlet
1 - 6.0 kW cook top
1 - 3.9 kW wall oven
1 – 0.8 kW heat pump storage H.W.S.

Consumer's Mains 16mm² XLPE Cu U/G

**A Notification of Service Work (NOSW)**

Authorised Service Providers must notify the distribution network service provider within 48 hours of completing service work. The person performing the connection work must first test and/or verify the installation to be free of defects, prior to energising. Connection without completely testing the installation can only be effected if the Authorised Person has met with and have in their keeping the original CCEW from the installing Electrical Contractor. The Authorised Person is then responsible for the lodgement of both notices concurrently.

# CERTIFICATE OF COMPLIANCE – ELECTRICAL WORK

*Customer COPY*

**CERTIFICATE NO:**

**CUSTOMER DETAILS**

| | | | |
|---|---|---|---|
| Name | | Telephone Contact | |
| Address | | Meter No: | |
| Cross Street | Postcode | NMI (if applicable) | |

**INSTALLATION WORK DETAILS** Indicate the type of installation and types of work performed under this Notice

| | | | | | |
|---|---|---|---|---|---|
| **Type of Installation** | ☐ Residential | ☐ Commercial | ☐ Industrial | ☐ Rural | ☐ Other |
| **Special Conditions** | ☐ over 100 amps | ☐ High Voltage | ☐ Hazardous Area | ☐ Generator | ☐ Unmetered Supply |

**CERTIFICATE MUST BE ISSUED TO THE CUSTOMER FOR ALL ELECTRICAL WORK**

Work of the following type must ALSO be notified to the **ELECTRICITY DISTRIBUTOR (DNSP)**

☐ New Installation
☐ Additions or alterations to a switchboard or associated equipment
☐ Network connection or metering
☐ Defect Rectification No:

**DETAILS OF EQUIPMENT** *Describe the equipment and estimate load increase of the work affected by this Notice. If insufficient space attach separate sheets.*

| EQUIPMENT | RATING | No. | PARTICULARS OF WORK |
|---|---|---|---|
| ☐ Switchboards | | | |
| ☐ Circuits | | | |
| ☐ Lighting | | | |
| ☐ Socket-outlets | | | |
| ☐ Appliances | | | |
| Estimated increase in load A/ph | | | ☐ Increased load is within capacity of installation/service mains |
| ☐ Work is connected to supply | | | ☐ Work is not connected to supply pending inspection by DNSP |

*The work has been carried out or supervised by:* | *Licence No:*

**TEST REPORT** *Indicate the relevant tests and checks that have been performed on the work. If test records are provided attach as separate sheets.*

| | |
|---|---|
| ☐ Earthing system integrity Ω | ☐ Residual current device operation |
| ☐ Insulation resistance MΩ | ☐ Visual check that installation is suitable for connection to supply |
| ☐ Polarity | ☐ Stand-alone power system complies with AS 4509 |
| ☐ Correct circuit connections | ☐ Fault loop impedance (if necessary) |

**I confirm that I have carried out the above tests and visually checked that the installation work described in this Certificate complies with AS/NZS 3000 and is suitable for its intended use.**

| | | | |
|---|---|---|---|
| *Name:* | | *Licence No:* | |
| *Signature:* | | *Date of Testing:* | |

**CERTIFICATION**

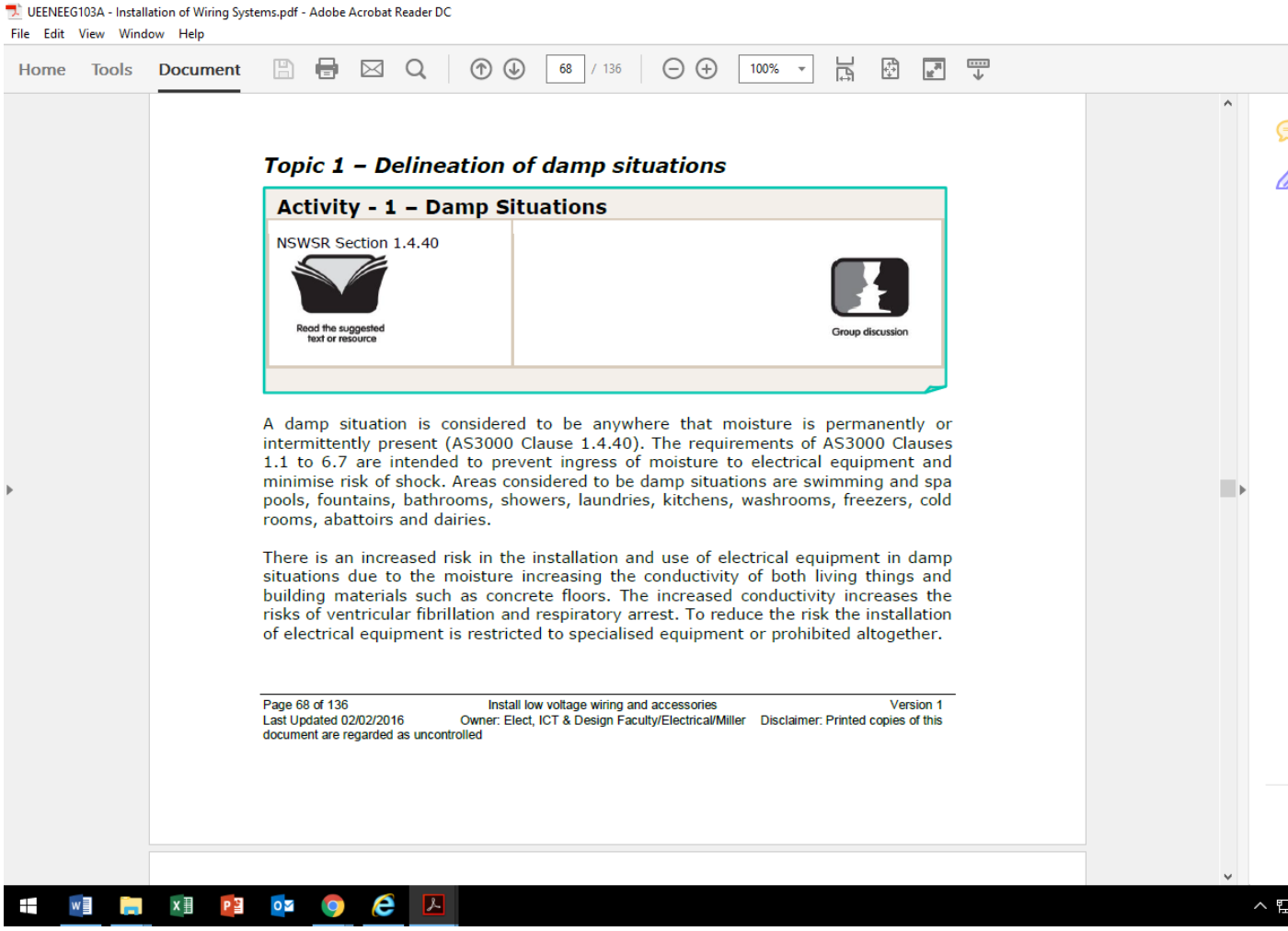
**I, the Electrical Contractor give notice to the Customer and _____ (Name of DNSP or OFT), that the work described in this Certificate has been completed in accordance with the Electricity (Consumer Safety) Regulation 2006**

| | | | |
|---|---|---|---|
| *Name:* | | *Licence No:* | |
| *Signature:* | | *Date of Notice:* | |
| *Address:* | | *Telephone No. or Other Contact* | |

**ELECTRICITY DISTRIBUTOR (DNSP) REMARKS**

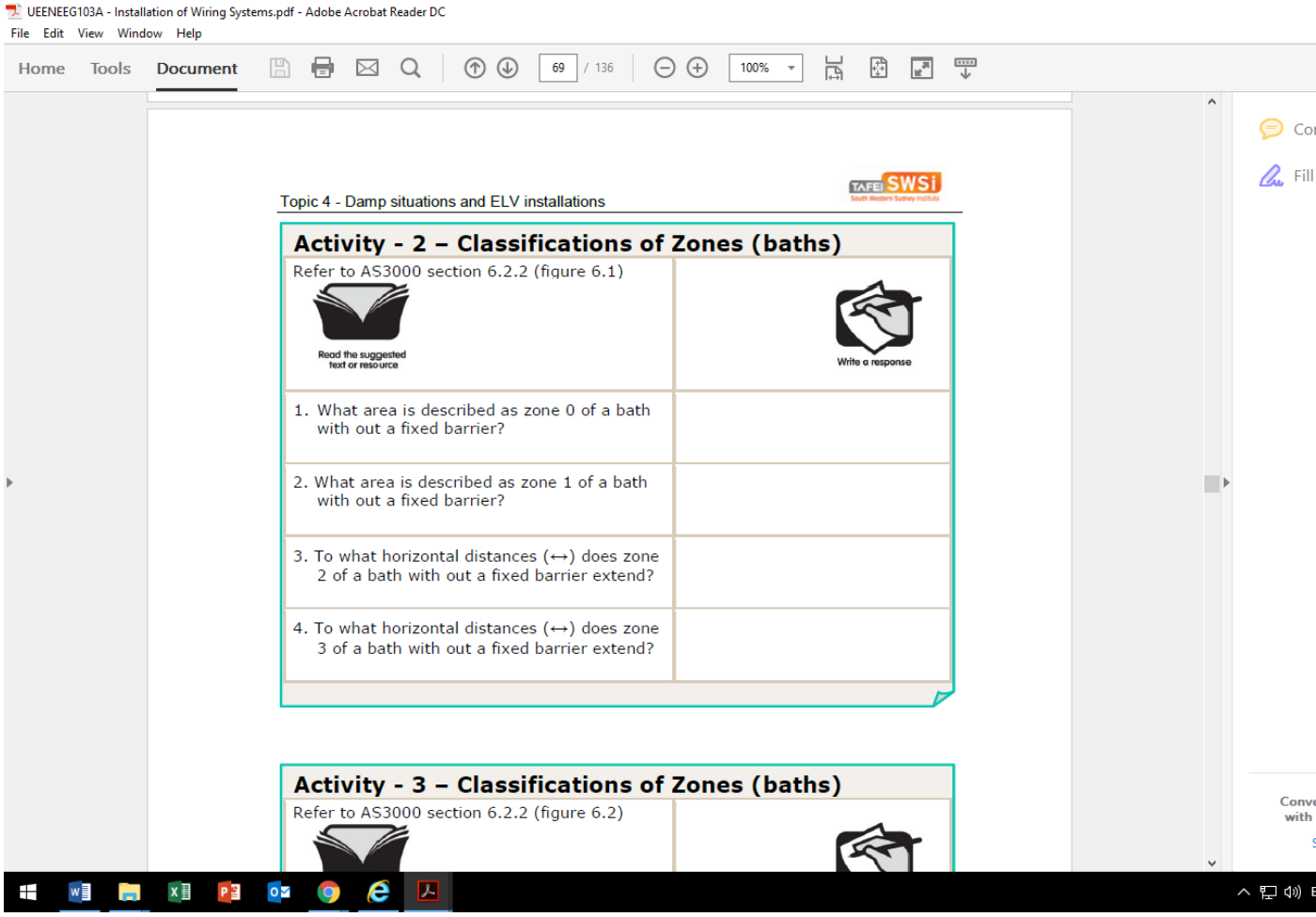
| | | | |
|---|---|---|---|
| *Inspected by:* | | *Date* | |
| *Comments:* | | | |

neca




1.4.44 Damp situation

A situation in which moisture is either permanently present, or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation that complies with this Standard for ordinary situations.




6.2.2 Classification of zones

6.2.2.1 Baths and showers

Four zones (Zones 0, 1, 2 and 3) are classified for baths and showers:

(a) Zone 0 shall be the area of the interior of a bath or a shower base.

NOTE: A shower base may be defined by either a raised hob or a depression in the floor.

(b) Zone 1 for a bath shall be the area limited by the following:

(i) Zone 0.

(ii) The vertical projection of the internal rim of the bath above Zone 0.

(iii) When the bath contains a shower, by the vertical plane 1.2 m radius from the shower fixed plumbing connection.

(iv) In Australia, by the floor and a horizontal plane 2.5 m above the floor.

(v) In New Zealand, by the floor and a horizontal plane 2.25 m above the floor.

(vi) The height of the fixed plumbing connection, if higher than the horizontal plane specified in Item (iv) or (v).

NOTE: A barrier of a height at which the shower connection is made to the fixed plumbing, or 1.8 m, whichever is the greater, may be used to reduce the 1.2 m dimension in Item (b)(iii).

(c) Zone 1 for a shower shall be the area limited by the following:

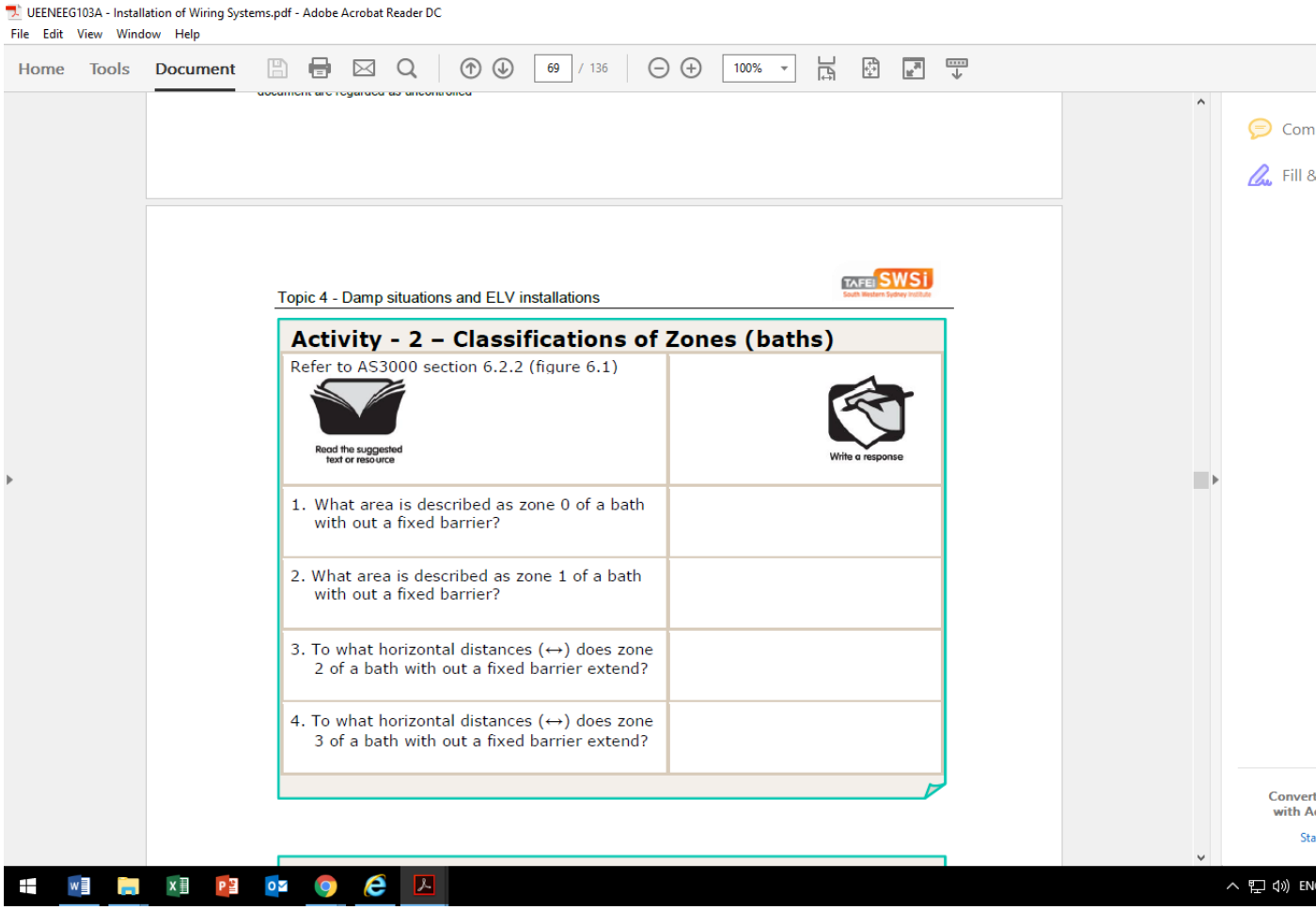
(i) Zone 0.
(ii) For a fixed plumbing connection on the wall, by the vertical plane 1.2 m radius from the fixed plumbing connection. A barrier of a height at which the shower connection is made to the fixed plumbing, or 1.8 m, whichever is the greater, may be used to reduce the 1.2 m dimension.
* (iii) For a fixed plumbing connection on the ceiling, by the vertical plane horizontally distant from the fixed plumbing connection, and as follows:
(A) In Australia, a radius of 0.6 m.
Exception: A barrier with a minimum height of 1.8 m may be used to reduce the 0.6 m dimension.
(B) In New Zealand, a radius of 1.2 m.
Exception: A barrier with a minimum height of 1.8 m may be used to reduce the 1.2 m dimension.
(iv) In Australia, by the floor and a horizontal plane 2.5 m above the floor.
(v) In New Zealand, by the floor and a horizontal plane 2.25 m above the floor.
(vi) The height of the fixed plumbing connection, if higher than the horizontal plane specified in Item (iv) or (v).
NOTE: Examples of barriers include a hinged or sliding door, or a shower curtain.
(d) Zone 2 shall be the area limited by-
(i) the vertical plane limiting Zone 1 and the parallel vertical plane 0.6 m external to Zone 1; and
(ii) the floor and the horizontal plane 2.25 m above the floor.
(e) Zone 3 shall be the area limited by the following:
(i) The vertical plane limiting Zone 2 and the parallel vertical plane 2.4 m external to Zone 2.
(ii) In Australia, by the floor and a horizontal plane 2.5 m above the floor.
(iii) In New Zealand, by the floor and a horizontal plane 2.25 m above the floor.
(iv) In Australia, Zone 3 shall include the area above Zone 2 up to 2.5 m above the floor.
Examples of these zones are shown in Figures 6.1 to 6.11.
6.2.2.2 Other fixed water containers
Two zones (Zones 0 and 2) are classified for fixed water containers other than baths and showers:
(a) Zone 0 shall be the area of the interior of the water container.
* (b) Zone 2 for an individual water container with a capacity not exceeding 40 L, and having fixed water outlets, shall be the area limited by-
(i) the vertical plane 0.15 m from the internal rim of the water container; and
(ii) the floor and the horizontal plane 0.4 m above the water

container.
NOTE: Figure 6.12 shows a typical double bowl sink where the capacity of each container does not exceed 40 L.
* (c) Zone 2 for water containers having either a capacity exceeding 40 L, or a water outlet through a flexible hose, shall be the area limited by-
(i) the vertical plane 0.5 m from the internal rim of the water container; and
(ii) the floor and the horizontal plane 1.0 m above the water container.
Examples of these zones are shown in Figures 6.13 and 6.14.
NOTES:
1 There is no Zone 1 or 3 for these water containers.
2 An example of a water outlet through a flexible hose is a vegetable sprayer.
A
NZ
A

6.2.3 Protection against electric shock-Prohibited measures
The following measures of protection against electric shock are prohibited and shall not be used:
(a) Protection by means of obstacles, in accordance with Clause 1.5.4.5.
(b) Protection by placing out of reach, in accordance with Clause 1.5.4.6.
6.2.4 Selection and installation of electrical equipment
6.2.4.1 Degree of protection required
Electrical equipment permitted to be installed in a classified zone shall have at least the following degree of protection:
(a) In Zone 0-IPX7.
(b) In Zones 1 and 2-IPX5 in communal baths/showers; IPX4 in other locations.
(c) In Zone 3-IPX5 in communal baths/showers; no specific degree of protection in other locations.
The requirements for selection and installation of electrical equipment are provided in Table 6.1.
6.2.4.2 Socket-outlets
Socket-outlets shall not be installed within 0.3 m of the floor of a bathroom, laundry or other similar location where the floor is likely to become wet.
Regardless of the degree of protection provided by the equipment, the following requirements apply to the installation of socket-outlets in classified zones:
(a) Zone 0 and Zone 1 Socket-outlets shall not be installed in Zone 0 or 1.
(b) Zone 2 Socket-outlets installed in Zone 2 shall be-
(i) of the automatic switching type incorporated in a shaver supply unit complying with AS/NZS 3194; or
(ii) protected by an RCD with a fixed rated residual current not exceeding 30 mA and enclosed in a cupboard that maintains the enclosure of the socket-outlet during normal operation of the

connected equipment.
(c) Zone 3 Socket-outlets installed in Zone 3 shall be-
(i) protected by an RCD with a fixed rated residual current not exceeding 30 mA;
(ii) supplied individually as a separated circuit, in accordance with Clause 7.4; or
(iii) supplied as an SELV or a PELV system, in accordance with Clause 7.5.
6.2.4.3 Switches and other accessories
Switches and other accessories shall not be installed within 0.3 m of the floor of a bathroom, laundry or other similar location where the floor is likely
to become wet.
The following requirements apply to the installation of switches and other accessories in classified zones:
(a) Zone 0 Switches and other accessories shall not be installed in Zone 0.
(b) Zone 1 and Zone 2 Only switches and accessories with at least the required degree of protection shall be installed in Zones 1 and 2.
6.2.4.4 Luminaires
The following requirements apply to the installation of luminaires in classified zones:
(a) Zone 0 Luminaires installed in Zone 0 shall be-
(i) provided with the required degree of protection;
(ii) designed and constructed specifically for use in a bath, shower or water container;
(iii) supplied at a nominal voltage not exceeding 12 V a.c. or 30 V ripple-free d.c.; and
(iv) supplied from a source located outside Zone 0 as an SELV or a PELV system, in accordance with Clause 7.5.
(b) Zones 1, 2 and 3 Luminaires installed in Zones 1, 2 and 3 shall be provided with at least the required degree of protection.
Exceptions: Regardless of the degree of protection provided by the equipment, the following luminaires may be installed in Zone 2:
1 Luminaires of Class II construction (double or reinforced insulation) that require the removal of a cover to access lamps.
NOTE: A batten holder is not a Class II luminaire.
2 Luminaires supplied from a source located outside Zone 2 as an SELV or a PELV system, in accordance with Clause 7.5.
6.2.4.5 Other electrical equipment
The following requirements apply to the installation of appliances and other electrical equipment in classified zones:
(a) Zone 0 Appliances and other electrical equipment installed in Zone 0 shall be-
(i) designed and constructed specifically for use in a bath, shower or water container;

(ii) provided with the required degree of protection; and
(iii) supplied–
(A) from a source located outside Zone 0;
(B) at a nominal voltage not exceeding 12 V a.c. or 30 V ripplefree d.c.; and
(C) as an SELV or a PELV system, in accordance with Clause 7.5.
(b) Zones 1, 2 and 3 Appliances and other electrical equipment installed in Zones 1, 2 and 3 shall be provided with at least the required degree of protection for the particular zone.
Heating cable systems intended for heating the location, and that are embedded in the floor and protected in accordance with Clause 4.10, may be installed.



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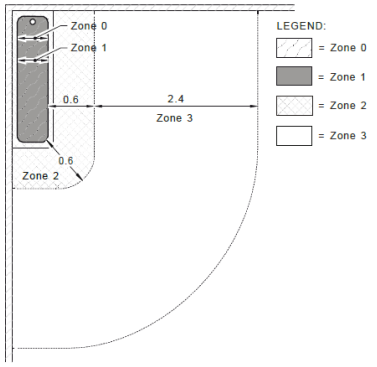
| | | | | |
|---|---|---|---|---|
| Clause 6.2.4.7—Electricity generation systems | Not permitted | Not permitted | Not permitted | Not permitted |

† Degree of protection IPX5 required in communal baths/showers.




DIMENSIONS IN METRES

FIGURE 6.1 ZONE DIMENSIONS (PLAN)—
BATH WITHOUT SHOWER OR FIXED BARRIER





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## Activity - 3 – Classifications of Zones (baths)

| Refer to AS3000 section 6.2.2 (figure 6.2) | |
|---|---|
| Read the suggested text or resource | Write a response |
| 1. What area is described as zone 0 of a bath with out a fixed barrier? | |
| 2. What area is described as zone 1 of a bath with out a fixed barrier? | |
| 3. To what vertical distances (↕) does zone 2 of a bath with out a fixed barrier extend? | |
| 4. To what vertical distances (↕) does zone 3 of a bath with out a fixed barrier extend. | |

**Note: The typical height of a ceiling is 2.4m.**



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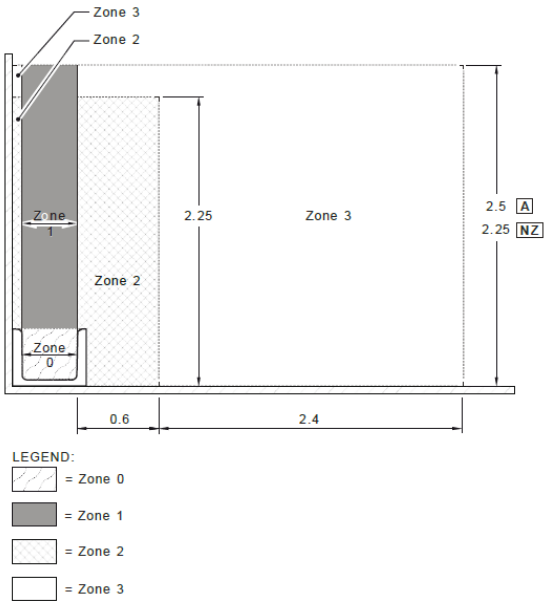



DIMENSIONS IN METRES

FIGURE 6.2 ZONE DIMENSIONS (ELEVATION)—
BATH WITHOUT SHOWER OR FIXED BARRIER

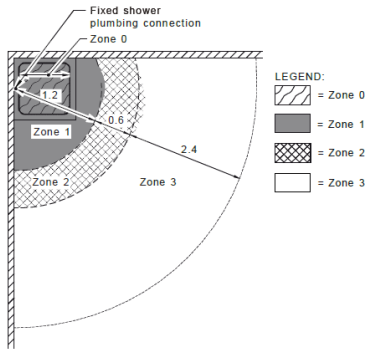
## Activity - 4 – Classifications of Zones (showers)

| Refer to AS3000 section 6.2.2 (figure 6.3) Read the suggested text or resource | Write a response |
|---|---|
| 1. What area is described as zone 0 of a shower base with out a fixed barrier? | |
| 2. What area is described as zone 1 of a shower base with out a fixed barrier? | |
| 3. To what horizontal distances (↔) does zone 2 of a shower base with out a fixed barrier extend? | |
| 4. To what horizontal distances (↔) does zone 3 of a shower base with out a fixed barrier extend? | |

## Activity - 5 – Classifications of Zones (showers)

Refer to AS3000 section 6.2.2 (figure 6.4)






DIMENSIONS IN METRES

FIGURE 6.3 ZONE DIMENSIONS (PLAN)—SHOWER WITH FIXED PLUMBING CONNECTION ON WALL AND BASE WITHOUT BARRIERS

| 3 of a shower base with out a fixed barrier extend? | |
|---|---|

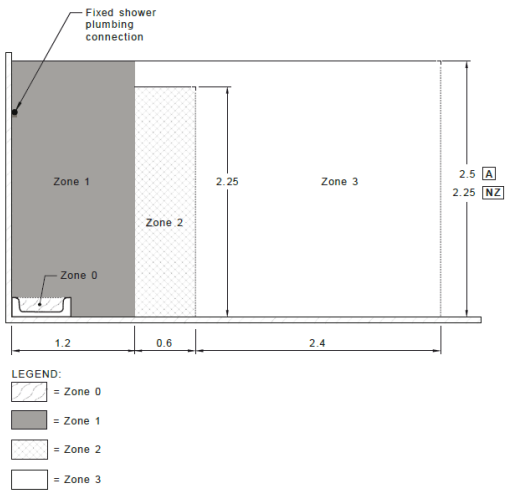
## Activity - 5 – Classifications of Zones (showers)

| Refer to AS3000 section 6.2.2 (figure 6.4)<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. What area is described as zone 0 of a shower base with out a fixed barrier? | |
| 2. What area is described as zone 1 of a shower base with out a fixed barrier? | |
| 3. To what vertical distances (↕) does zone 2 of a shower base with out a fixed barrier extend? | |
| 4. To what vertical distances (↕) does zone 3 of a shower base with out a fixed barrier extend. | |










DIMENSIONS IN METRES

FIGURE 6.4 ZONE DIMENSIONS (ELEVATION)—SHOWER WITH FIXED PLUMBING CONNECTION ON WALL AND BASE WITHOUT BARRIERS

Topic 4 - Damp situations and ELV installations

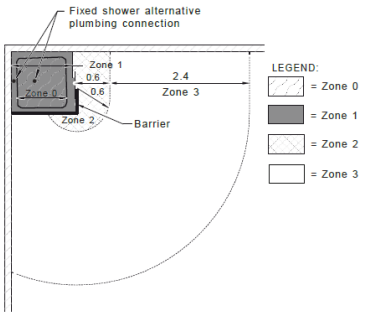
## Activity - 6 – Classifications of Zones (kitchen sinks)

| | |
|---|---|
| Refer to AS3000 section 6.2.2 (figure 6.10)<br>Read the suggested text or resource | Write a response |
| 1. What area is described as zone 0 of a fixed water container ≤ 45L? | |
| 2. To what horizontal distances (↔) does zone 2 of a fixed water container ≤ 45L extend? | |
| 3. To what vertical distances (↕) does zone 2 of a fixed water container ≤ 45L extend? | |










DIMENSIONS IN METRES

FIGURE 6.10 ZONE DIMENSIONS (PLAN)—ENCLOSED SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING OR WALL AND A BARRIER

## Activity - 7 – Classifications of Zones (laundry tubs)

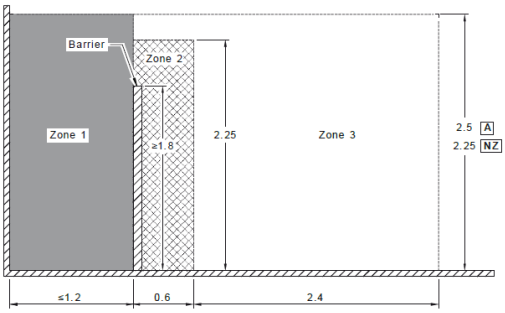
| Refer to AS3000 section 6.2.2 (figure 6.11)<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. What area is described as zone 0 of a fixed water container > 45L? | |
| 2. To what horizontal distances (↔) does zone 2 of a fixed water container > 45L extend? | |
| 3. To what vertical distances (↕) does zone 2 of a fixed water container > 45L extend? | |












NOTE: Refer to Clause 6.2.2.1(a) for Zone 0.

DIMENSIONS IN METRES

* FIGURE 6.11 ZONE DIMENSIONS (ELEVATION)—SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING OR WALL AND A BARRIER

## Activity - 8 – Classifications of Zones (pools)

Refer to AS3000 section 6.2.2 (figure 6.12)

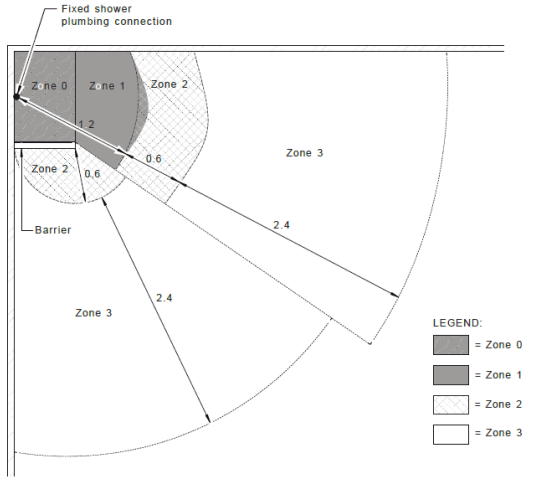
Read the suggested text or resource

Write a response

1. What area is described as zone 0 of an in-ground swimming pool?
2. To what horizontal distances (↔) does zone 1 of an in-ground swimming pool extend from the waters edge?
3. To what horizontal distances (↔) does zone 2 of an in-ground swimming pool extend from the waters edge?
4. To what horizontal distances (↔) does zone 3 of an in-ground swimming pool extend from the waters edge?








DIMENSIONS IN METRES

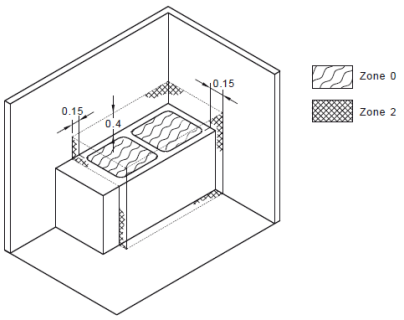
FIGURE 6.12 ZONE DIMENSIONS (PLAN)—PARTIALLY ENCLOSED SHOWER WITH FIXED PLUMBING CONNECTION ON WALL

## Activity - 10 – Classifications of Zones (pools)

| Refer to AS3000 section 6.2.2 (figure 6.13)<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. What area is described as zone 0 of an above ground swimming pool? | |
| 2. To what horizontal distances (↔) does zone 1 of an above ground swimming pool extend from the waters edge? | |
| 3. To what horizontal distances (↔) does zone 2 of an above ground swimming pool extend from the waters edge? | |
| 4. To what horizontal distances (↔) does zone 3 of an above ground swimming pool extend from the waters edge? | |








DIMENSIONS IN METRES

* FIGURE 6.13 ZONE DIMENSIONS FOR OTHER FIXED WATER CONTAINERS WITH FIXED WATER OUTLETS WHERE NO CONTAINER HAS A CAPACITY EXCEEDING 40 L

## Activity - 12 – Classifications of Zones (spa's)

Refer to AS3000 section 6.2.2 (figure 6.15)

Read the suggested text or resource

Write a response

1. What area is described as zone 0 of an in-ground spa pool?
2. To what horizontal distances (↔) does zone 1 of an in-ground spa pool extend from the waters edge?
3. To what vertical distances (↕) does zone 1 of an in-ground spa pool extend from the waters edge?

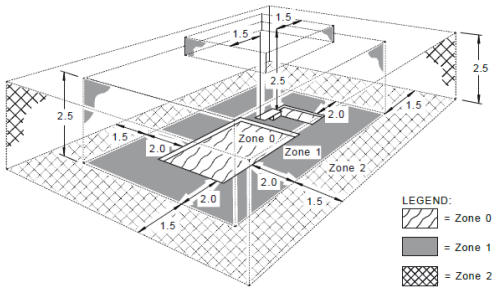
## Activity - 13 – Classifications of Zones (spa's)





TABLE 6.2 (*continued*)

| Equipment | Zone 0 | Zone 1 | Zone 2 |
|---|---|---|---|
| Clause 6.3.4.6—Switchboards | Not permitted | Not permitted | Not permitted |
| * Clause 6.3.4.7—Electricity generation systems | Not permitted | Not permitted | Not permitted |
| * Clause 6.3.4.8—Electricity distributor's electrical equipment | Not permitted | Not permitted | Not permitted |




DIMENSIONS IN METRES

FIGURE 6.15 ZONE DIMENSIONS OF IN-GROUND SWIMMING POOLS

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## Activity - 13 – Classifications of Zones (spa's)

| Refer to AS3000 section 6.2.2 (figure 6.16)<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. What area is described as zone 0 of an above ground spa pool? | |
| 2. To what horizontal distances (↔) does zone 1 of an above ground spa pool extend from the waters edge? | |
| 3. To what vertical distances (↕) does zone 1 of an above ground spa pool extend from the waters edge? | |



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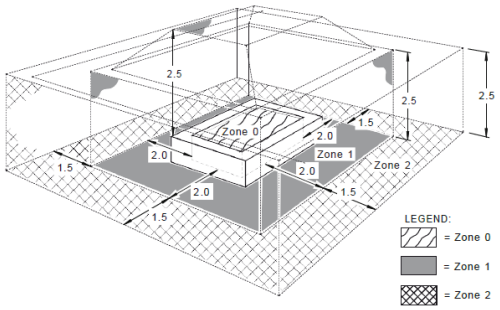


DIMENSIONS IN METRES

FIGURE 6.16 ZONE DIMENSIONS OF ABOVE-GROUND SWIMMING POOLS

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Topic 4 - Damp situations and ELV installations

## Activity - 14 – Classifications of Zones (fountains)

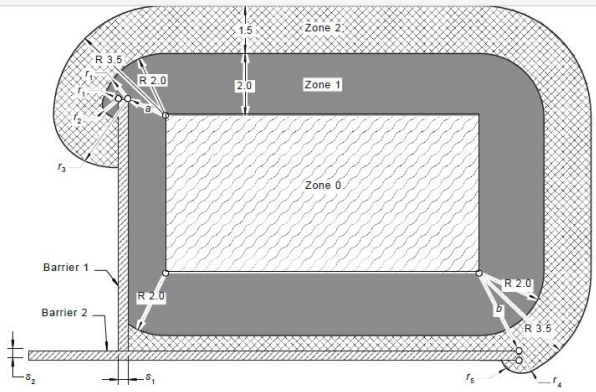
Refer to AS3000 section 6.2.2 (figure 6.17)

Read the suggested text or resource

Write a response

1. What area is described as zone 0 of a fountain?
2. To what horizontal distances (↔) does zone 1 of a fountain extend from the waters edge?
3. To what vertical distances (↕) does zone 1 of a fountain extend from the waters edge?






LEGEND:

$r_1 = 2.0 - a$
$s_1$ = Width of barrier 1
$r_2 = r_1 - s_1$
$s_2$ = Width of barrier 2
$r_3 = 3.5 - a$
$r_4 = 3.5 - b$
$r_5 = r_4 - s_2$

= Zone 0
= Zone 1
= Zone 2

NOTE: These dimensions apply to swimming pools, paddling pools and wading pools.

DIMENSIONS IN METRES

FIGURE 6.17 ZONE DIMENSIONS OF SWIMMING POOLS WITH FIXED BARRIERS (MINIMUM 1.8 m HIGH)

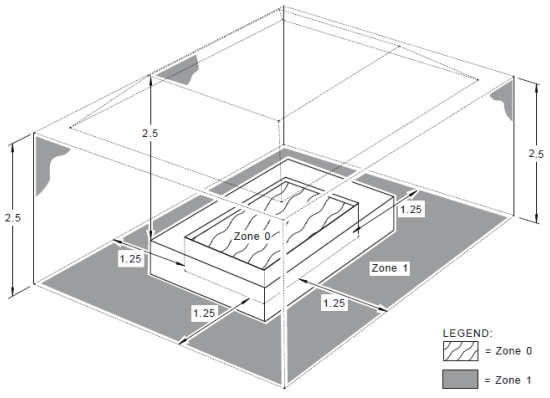
| | |
|---|---|
| 3. To what vertical distances (↕) does zone 1 of a fountain extend from the waters edge? | |

## Activity - 15 – Classifications of Zones (saunas)

| | |
|---|---|
| Refer to AS3000 section 6.2.2 (figure 6.19)<br>Read the suggested text or resource | Write a response |
| 1. To what horizontal distances (↔) does zone 1 of a sauna extend from the sauna heater edge? | |
| 2. To what vertical distances (↕) does zone 1 of a sauna extend? | |
| 3. To what vertical distances (↕) does zone 2 of a sauna extend from zone 1? | |
| 4. To what vertical distances (↕) does zone 3 of a sauna extend from zone 2? | |








DIMENSIONS IN METRES

FIGURE 6.19 ZONE DIMENSIONS OF ABOVE-GROUND SPA POOLS AND TUBS WITH WATER CAPACITY NOT EXCEEDING 5000 L

### 6.4 FOUNTAINS AND WATER FEATURES

## *Topic 2 – Selection of equipment for damp situations.*

Some electrical equipment is not suitable for use in damp situations. Often an I.P. rating is required

### Activity - 16 – International Protection Ratings

| Refer to AS3000 section G1 Table G1b<br>Read the suggested text or resource | Write a response |
|---|---|
| Specify the degree of protection from water for the fllowing I.P. ratings | Typical Use |
| 1. I.P. 20 | |
| 2. I.P. 53 | |
| 3. I.P. 66 | |
| 4. I.P. 68 | |

### Activity - 17 – Degree of protection required

Refer to AS3000 clause 6.2.4.1





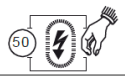
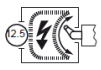
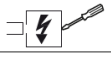
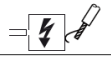
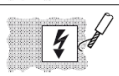
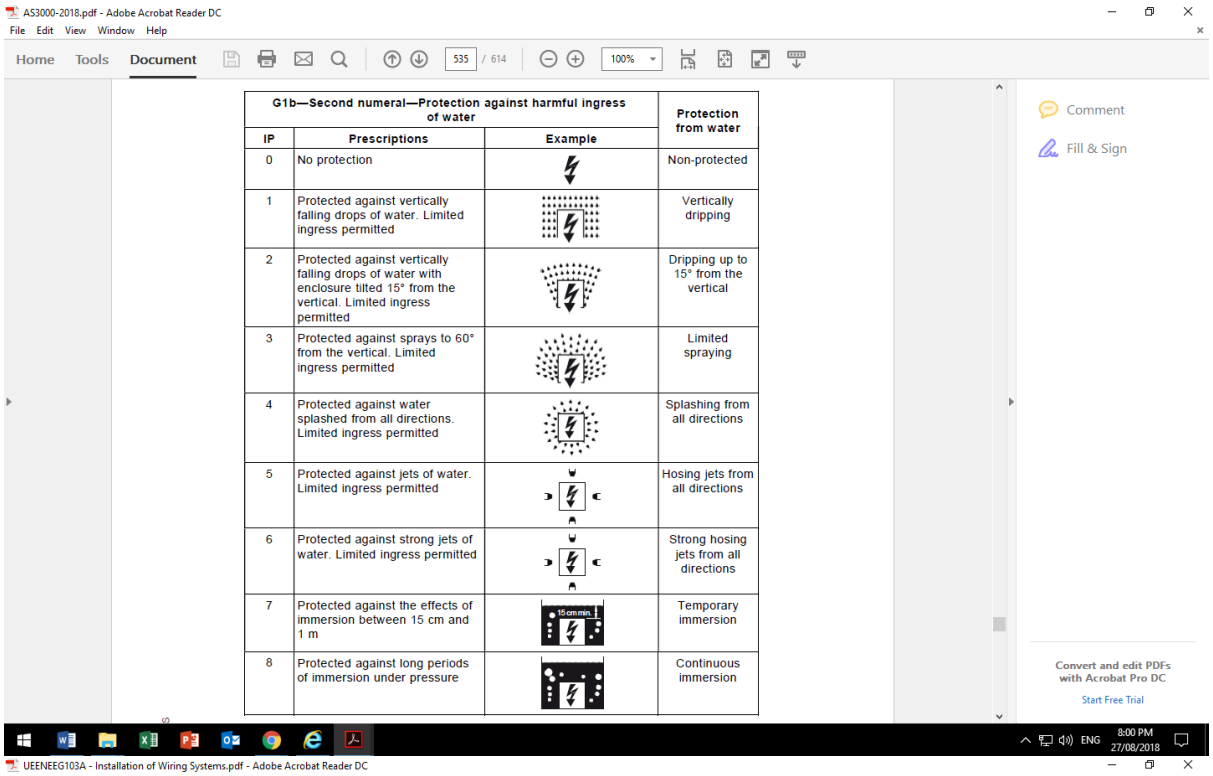
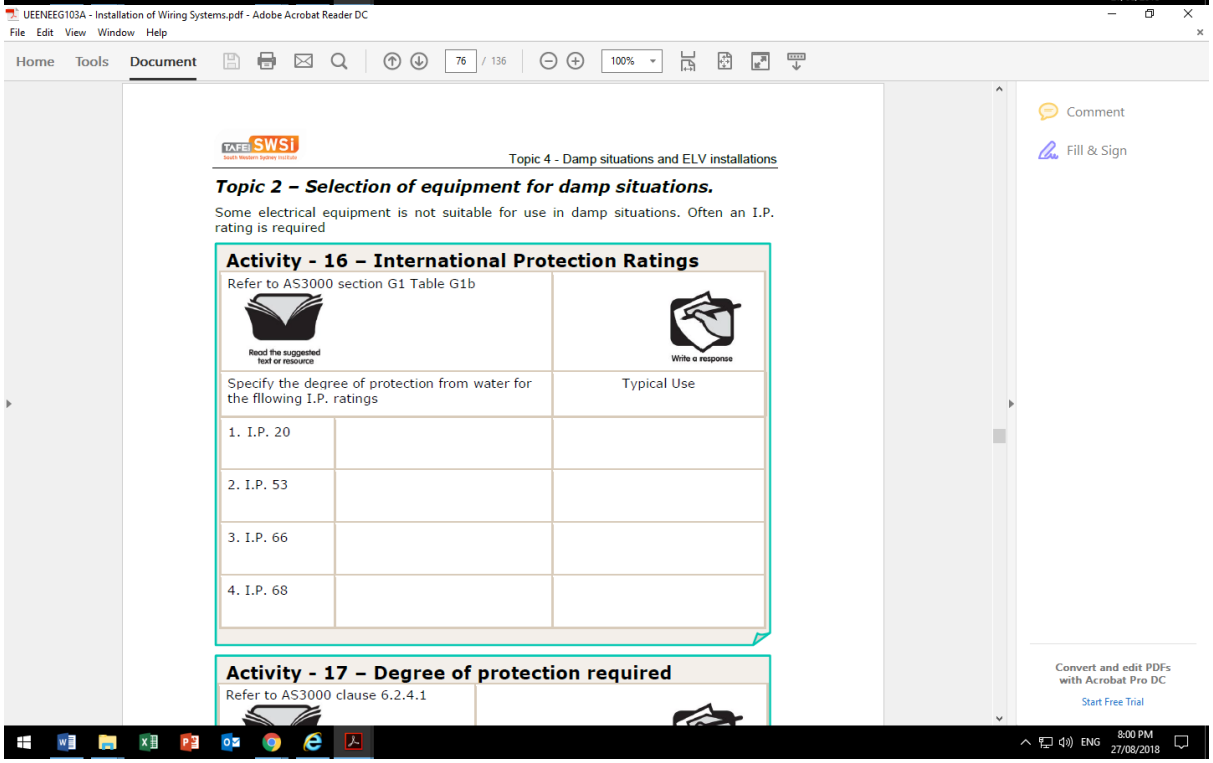
| G1a—First numeral—Protection against ingress of solid objects | | | Protection of persons against access to hazardous parts with |
|---|---|---|---|
| IP | Requirements | Example | |
| 0 | No protection | | Non-protected |
| 1 | Full penetration of 50 mm diameter sphere not allowed. Contact with hazardous parts not permitted |  | Back of hand |
| 2 | Full penetration of 12.5 mm diameter sphere not allowed. The jointed test finger is to have adequate clearance from hazardous parts |  | Finger |
| 3 | The access probe of 2.5 mm diameter is not to penetrate |  | Tool |
| 4 | The access probe of 1.0 mm diameter is not to penetrate |  | Wire |
| 5 | Limited ingress of dust permitted (no harmful deposit) |  | Wire |
| 6 | Totally protected against ingress of dust |  | Wire |

FIGURE G1 (in part) IP CODES



| G1b—Second numeral—Protection against harmful ingress of water | | | Protection from water |
|---|---|---|---|
| IP | Prescriptions | Example | |
| 0 | No protection | | Non-protected |
| 1 | Protected against vertically falling drops of water. Limited ingress permitted | | Vertically dripping |
| 2 | Protected against vertically falling drops of water with enclosure tilted 15° from the vertical. Limited ingress permitted | | Dripping up to 15° from the vertical |
| 3 | Protected against sprays to 60° from the vertical. Limited ingress permitted | | Limited spraying |
| 4 | Protected against water splashed from all directions. Limited ingress permitted | | Splashing from all directions |
| 5 | Protected against jets of water. Limited ingress permitted | | Hosing jets from all directions |
| 6 | Protected against strong jets of water. Limited ingress permitted | | Strong hosing jets from all directions |
| 7 | Protected against the effects of immersion between 15 cm and 1 m | 15 cm min. | Temporary immersion |
| 8 | Protected against long periods of immersion under pressure | | Continuous immersion |



Topic 4 - Damp situations and ELV installations

***Topic 2 – Selection of equipment for damp situations.***

Some electrical equipment is not suitable for use in damp situations. Often an I.P. rating is required

**Activity - 16 – International Protection Ratings**

| Refer to AS3000 section G1 Table G1b (Read the suggested text or resource) | (Write a response) |
|---|---|
| Specify the degree of protection from water for the fllowing I.P. ratings | Typical Use |
| 1. I.P. 20 | |
| 2. I.P. 53 | |
| 3. I.P. 66 | |
| 4. I.P. 68 | |

**Activity - 17 – Degree of protection required**

Refer to AS3000 clause 6.2.4.1

6.2.4 Selection and installation of electrical equipment

6.2.4.1 Degree of protection required

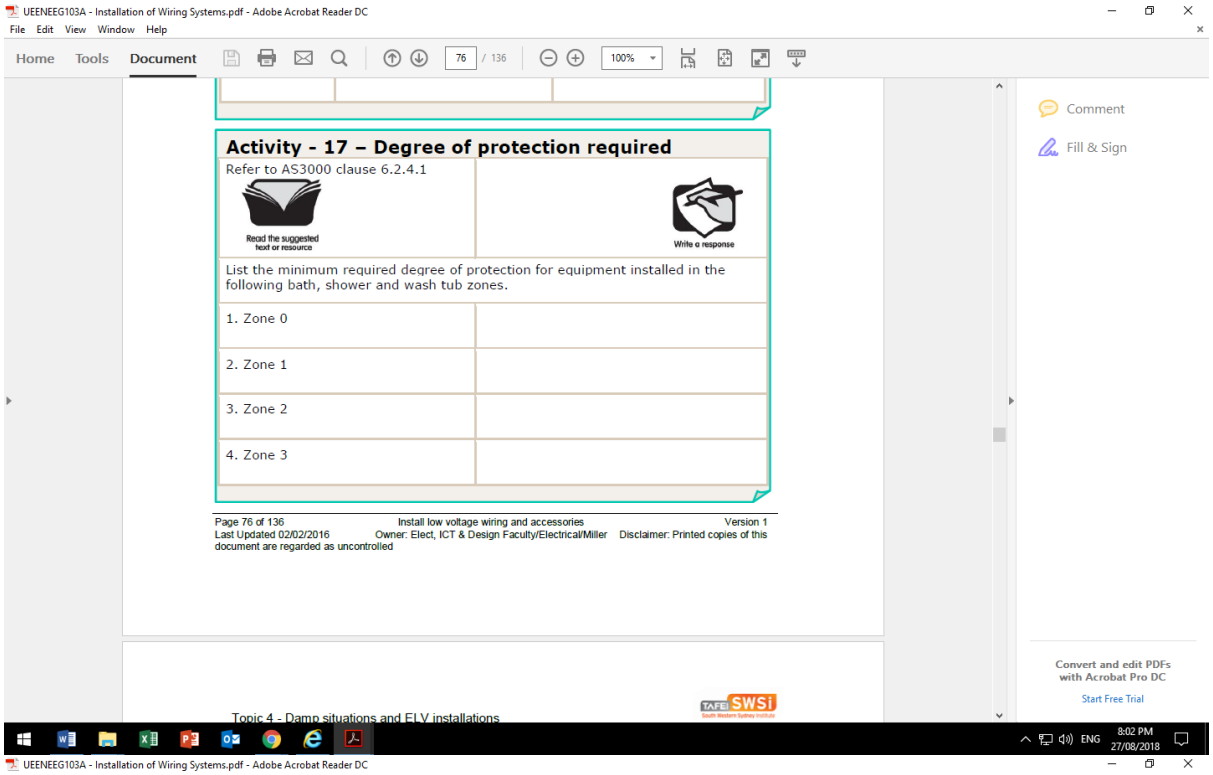
Electrical equipment permitted to be installed in a classified zone shall have at least the following degree of protection:

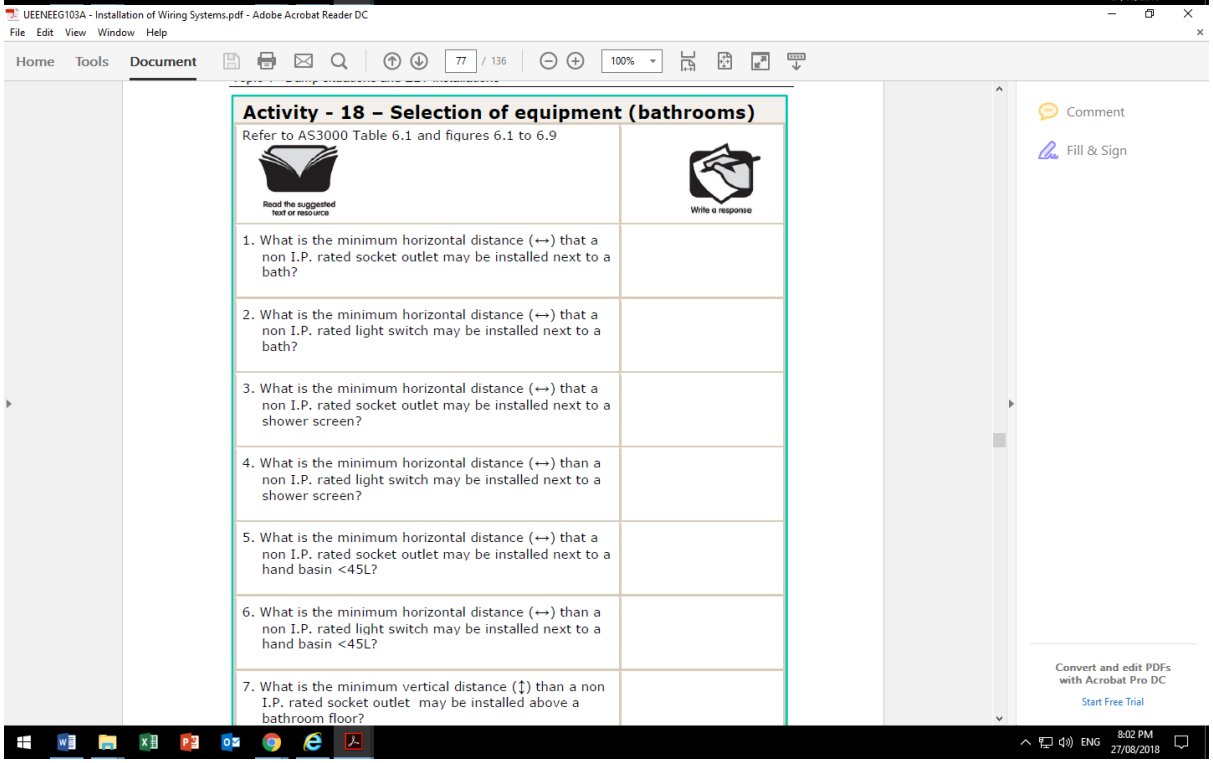
(a) In Zone 0—IPX7.

(b) In Zones 1 and 2—IPX5 in communal baths/showers; IPX4 in other locations.

(c) In Zone 3—IPX5 in communal baths/showers; no specific degree of

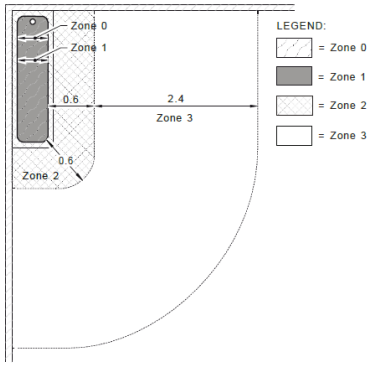
protection in other locations.



| | | | | |
|---|---|---|---|---|
| Electricity generation systems | Not permitted | Not permitted | | |

† Degree of protection IPX5 required in communal baths/showers.



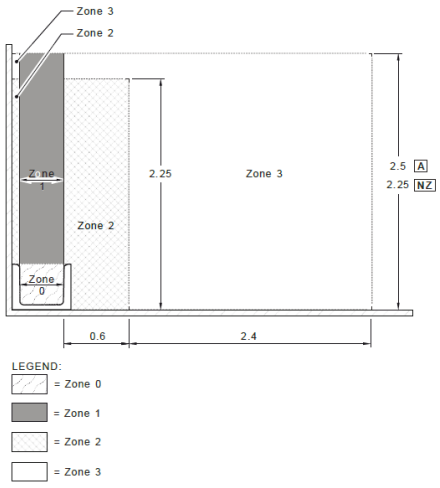

DIMENSIONS IN METRES

FIGURE 6.1 ZONE DIMENSIONS (PLAN)—
BATH WITHOUT SHOWER OR FIXED BARRIER



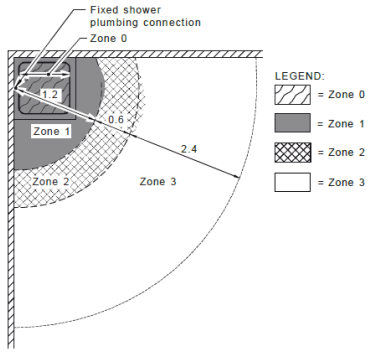







DIMENSIONS IN METRES

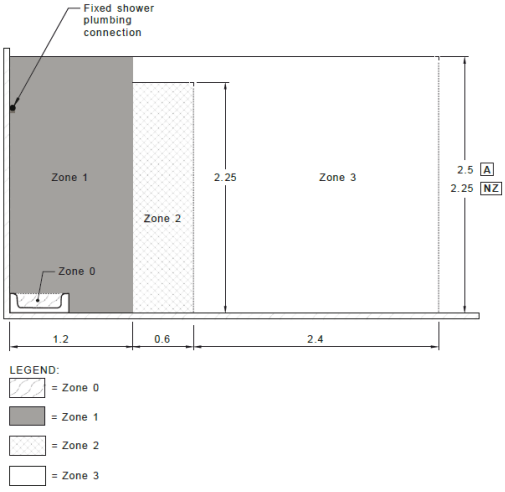
FIGURE 6.2 ZONE DIMENSIONS (ELEVATION)—
BATH WITHOUT SHOWER OR FIXED BARRIER




DIMENSIONS IN METRES

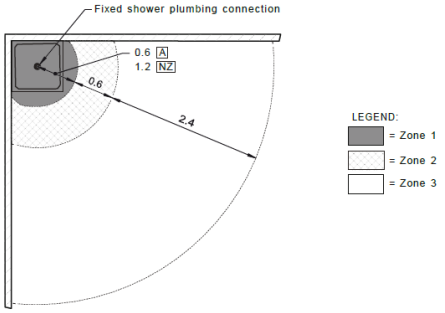
FIGURE 6.3 ZONE DIMENSIONS (PLAN)—SHOWER WITH FIXED PLUMBING CONNECTION ON WALL AND BASE WITHOUT BARRIERS






DIMENSIONS IN METRES

FIGURE 6.4 ZONE DIMENSIONS (ELEVATION)—SHOWER WITH FIXED PLUMBING CONNECTION ON WALL AND BASE WITHOUT BARRIERS




NOTE: Limitation of zones by barriers or enclosures apply, as they do for wall-mounted plumbing connections.

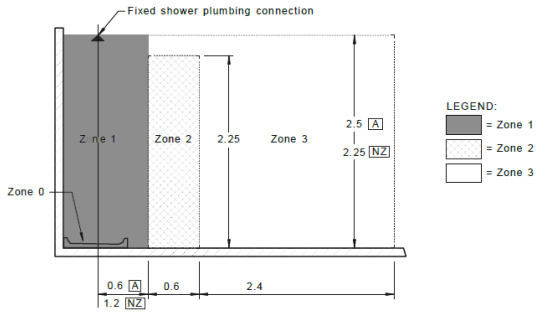
DIMENSIONS IN METRES

FIGURE 6.5 BATHS AND SHOWERS, ZONE DIMENSIONS (PLAN)—
SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING
AND WITHOUT BARRIERS



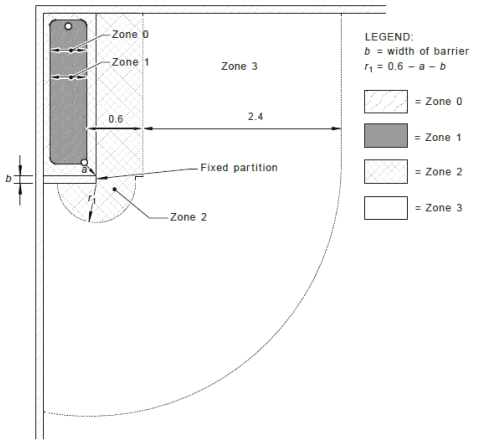







DIMENSIONS IN METRES

FIGURE 6.6 BATHS AND SHOWERS, ZONE DIMENSIONS (ELEVATION)—
SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING
AND WITHOUT BARRIERS



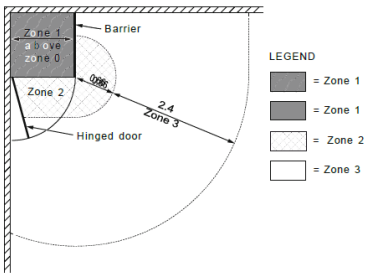

DIMENSIONS IN METRES

FIGURE 6.7 ZONE DIMENSIONS (PLAN)—
BATH WITHOUT SHOWER WITH FIXED BARRIER










DIMENSIONS IN METRES

FIGURE 6.8 ZONE DIMENSIONS (PLAN)—
ENCLOSED SHOWER WITH HINGED DOOR

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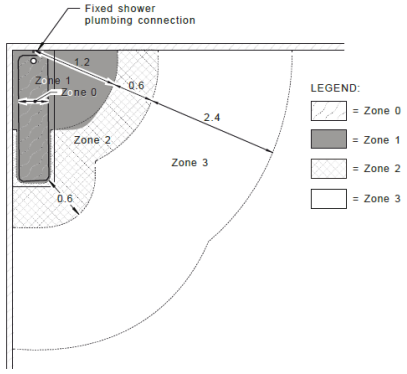


DIMENSIONS IN METRES

FIGURE 6.9 ZONE DIMENSIONS (PLAN)—
BATH WITH SHOWER WITHOUT BARRIER

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## Activity - 19 – Selection of equipment (kitchen)

| Refer to AS3000 Table 6.1 and figure 6.10<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. What is the minimum horizontal distance (↔) that a non I.P. rated socket outlet may be installed next to a kitchen sink <45L? | |
| 2. What is the minimum horizontal distance (↔) that a non I.P. rated light switch may be installed next to a kitchen sink <45L? | |
| 3. What is the minimum vertical height (↕) above a kitchen sink <45L, that a non I.P. rated socket outlet may be installed? | |
| 4. What is the minimum vertical height (↕) above a kitchen sink <45L, that a non I.P. rated light switch may be installed? | |

## Activity - 20 – Selection of equipment (laundry)

Refer to AS3000 Table 6.1 and figure 6.11

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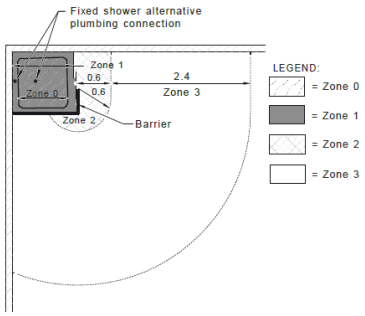



DIMENSIONS IN METRES

FIGURE 6.10 ZONE DIMENSIONS (PLAN)—ENCLOSED SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING OR WALL AND A BARRIER





6.2.4.6 *Switchboards*

A switchboard shall not be located within any classified zone.

**6.2.4.7** *Electricity generation systems*

* Electricity generation systems, including engine-driven generator sets, stand-alone power systems, grid-connected inverter systems and battery systems shall not be installed within any classified zone.

**TABLE 6.1**

**SELECTION AND INSTALLATION OF ELECTRICAL EQUIPMENT FOR BATHS, SHOWERS AND OTHER FIXED WATER CONTAINERS**

| Equipment | Zone 0 | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|---|
| Clause 6.2.4.2—Socket-outlets | Not permitted | Not permitted | (a) A shaver outlet; or<br>(b) RCD-protected and in a cupboard (no specific IP rating). | (a) <0.3 m not permitted<br>(b) ≥0.3 m no IP rating† but shall have—<br>(i) RCD protection;<br>(ii) separated supply; or<br>(iii) SELV or PELV supply. |
| Clause 6.2.4.3—Switches/ accessories | Not permitted | Same as Zone 2 | <0.3 m not permitted<br>≥0.3 m IPX4† | <0.3 m not permitted<br>≥0.3 m—No IP rating† |

(*continued*)

| | |
|---|---|
| kitchen sink <45L? | |
| 3. What is the minimum vertical height (↕) above a kitchen sink <45L, that a non I.P. rated socket outlet may be installed? | |
| 4. What is the minimum vertical height (↕) above a kitchen sink <45L, that a non I.P. rated light switch may be installed? | |

## Activity - 20 – Selection of equipment (laundry)

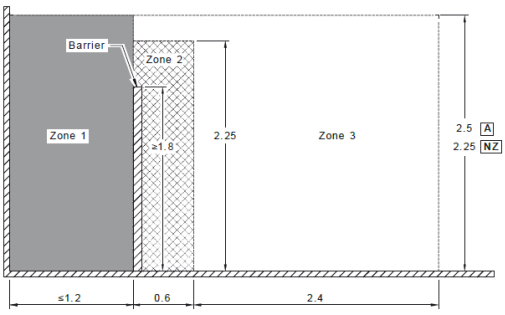
| | |
|---|---|
| Refer to AS3000 Table 6.1 and figure 6.11<br>Read the suggested text or resource | Write a response |
| 1. What is the minimum horizontal distance (↔) that a non I.P. rated socket outlet may be installed next to a laundry tub >45L? | |
| 2. What is the minimum horizontal distance (↔) that a non I.P. rated light switch may be installed next to a laundry tub >45L? | |
| 3. What is the minimum vertical height (↕) above a laundry tub >45L, that a non I.P. rated socket outlet may be installed? | |
| 4. What is the minimum vertical height (↕) above a laundry tub >45L, that a non I.P. rated light switch may be installed? | |









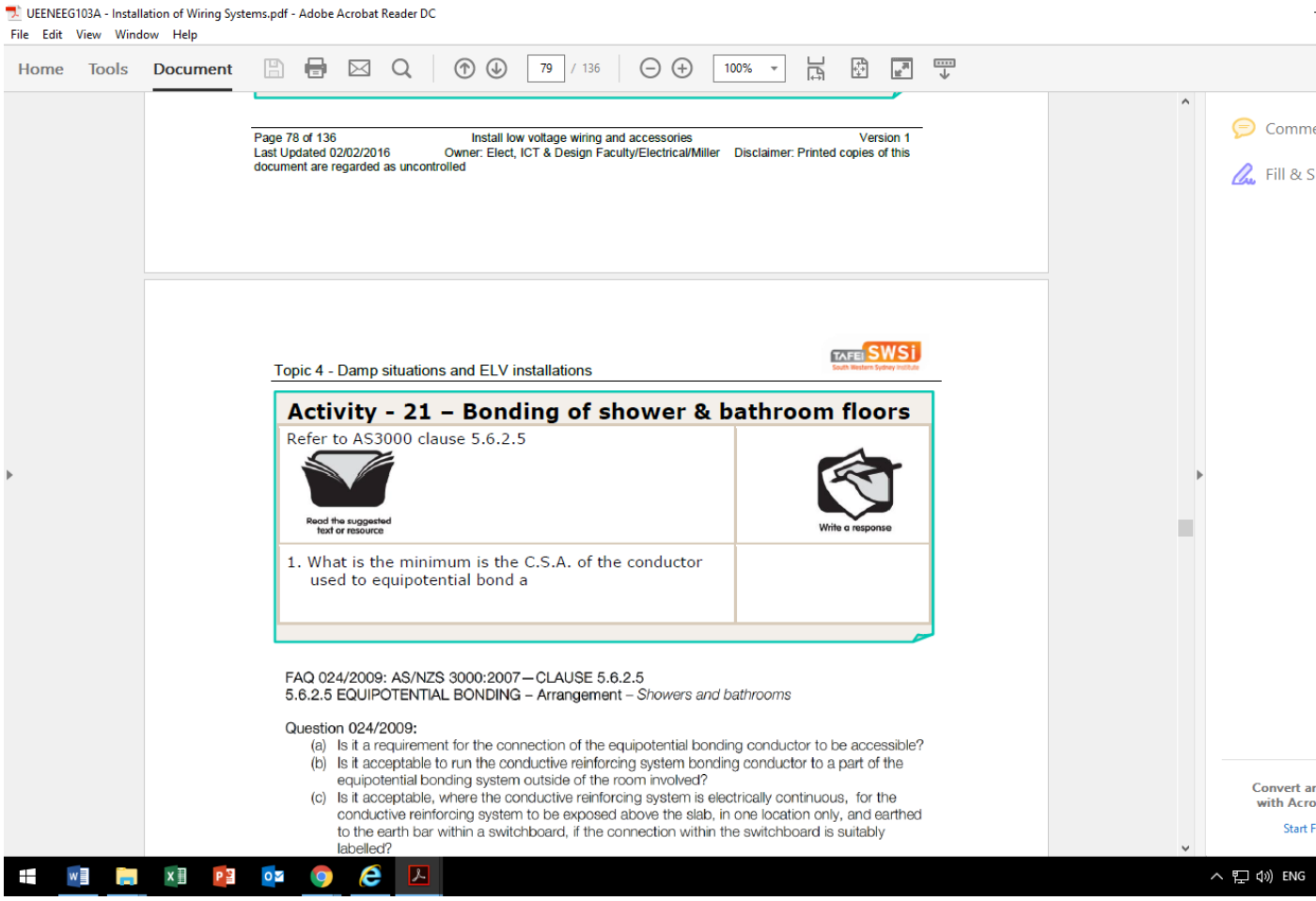



LEGEND:
= Zone 1
= Zone 2
= Zone 3

NOTE: Refer to Clause 6.2.2.1(a) for Zone 0.

DIMENSIONS IN METRES

* FIGURE 6.11 ZONE DIMENSIONS (ELEVATION)—SHOWER WITH FIXED PLUMBING CONNECTION ON CEILING OR WALL AND A BARRIER



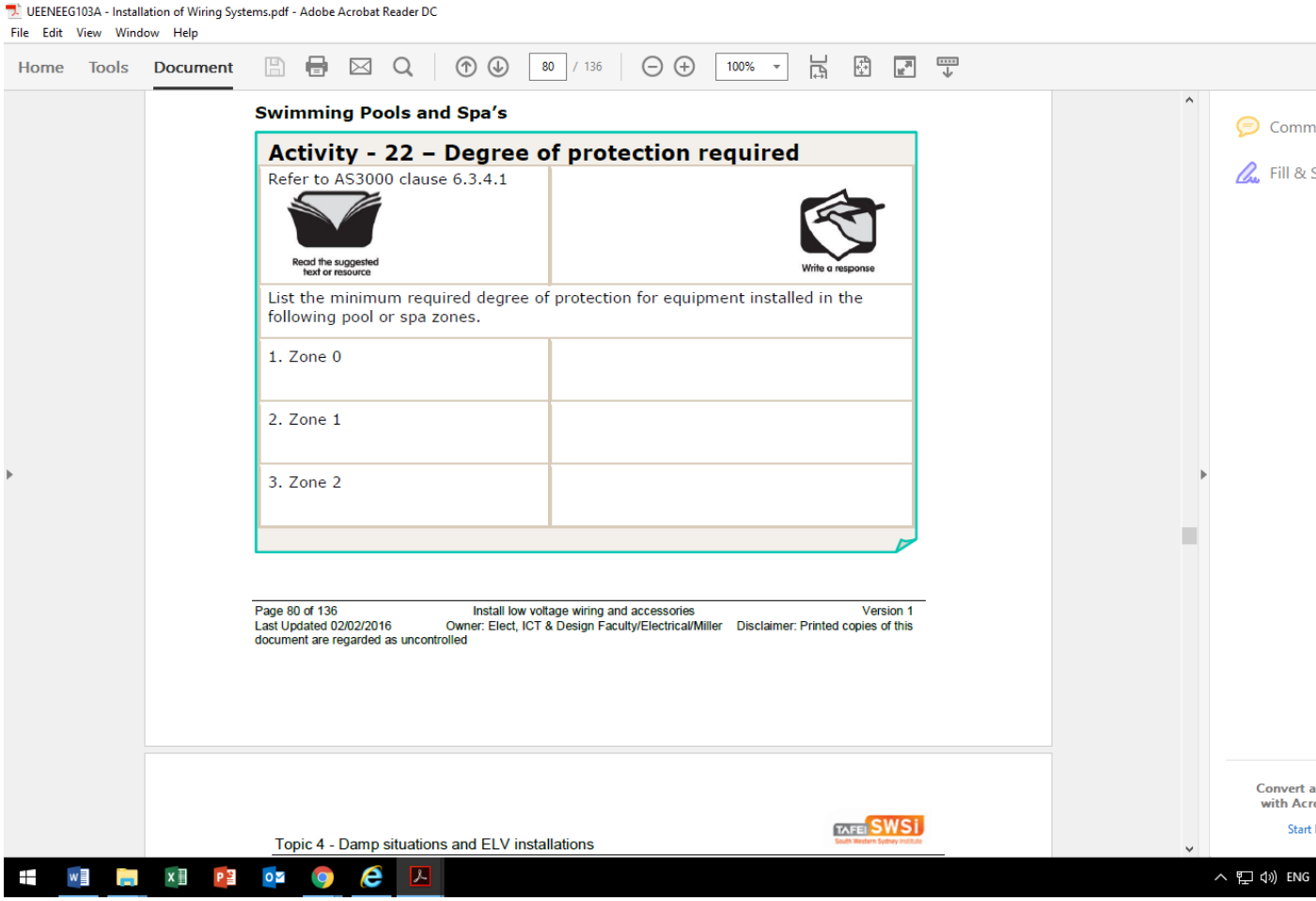

5.6.2.5 Showers and bathrooms

Any conductive reinforcing within a concrete floor or wall of a room containing a shower or bath shall be bonded to the earthing system of the electrical installation.

An equipotential bonding conductor, in accordance with Clause 5.6.3, shall be connected between the reinforcing material and any part of the earthing system.

* For a combined outbuilding, each structure within that outbuilding that contains a shower or bathroom shall contain its own individual bonding connection to the conductive reinforcing within that structure.

* Providing the reinforcement is electrically continuous across the whole of the combined outbuilding (refer to Note 3), one bonding conductor connecting the reinforcement to the earth bar or link of the switchboard that supplies all of the combined outbuilding is satisfactory.




6.3.4 Selection and installation of electrical equipment

6.3.4.1 Degree of protection required

Electrical equipment permitted to be installed in a classified zone shall have at least the following degree of protection:

(a) In Zone 0–IPX8.

(b) In Zone 1–IPX5.

(c) In Zone 2–IPX4.

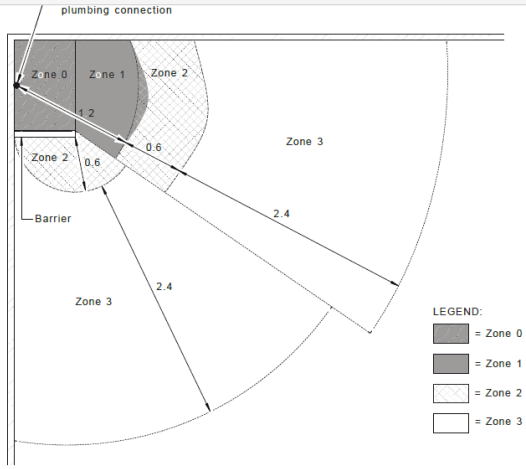
## Activity - 23 – Selection of equipment (pool and spa)

| Refer to AS3000 Table 6.2 and figures 6.12 to 6.15<br>Read the suggested text or resource | Write a response |
|---|---|
| 1. Is it permissible to install a I.P. 53 rated 10A socket outlet at a horizontal distance (↔) of 1.5m from the internal rim of the pool to supply the pool pump and salt water chlorinator. (without further enclosure) | |
| 2. Is it permissible to install a I.P. 56 rated 10A socket outlet at a horizontal distance (↔) of 1.5m from the internal rim of the pool to supply general equipment | |
| 3. What are the requirements for light switches installed in zone 1 of a pool or spa zone? | |
| 4. What are the requirements for light switches installed in zone 2 of a pool or spa zone? | |
| 5. What are the requirements for pool lights installed in zone 0 of a pool or spa zone? | |
| 6. Is it permissible to install a 230V light fitting at a horizontal distance (↔) of 2.1m from the internal rim of the pool. | |
| 7. What is the maximum permissible residual current | |



### SELECTION AND INSTALLATION OF ELECTRICAL EQUIPMENT FOR SWIMMING POOLS, PADDLING POOLS AND SPA POOLS OR TUBS

| Equipment | Zone 0 | Zone 1 | Zone 2 |
|---|---|---|---|
| Clause 6.3.4.3—Socket-outlets | Not permitted | Not permitted for general use<br>For pool equipment only:<br>(a) IPX5.<br>(b) (i) ≥0.45 m high; and ≥1.25 m from internal rim; or<br>(ii) under and ≥0.5 m from edge of fixed continuous horizontal barrier ≥1.25 m wide.<br>(c) (i) separated supply;<br>(ii) SELV or PELV supply; or<br>(iii) RCD protection. | IPX4 and—<br>(a) separated supply;<br>(b) SELV or PELV supply; or<br>(c) RCD protection. |
| Clause 6.3.4.4—Switches/accessories | Not permitted | IPX5 | IPX4 |
| Clause 6.3.4.5(a), (b) and (c)—Luminaires, appliances and other equipment | IPX8; and specifically for use; and 12 V a.c./30 V d.c. SELV or PELV supply from source outside zone<br>No earth | IPX5 and—<br>(a) SELV or PELV supply;<br>(b) Class II construction (double or reinforced insulation); or<br>(c) Class I construction (earthed conductive parts), fixed in position and RCD protection. | IPX4 and—<br>(a) SELV or PELV supply;<br>(b) separated supply;<br>(c) Class II construction (double or reinforced insulation); or<br>(d) Class I construction (earthed conductive parts), |



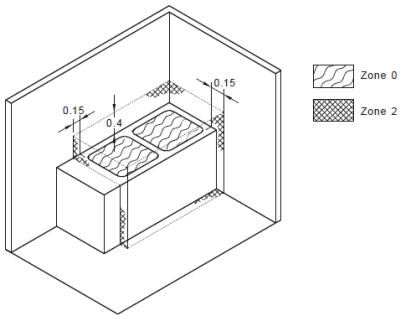

DIMENSIONS IN METRES

FIGURE 6.12 ZONE DIMENSIONS (PLAN)—PARTIALLY ENCLOSED SHOWER WITH FIXED PLUMBING CONNECTION ON WALL



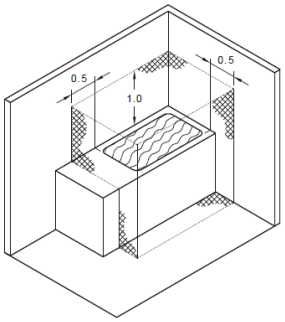







DIMENSIONS IN METRES

* FIGURE 6.13 ZONE DIMENSIONS FOR OTHER FIXED WATER CONTAINERS WITH FIXED WATER OUTLETS WHERE NO CONTAINER HAS A CAPACITY EXCEEDING 40 L




DIMENSIONS IN METRES

* FIGURE 6.14 ZONE DIMENSIONS FOR OTHER FIXED WATER CONTAINERS WITH A FLEXIBLE WATER OUTLET OR WITH A CAPACITY EXCEEDING 40 L

### 6.3 SWIMMING POOLS, PADDLING POOLS AND SPA POOLS OR TUBS

#### 6.3.1 Scope

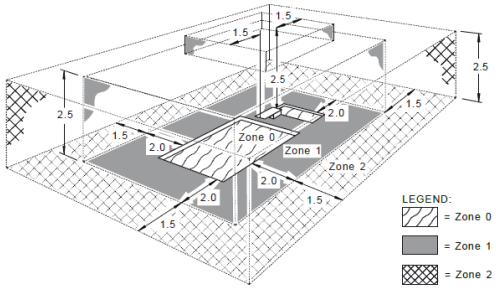
**The particular requirements of this Clause (Clause 6.3) apply to electrical installations in locations containing swimming pools,**





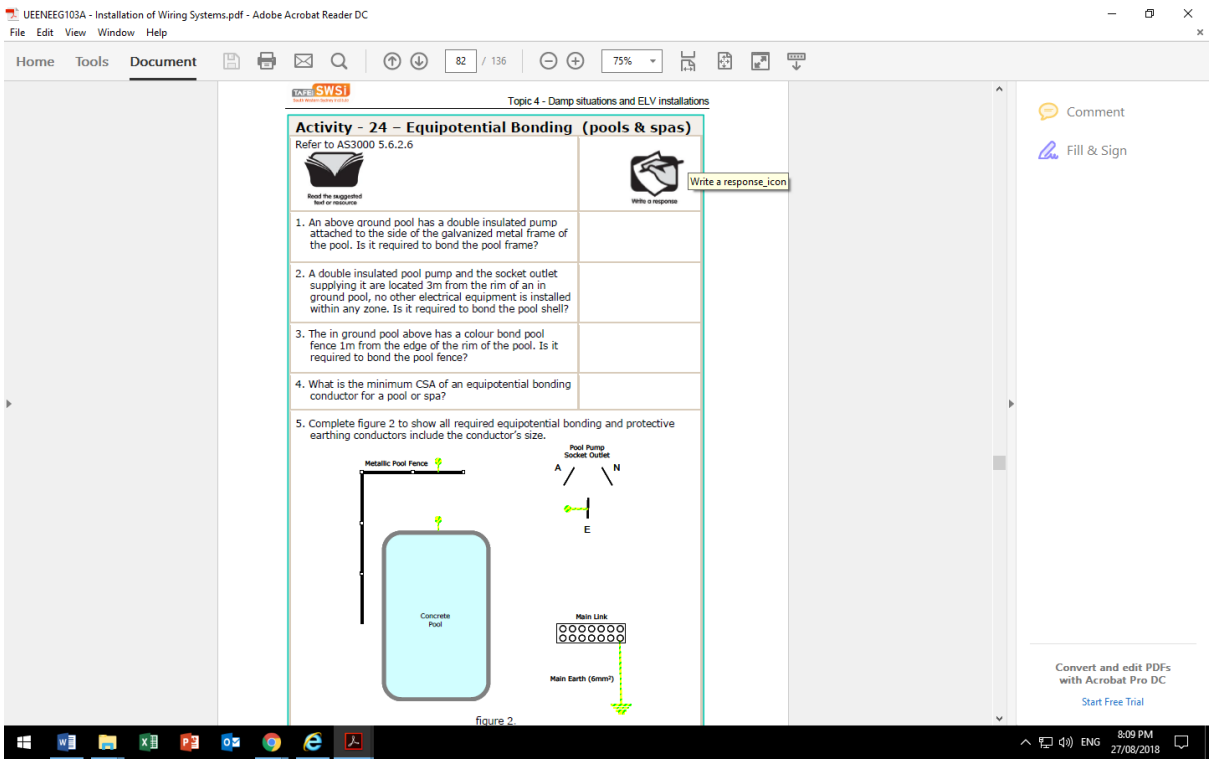
TABLE 6.2 *(continued)*

| Equipment | Zone 0 | Zone 1 | Zone 2 |
|---|---|---|---|
| Clause 6.3.4.6—Switchboards | Not permitted | Not permitted | Not permitted |
| * Clause 6.3.4.7—Electricity generation systems | Not permitted | Not permitted | Not permitted |
| * Clause 6.3.4.8—Electricity distributor's electrical equipment | Not permitted | Not permitted | Not permitted |




DIMENSIONS IN METRES

FIGURE 6.15 ZONE DIMENSIONS OF IN-GROUND SWIMMING POOLS




5.6.2.6 Swimming and spa pools

* 5.6.2.6.1 Bonding arrangement

An equipotential bonding conductor, in accordance with Clause 5.6.3, shall be connected between—

(a) the conductive pool structure and the pool equipotential bonding conductor connection point specified in Clauses 5.6.2.6.2 and 5.6.2.6.3;

(b) the items of electrical equipment specified in Clause 5.6.2.6.4;

(c) the conductive fixtures and fittings specified in Clause 5.6.2.6.5; and

(d) the earthing conductors associated with each circuit supplying the pool or spa, or the earthing bar at the switchboard at which the circuits originate.

The resistance of an equipotential bonding conductor connected between the items listed (a) to (d) shall not exceed 0.5 ·.

* A bonding arrangement for pools and spas is provided in Figure 5.9.

5.6.2.6.2 Conductive pool structures

Where the pool structure is conductive, all extraneous conductive parts, including the reinforcing metal of the pool shell or deck, shall be connected to a pool equipotential bonding conductor connection point complying with Clause 5.6.2.6.3.

The connection point shall also be bonded to the earthing conductors associated with each circuit supplying the pool or spa, or the earthing bar at the switchboard at which the circuits originate.

* Where the pool structure is conductive, the connection point shall be installed and bonded to the installation earthing system regardless of other requirements specified in Clauses 5.6.2.6.4 and 5.6.2.6.5.

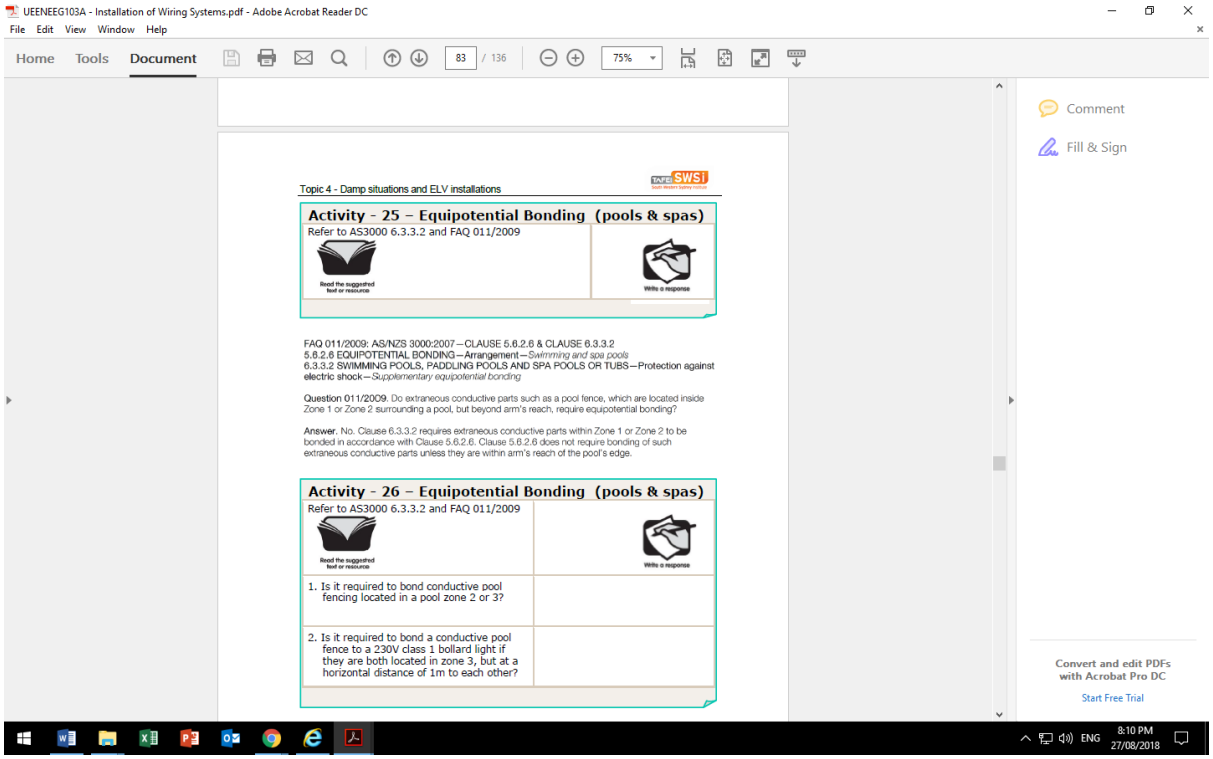
Exception: This requirement need not apply where the reinforcing metal of

the pool shell or deck is electrically continuous (0.5 · ) to the reinforcing metal within the concrete floor of the electrical installation, and that reinforcing metal has been bonded to the earthing system of the electrical installation as required in Clause 5.6.2.5.

NOTES:

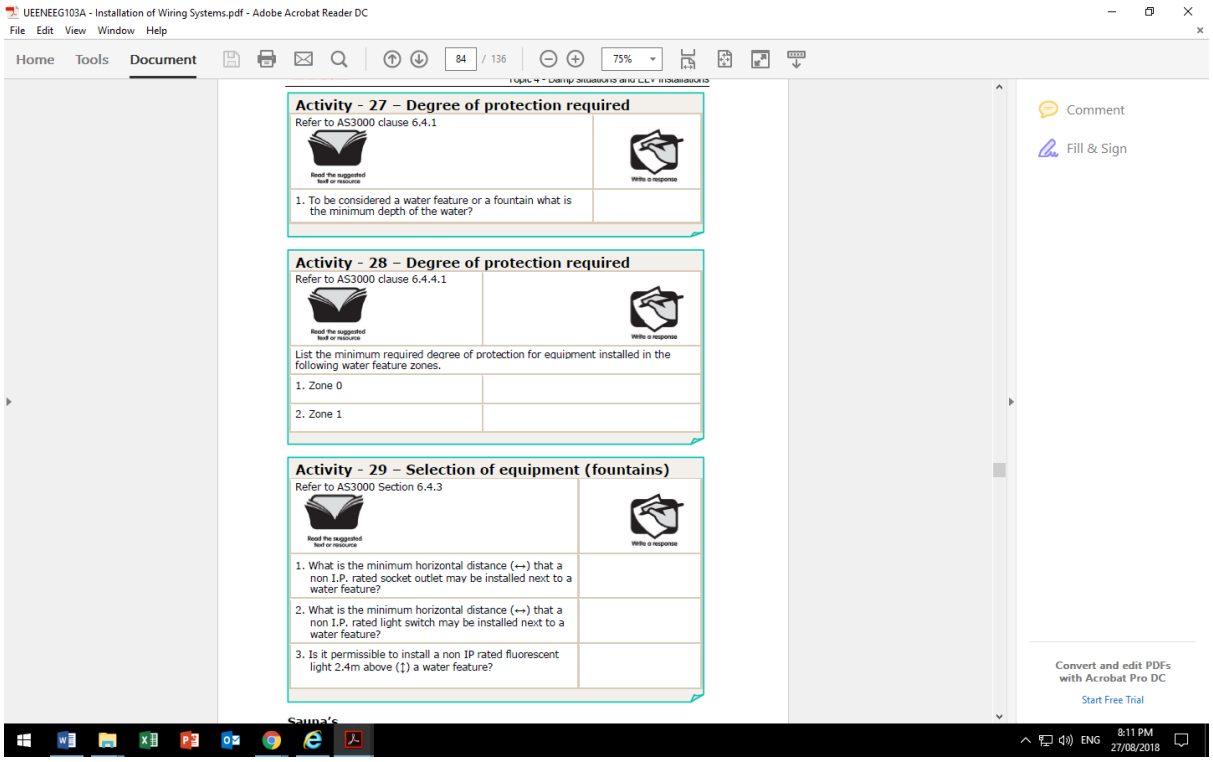
1 Connections to the conductive reinforcement of the pool will generally be subject to the effects of water during the construction phase and to subsequent dampness.

2 Conductive tie-wires used during construction of reinforced concrete pools are considered to be an adequate electrical bond between the conductive reinforcing components. Provided that the reinforcement is satisfactorily electrically connected together, one point of connection of the bonding conductor to the reinforcement is sufficient.




6.3.3.2 Supplementary equipotential bonding

Where electrical equipment situated in a classified zone is required to be earthed, all extraneous conductive parts in Zones 0, 1 and 2 shall be connected together by equipotential bonding conductors and connected to the protective earthing conductor of the electrical equipment, in accordance with Clause 5.6.2.6.




6.4.1 Scope

The particular requirements of this Clause (Clause 6.4) apply to the electrical installations associated with water containers of fountains and water features and their surrounding zones where the risk of electric shock is increased by a reduction in body with the water and conductive structure(s) in contact with the general mass of earth.

These requirements are based on the classification of zones surrounding the water container associated with the fountain or water feature and are intended to–

(a) protect electrical material and electrical equipment from the corrosive effects of chemicals used in the treatment of water in fountains and water features; and

(b) counter the increased risks of using electrical equipment in areas where the body may be partially immersed in water.

6.4.4.1 Degree of protection required

Electrical equipment permitted to be installed in the classified zone shall have at least the following degree of protection:

(a) In Zone 0–IPX8.

(b) In Zone 1–IPX5.

The requirements for selection and installation of electrical equipment are provided in Table 6.3.

6.4.3 Protection against electric shock

6.4.3.1 Use of SELV

Where SELV is used, regardless of the nominal voltage, basic protection shall be provided in accordance with Clause 7.5.5.

6.4.3.2 Application of protective measures against electric shock

6.4.3.2.1 Supply

Electrical equipment shall be—

(a) earthed and protected by an RCD with a fixed rated residual current not exceeding 30 mA

b) supplied at either extra-low voltage or low voltage through an isolating transformer complying with AS/NZS 61558, and not earthed; or

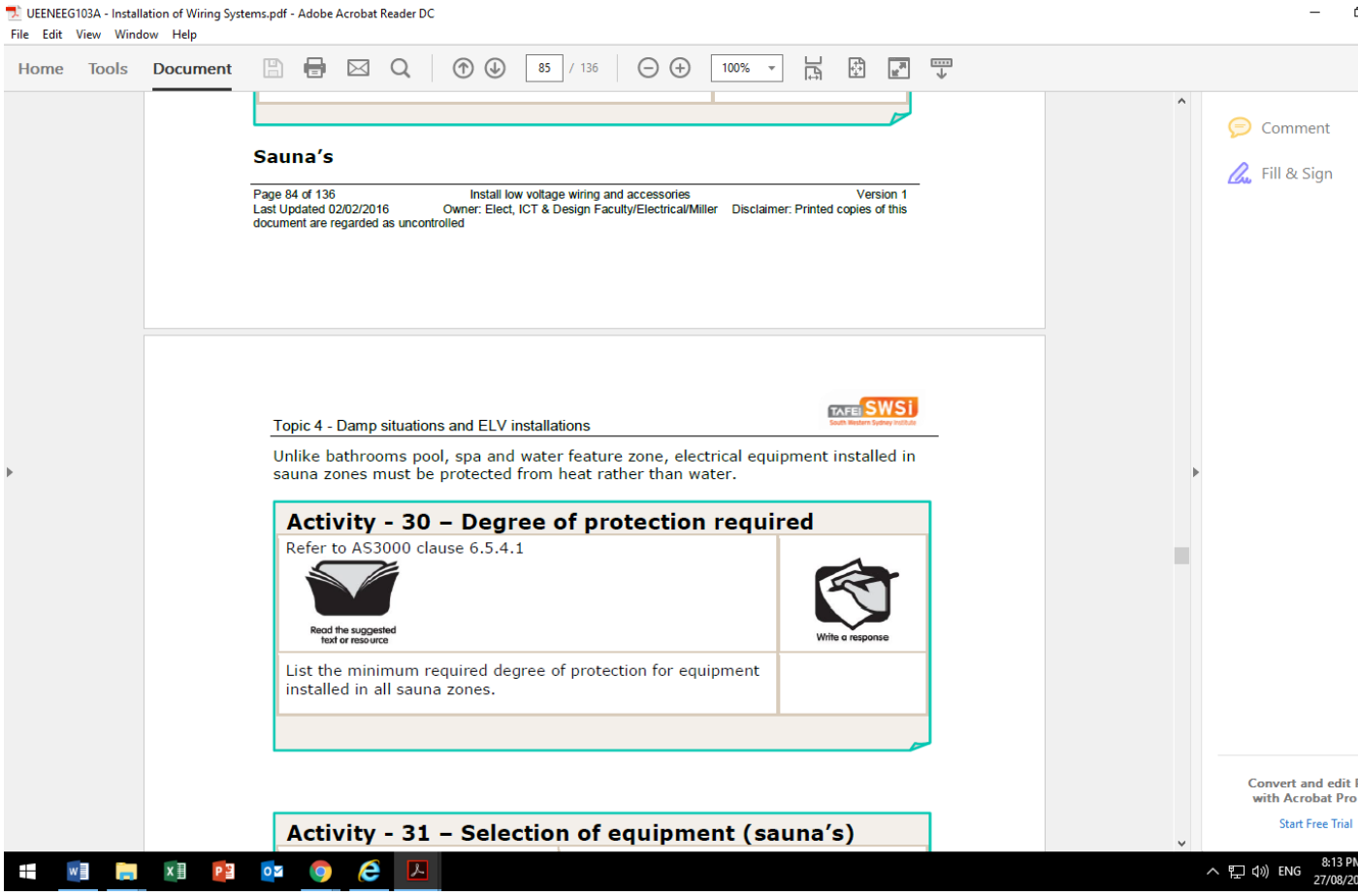
(c) supplied by other suitable measures that take account of the electrical equipment construction, installation methods and physical location.

6.4.3.2.2 Prohibited measures

The following measures of protection against electric shock are prohibited and shall not be used:

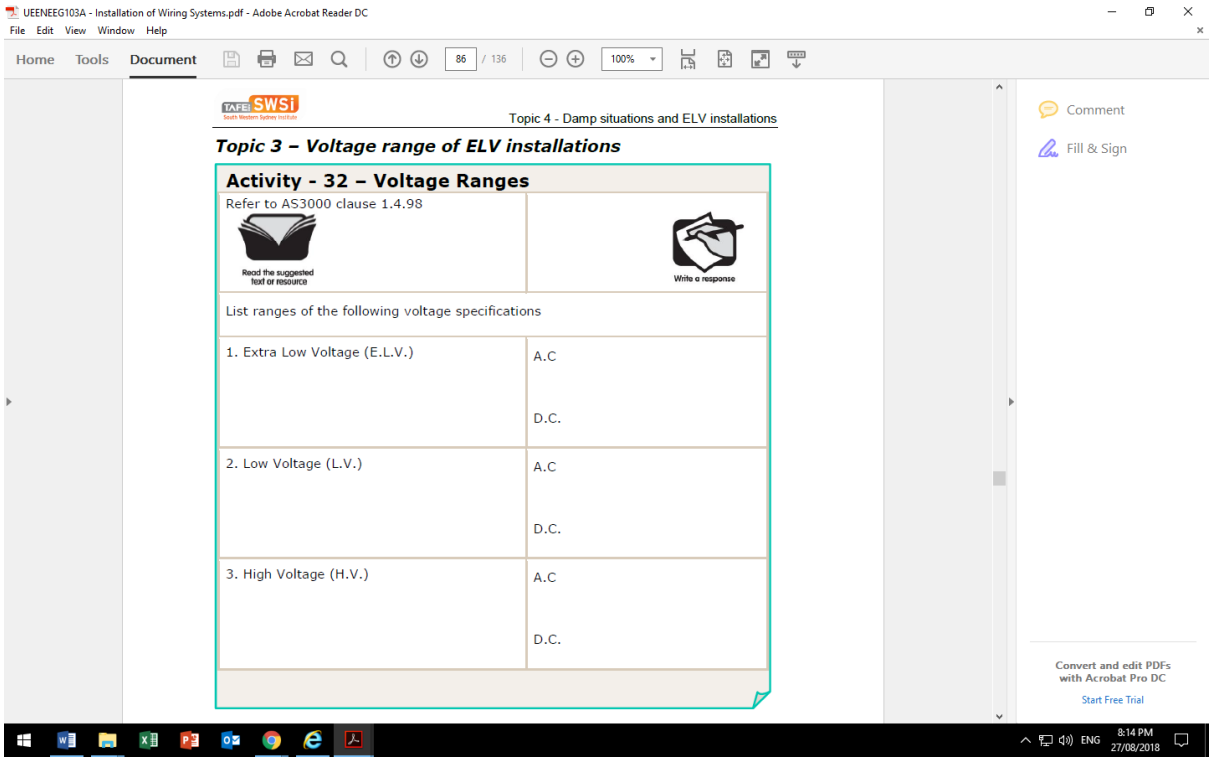
(a) Protection by means of obstacles, in accordance with Clause 1.5.4.5.

(b) Protection by placing out of reach, in accordance with Clause 1.5.4.6




6.5.4.1 Degree of protection required

Electrical equipment installed within the sauna room shall have a degree of protection of at least IPX4B or IP24.



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Topic 4 - Damp situations and ELV installations

***Topic 3 – Voltage range of ELV installations***

**Activity - 32 – Voltage Ranges**

| | |
|---|---|
| Refer to AS3000 clause 1.4.98<br>Read the suggested text or resource | Write a response |
| List ranges of the following voltage specifications | |
| 1. Extra Low Voltage (E.L.V.) | A.C<br>D.C. |
| 2. Low Voltage (L.V.) | A.C<br>D.C. |
| 3. High Voltage (H.V.) | A.C<br>D.C. |

1.4.128 Voltage

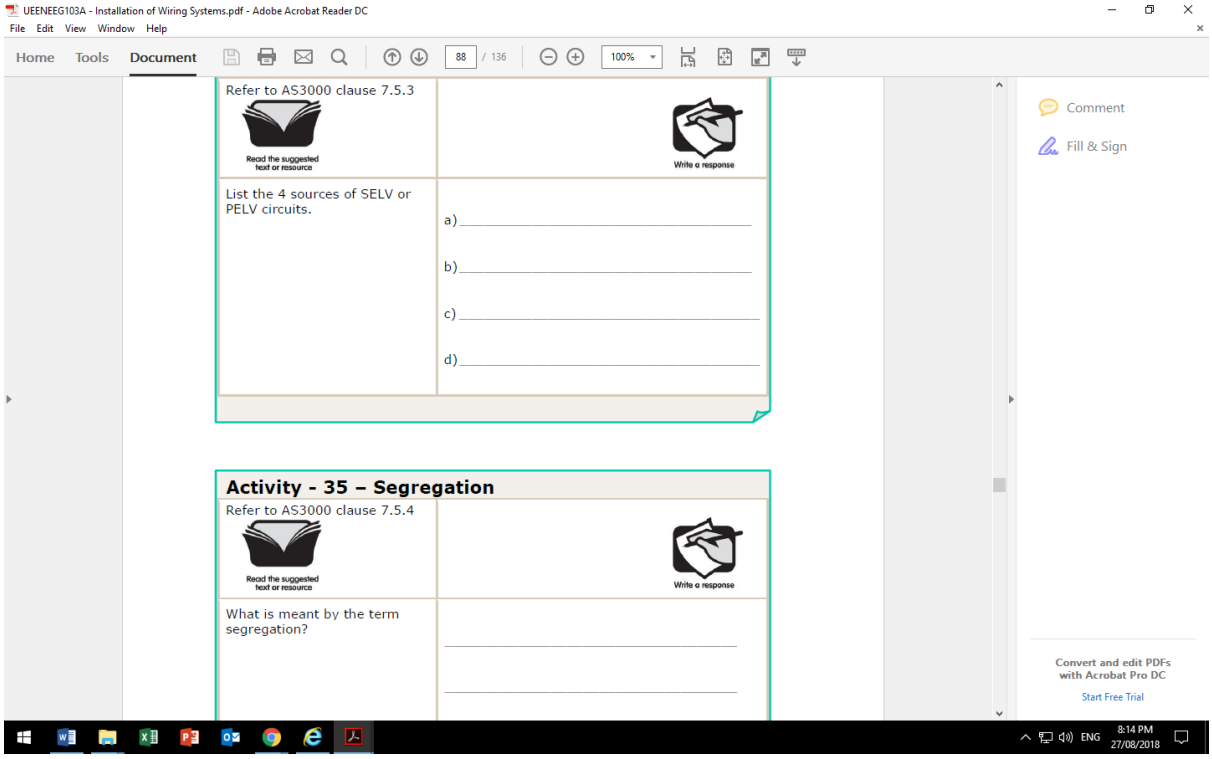
Differences of potential normally existing between conductors or between conductors and earth as follows:

(a) Extra-low voltage Not exceeding 50 V a.c. or 120 V ripple-free d.c.

(b) Low voltage Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

(b) High voltage Exceeding low voltage.

(c)



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| | |
|---|---|
| Refer to AS3000 clause 7.5.3<br>Read the suggested text or resource | Write a response |
| List the 4 sources of SELV or PELV circuits. | a) _____<br>b) _____<br>c) _____<br>d) _____ |

**Activity - 35 – Segregation**

| | |
|---|---|
| Refer to AS3000 clause 7.5.4<br>Read the suggested text or resource | Write a response |
| What is meant by the term segregation? | _____<br>_____ |

7.5.3 Sources of supply to SELV and PELV systems

The source supplying a SELV or PELV system shall be one of the following:

(a) A safety isolating transformer complying with AS/NZS 61558.

(b) A source of current independent of a higher voltage supply, such as an engine-driven generator, or an electrochemical source, such as a battery.

(c) A source of current separated from higher voltage electrical installations, such as a motor-generator set, with electrically separate windings having a degree of electrical separation equivalent to that specified by Item (a).

(d) Certain electronic devices complying with appropriate Standards, where, in the case of an internal fault, the voltage at the output terminals cannot exceed extra-low voltage. Higher voltages at the output terminals may be used, provided that the voltage at the output terminals is immediately reduced to extra-low voltage if contact is made with live parts under normal or fault conditions.

(a) NOTE: Such devices include insulation testing equipment.

7.5.4 Separation requirements for SELV and PELV circuits

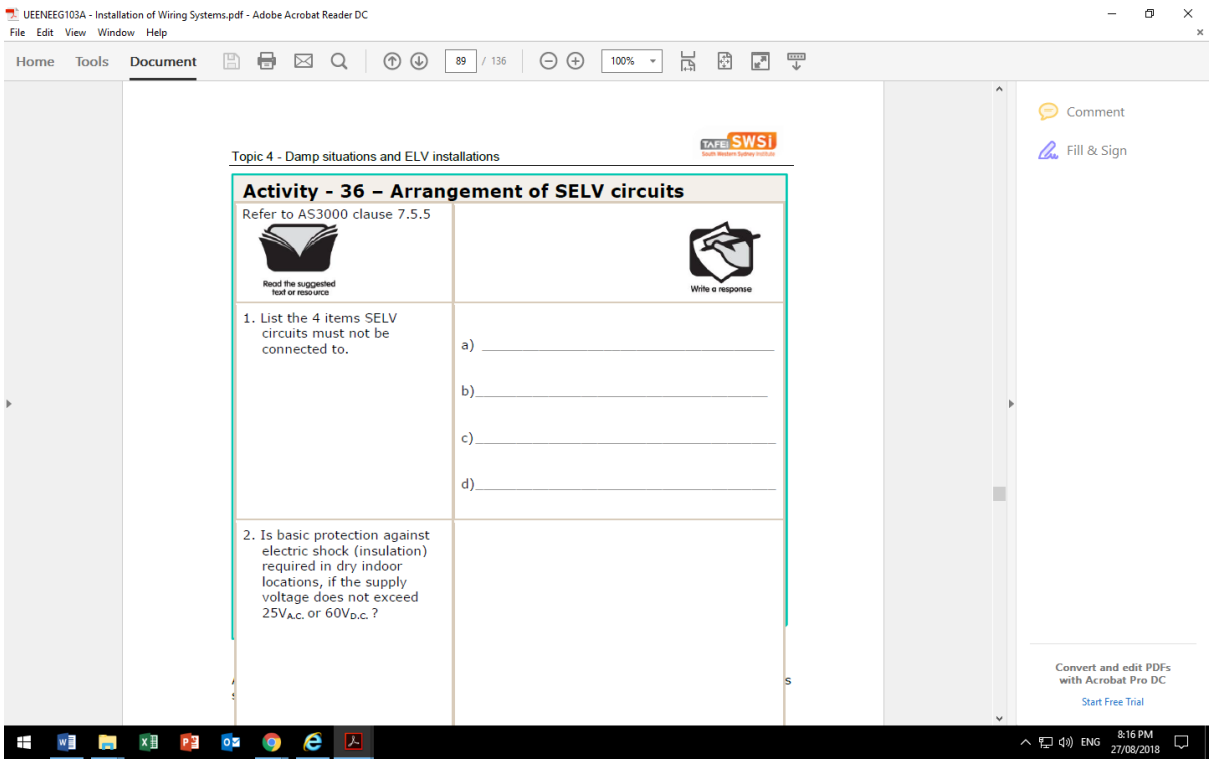
Live parts of SELV and PELV circuits shall be electrically separated from each other and from other higher voltage circuits.

Arrangements shall ensure a level of electrical separation equivalent to that between the input and output of a safety isolating transformer complying with AS/NZS 61558.

SELV and PELV circuit conductors shall be segregated from those of other circuit conductors.

Exception: SELV and PELV circuit conductors installed in accordance with Clause 3.9.8.3 may be contained within the same wiring system as low voltage circuits.

Live parts shall be arranged so that short-circuit or arcing, either between live parts or between live parts and other conductive material, will not take place under the conditions that may reasonably be expected in service.




7.5.5 Arrangement of SELV circuits

Live parts of SELV circuits shall not be connected to earth or protective earthing conductors that are part of other circuits or to other live parts.

SELV circuits shall not be connected to–

(a) other circuits;

(b) earth;

(c) earthing conductors or exposed conductive parts of another system; or

(d) extraneous conductive parts.

Exception: Connection to extraneous conductive parts may be made where electrical equipment is inherently required to be so connected and it is ensured that the extraneous conductive parts cannot attain a voltage exceeding that of the SELV circuit.

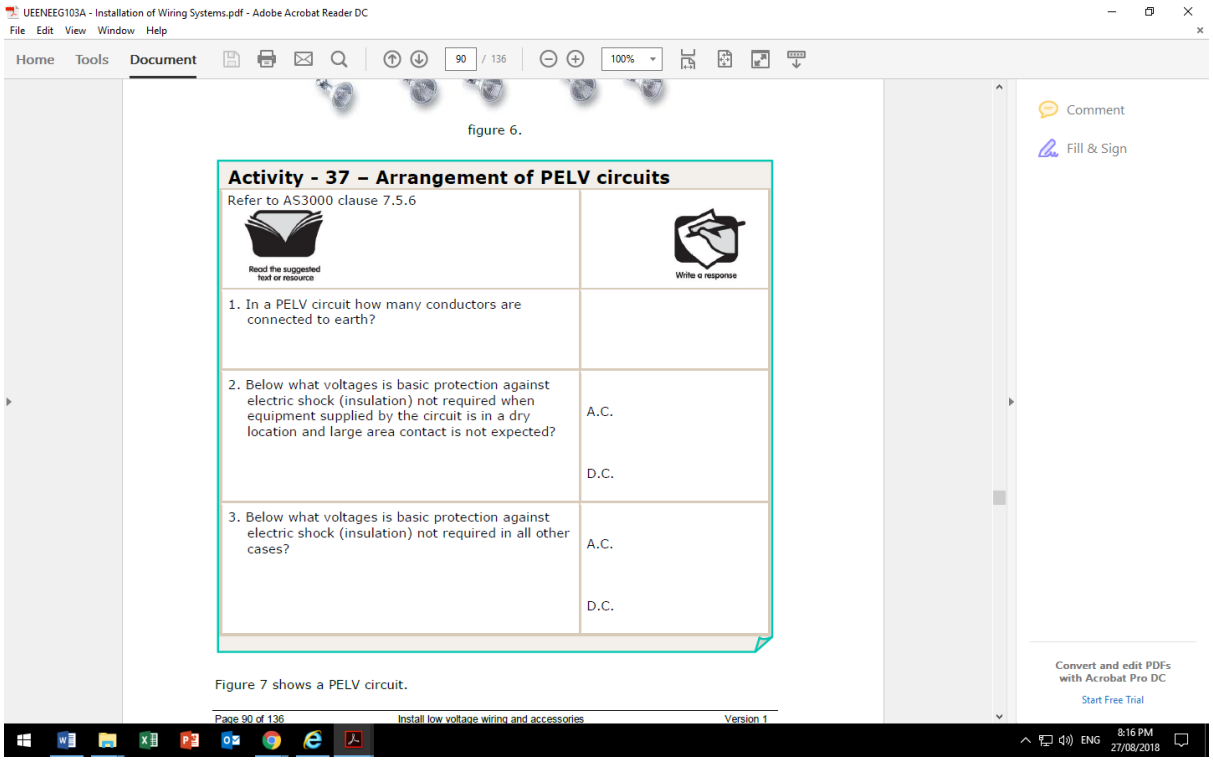


figure 6.

**Activity - 37 – Arrangement of PELV circuits**

Refer to AS3000 clause 7.5.6

Read the suggested text or resource

Write a response

| | |
|---|---|
| 1. In a PELV circuit how many conductors are connected to earth? | |
| 2. Below what voltages is basic protection against electric shock (insulation) not required when equipment supplied by the circuit is in a dry location and large area contact is not expected? | A.C.<br>D.C. |
| 3. Below what voltages is basic protection against electric shock (insulation) not required in all other cases? | A.C.<br>D.C. |

Figure 7 shows a PELV circuit.





7.5.6 Arrangement of PELV circuits

The following applies for PELV circuits, where one conductor of the output circuit is earthed.

Basic protection shall be provided by—

(a) barriers or enclosures affording a degree of protection of at least IPXXB or IP2X; or

(b) insulation capable of withstanding a test voltage of 500 V a.c. for 1 min.

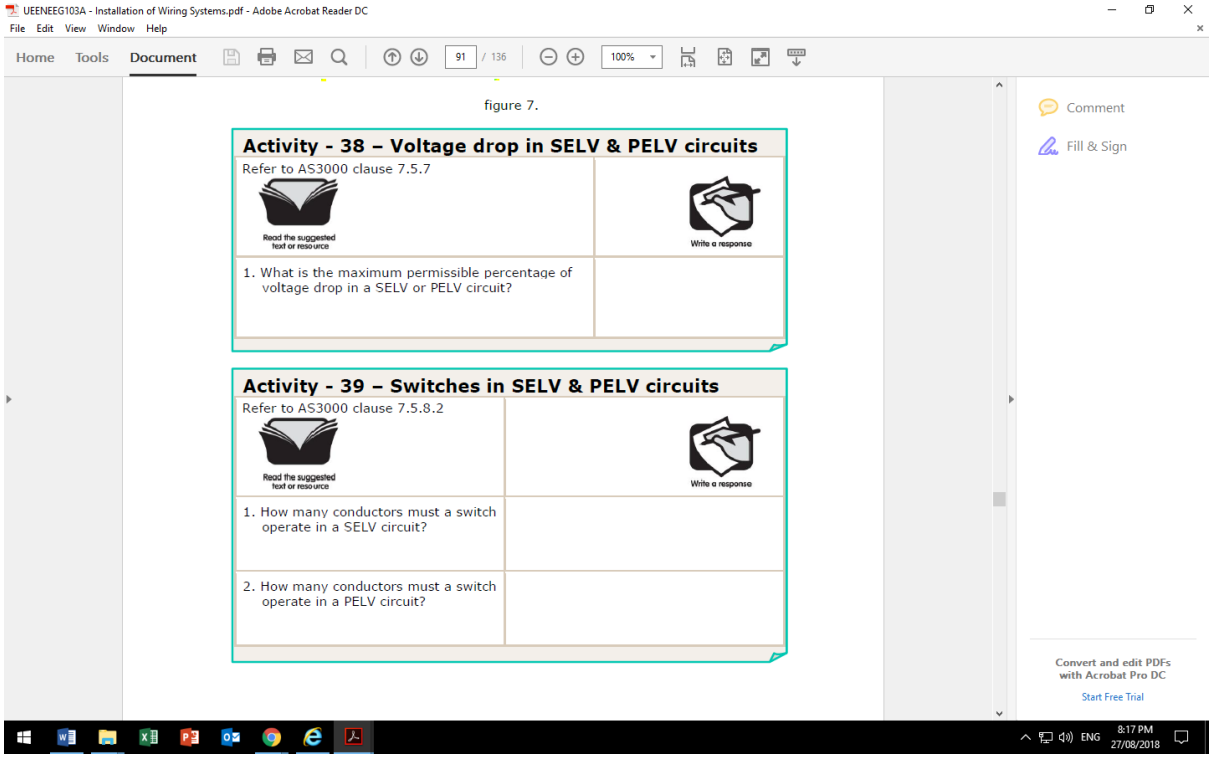


figure 7.

**Activity - 38 – Voltage drop in SELV & PELV circuits**

Refer to AS3000 clause 7.5.7

Read the suggested text or resource

Write a response

| | |
|---|---|
| 1. What is the maximum permissible percentage of voltage drop in a SELV or PELV circuit? | |

**Activity - 39 – Switches in SELV & PELV circuits**

Refer to AS3000 clause 7.5.8.2

Read the suggested text or resource

Write a response

| | |
|---|---|
| 1. How many conductors must a switch operate in a SELV circuit? | |
| 2. How many conductors must a switch operate in a PELV circuit? | |

7.5.7 Voltage drop in conductors

The drop in voltage at any point in an extra-low voltage electrical installation shall not exceed 10% of the nominal value when all live conductors are carrying the circuit-operating current.

NOTE: Information on voltage drop is given in the AS/NZS 3008.1 series.

Exception: This requirement need not apply where electrical equipment is specially designed for operation with a voltage drop greater than 10%.

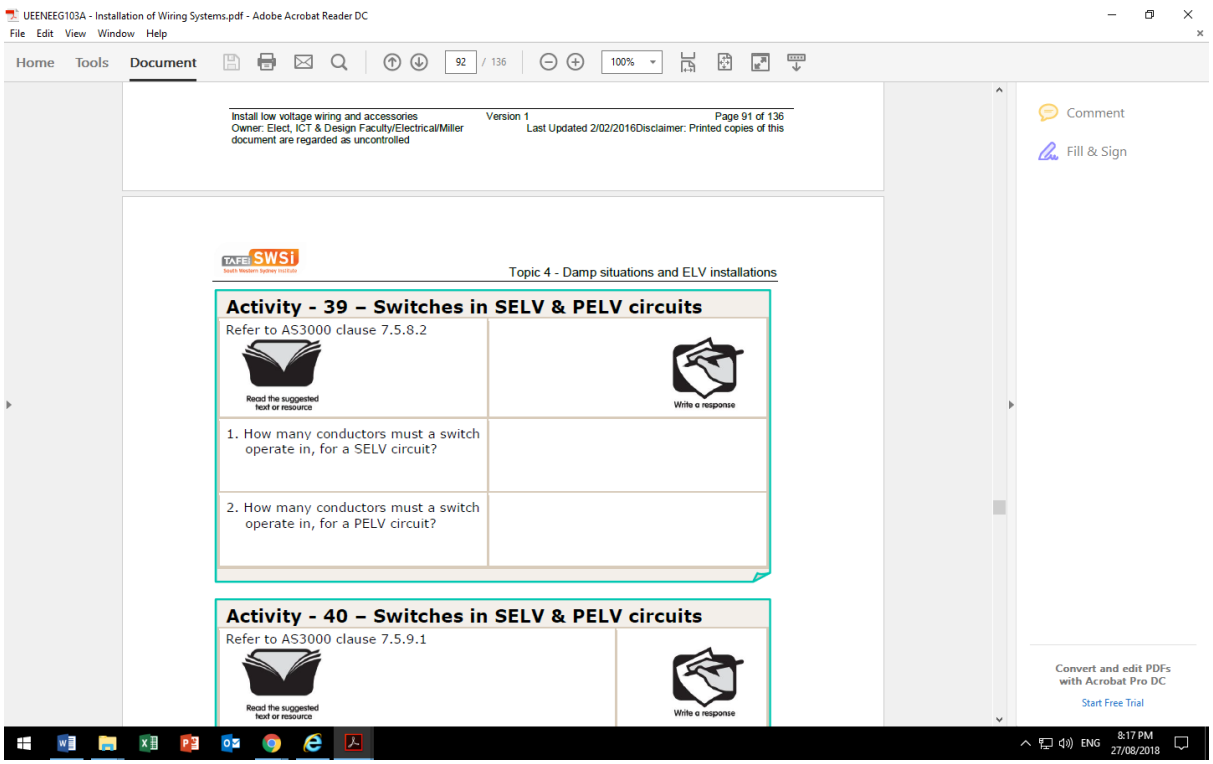
NOTE: Motor starting, solenoid closing and other similar applications where high transient currents may be experienced that can significantly increase voltage drop, are excluded from consideration.

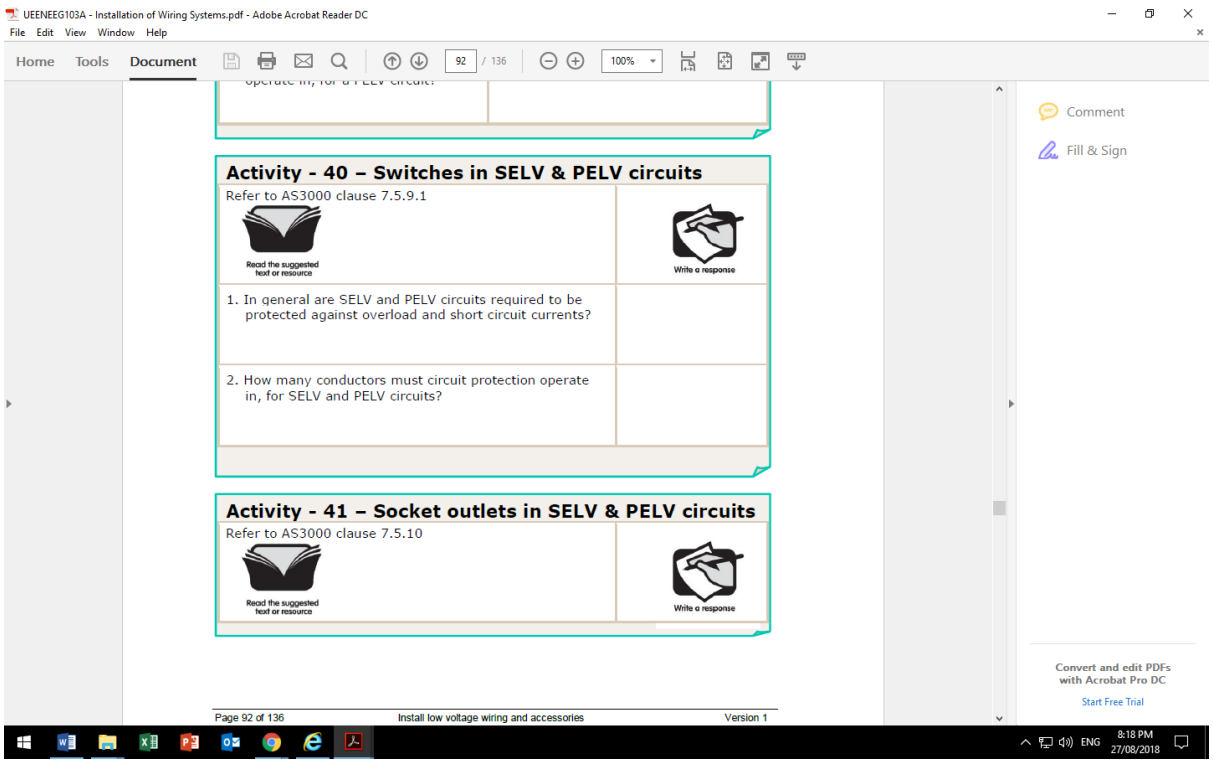
7.5.8.2 Other switches

Switches in an extra-low voltage electrical installation shall comply with the following:

(a) A switch shall operate in all unearthed conductors where the extra-low voltage supply is earthed at the point of supply, e.g. PELV.

(b) Switches may operate in one less conductor than the number of conductors in the circuit, e.g. SELV.






7.5.9.1 General

Every extra-low voltage circuit shall be individually protected at its origin against overload and short-circuit currents by a protective device that–

(a) shall comply with the applicable requirements of Clauses 2.2 and 2.5; and

(b) may be provided in one conductor less than the number of conductors in the circuit.

Where the extra-low voltage supply is earthed at the point of supply, the protective devices shall be installed in all the unearthed conductors.

Exception: Circuits arranged in accordance with Clause 7.5.9.2 need not be provided with overcurrent protection

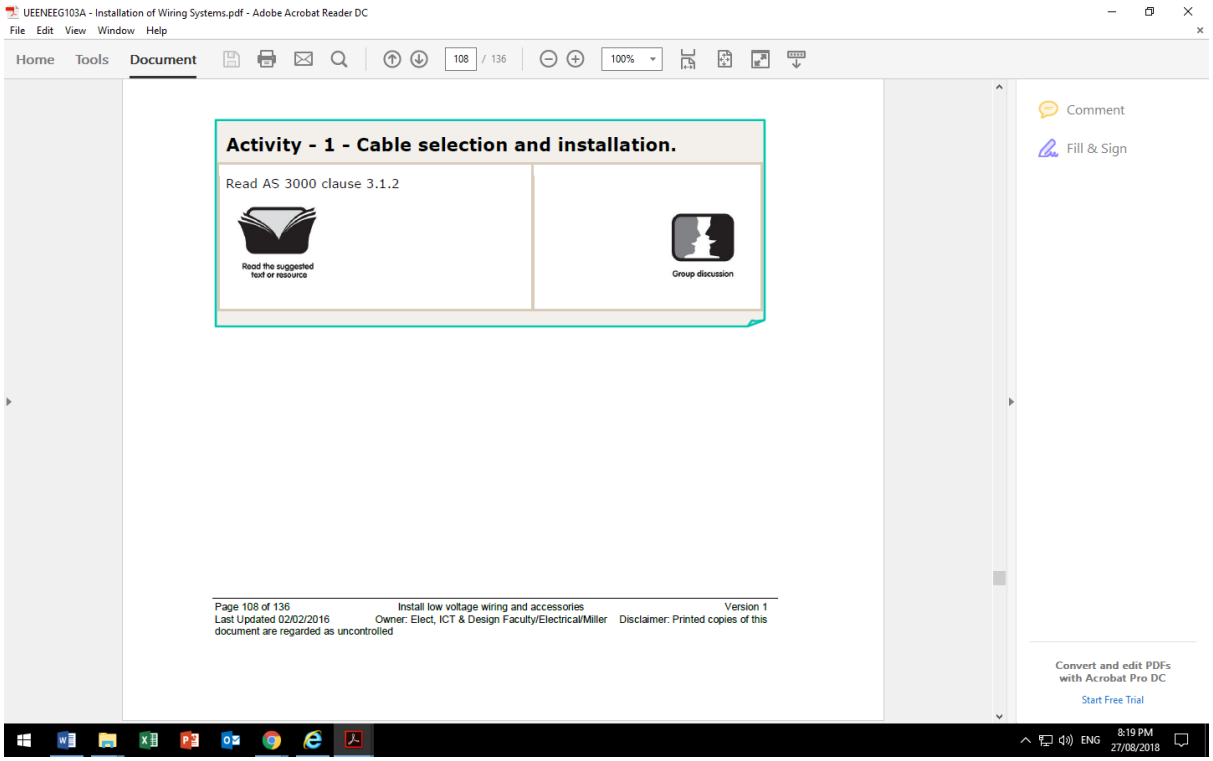
7.5.10 Connecting devices

Plug and socket-outlet devices, including installation couplers, for SELV and PELV shall comply with the following:

(a) Plugs shall not be able to enter sockets of other voltage systems.

(b) Sockets shall not accept plugs of other voltage systems.

(c) Sockets shall not have a contact for a protective earthing conductor.




3.1.2 Selection and installation

Wiring systems shall be selected and installed to perform the following functions or have the following features:

(a) Protect against physical contact with live parts by durable insulation materials or by placing live parts out of reach.

(b) Satisfy current-carrying capacity, voltage drop and other minimum size requirements for conductors.

(c) Provide reliability and electrical continuity of connections, joints and terminations.

(d) Provide adequate strength of supports, suspensions and fixings.

(e) Suit intended use, including applications requiring a particular type of wiring system, e.g. fire-resistance, explosion protection, safety services.

(f) Protect against mechanical damage, environmental and other external influences by enclosure or other means.

(g) Installed in accordance with the requirements of this Section and the additional requirements as specified in the manufacturer’s instructions

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## Activity - 2 - Installation conditions.

| | |
|---|---|
| Read AS 3000 Table 3.1<br>  <br> |  |
| Give examples of cables installed;<br>Unenclosed<br>• On a surface<br>• On a surface partly surrounded by thermal insulation<br>• On a surface fully surrounded by thermal insulation<br>• Buried direct in the ground | |
| In an enclosure<br>• On a surface<br>• On a surface and partly surrounded by thermal insulation<br>• Fully surrounded by thermal insulation<br>• Underground, | |
| Supported on a catenary system | |
| Supported on insulators | |

Comment

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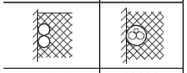
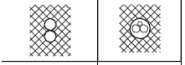
**TABLE 3.1**

**CABLE TYPES AND THEIR APPLICATION IN WIRING SYSTEMS**

| Installation method | Description | Typical cable types |
|---|---|---|
|  Unenclosed | On a surface (including cable tray or ladder) | Insulated and sheathed<br>Screened or armoured |
|  Unenclosed | On a surface partly surrounded by thermal insulation | Mineral insulated, metal sheathed (MIMS)<br>Earthing conductors |
|  Unenclosed | Fully surrounded by thermal insulation | |
|  Unenclosed | Buried direct in the ground, subject to the requirements of Clause 3.11 | Insulated and sheathed, screened or armoured, earthing conductors |

(*continued*)





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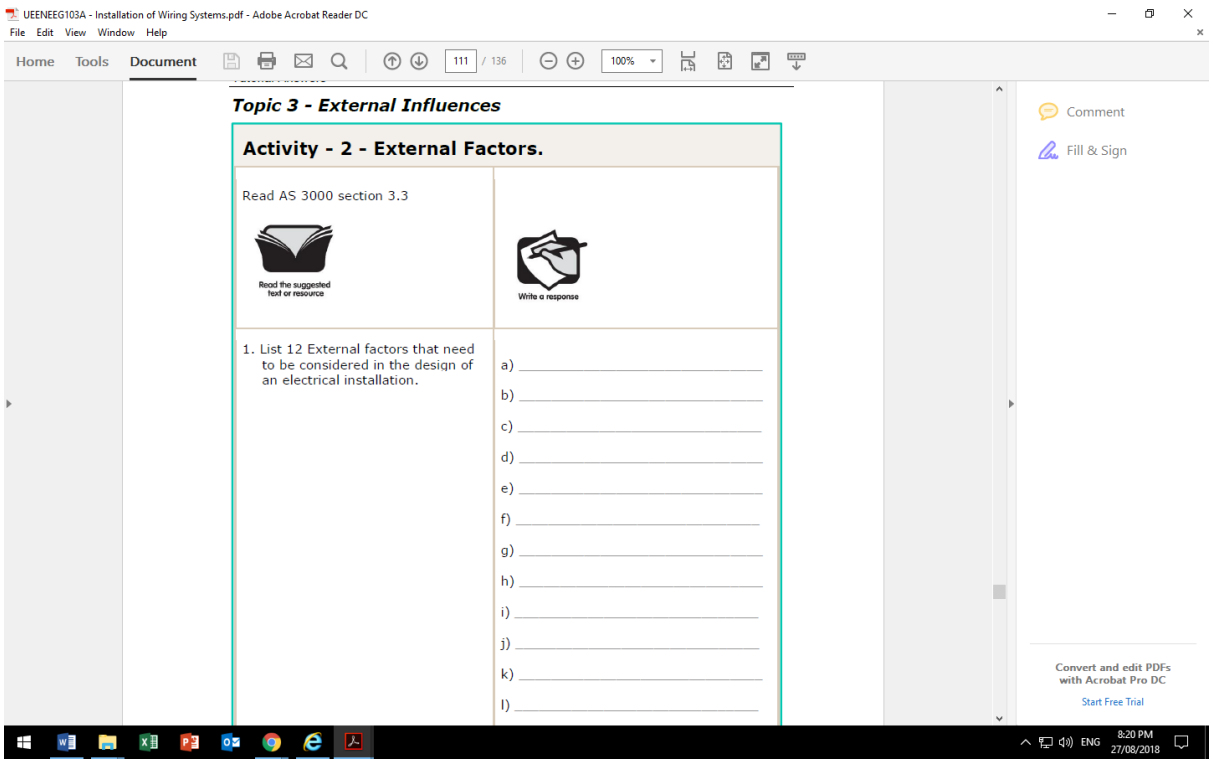



3.3.2.2 External heat sources

Wiring systems shall be protected against the effects of heat from external sources, including solar gain, by one or more of the following methods:

(a) Shielding.

(b) Placing sufficiently far from the source of heat.

(c) Selecting a system with due regard for the additional temperature rise that may occur.

(d) Limiting the current to be carried by the cable so as to reduce its operating temperature.

(e) Local reinforcement or substitution of insulating material.

(f) A method equivalent to one or more of those listed in Items (a) to (e).

Parts of a cable or flexible cord within an accessory, appliance or luminaire shall be suitable for the temperatures likely to be encountered, or shall be provided with additional insulation suitable for those temperatures.

* 3.3.2.3 Water or high humidity

Wiring systems shall be selected and installed so that high humidity or the entry of water does not cause damage.

Where water may collect or condensation may form in a wiring system, to the extent that it creates a hazard, provision shall be made for its harmless escape through suitably located drainage points.

Where a wiring system may be subjected to wave action (water), protection against excessive flexing and mechanical damage shall be provided in accordance with Clauses 3.3.2.6, 3.3.2.7 and 3.3.2.8.

* 3.3.2.4 Solid foreign bodies

Wiring systems shall be selected and installed so as to minimize the entry of solid foreign bodies during installation, use and maintenance.

In a location where dust or any other substance, in significant quantity, may

be present, additional precautions shall be taken to prevent its accumulation in quantities that could adversely affect the heat dissipation from the wiring system.

* 3.3.2.5 Corrosive or polluting substances

Where the presence of corrosive or polluting substances is likely to cause corrosion or deterioration, those parts of the wiring system likely to be affected shall be suitably protected or manufactured from materials resistant to such substances.

Dissimilar metals liable to initiate galvanic action shall not be placed in contact with each other.

Materials liable to cause mutual or individual deterioration, or hazardous degradation, shall not be placed in contact with each other.

NOTE: The effect of substances, such as esters, ketones, ethers, and aromatic and chlorinated hydrocarbons, should be considered when using insulating conduit, enclosures, cables or equipment.

* 3.3.2.6 Mechanical damage

Wiring systems shall be selected and installed so as to minimize the risk of mechanical damage.

Protection against mechanical damage shall be provided by one or any combination of the following:

(a) Mechanical characteristics of the wiring system.

(b) Location selected.

(c) Provision of additional local or general mechanical protection.

NOTE: Guide to adequacy and WS classification is provided in Appendix H.

3.3.2.7 Vibration

Wiring systems subject to vibration that is likely to cause damage to the wiring system, including all cables, fixings and connections, shall be suitable for the conditions.

3.3.2.8 Other mechanical stresses

Wiring systems shall be selected and installed so as to minimize damage to the cable insulation, sheathing and connections during installation, operation and maintenance.

Measures undertaken to minimize damage may include the following:

(a) Provision of supports, continuous or at appropriate intervals suitable for the mass of the cable.

(b) Use of suitable fixings for the cable size and type that hold the cable in position without damage.

(c) Use of suitable connections for the cable size and type that reduce mechanical strain at joints and terminations.

(d) Attention to minimum bending radius limits of cables.

(e) Provision of flexibility to accommodate any movement or tension stresses.

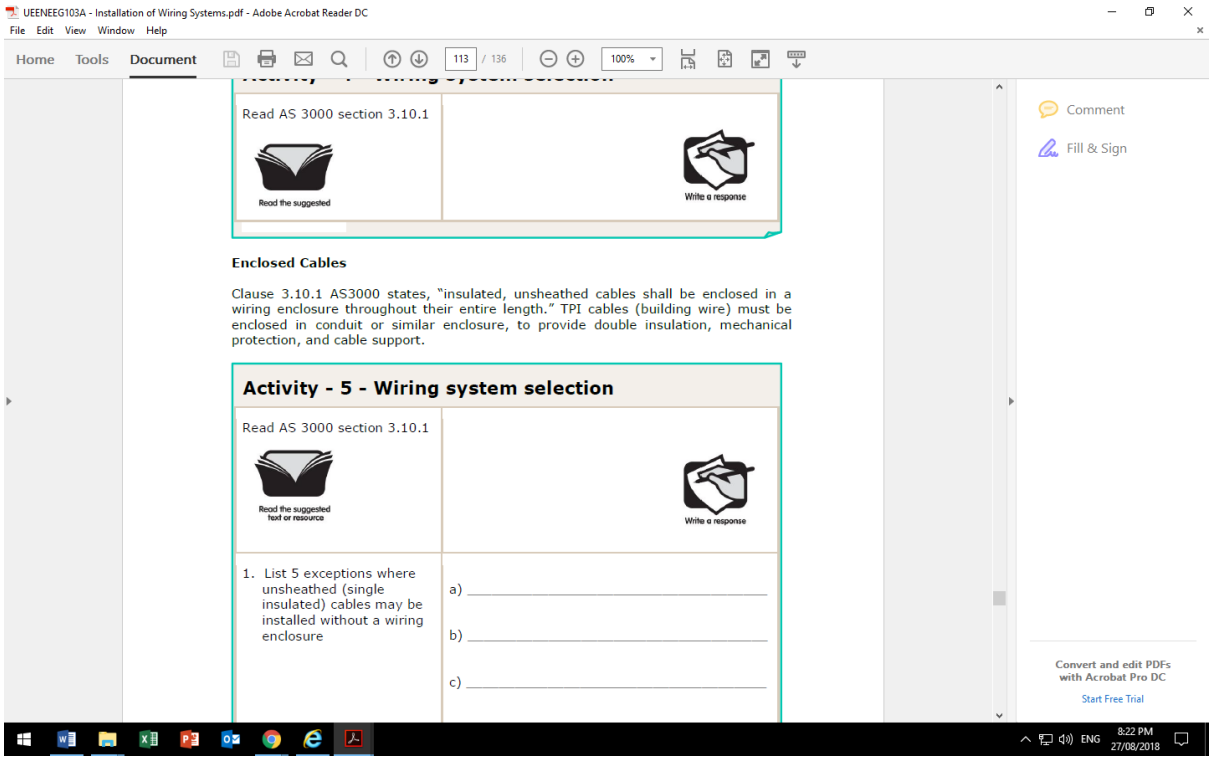
* 3.3.2.9 Flora

Where the presence of flora is expected to constitute a hazard, either the wiring system shall be selected accordingly, or special protective measures shall be adopted.

* 3.3.2.10 Fauna

Where the presence of fauna is expected to constitute a hazard, either the wiring system shall be selected accordingly, or special protective measures

(a) shall be adopted




3.10.1 General

3.10.1.1 Insulated, unsheathed cables

Insulated, unsheathed cables shall be enclosed in a wiring enclosure throughout their entire length.

Exceptions: Wiring enclosures need not be provided for insulated, unsheathed cables installed as follows:

1 As aerial conductors, in accordance with Clause 3.12.

2 In an enclosed wall cavity between an accessory and a wiring enclosure or sheathing terminated within 100 mm of the hole over or within which the accessory is mounted.

NOTE: This exception does not apply within a roof space.

3 Within switchboards, metering and similar enclosures, provided that such cables are not exposed to touch during normal switching or meter-reading operations.

4 As earthing or equipotential bonding conductors installed in accordance with Section 5.

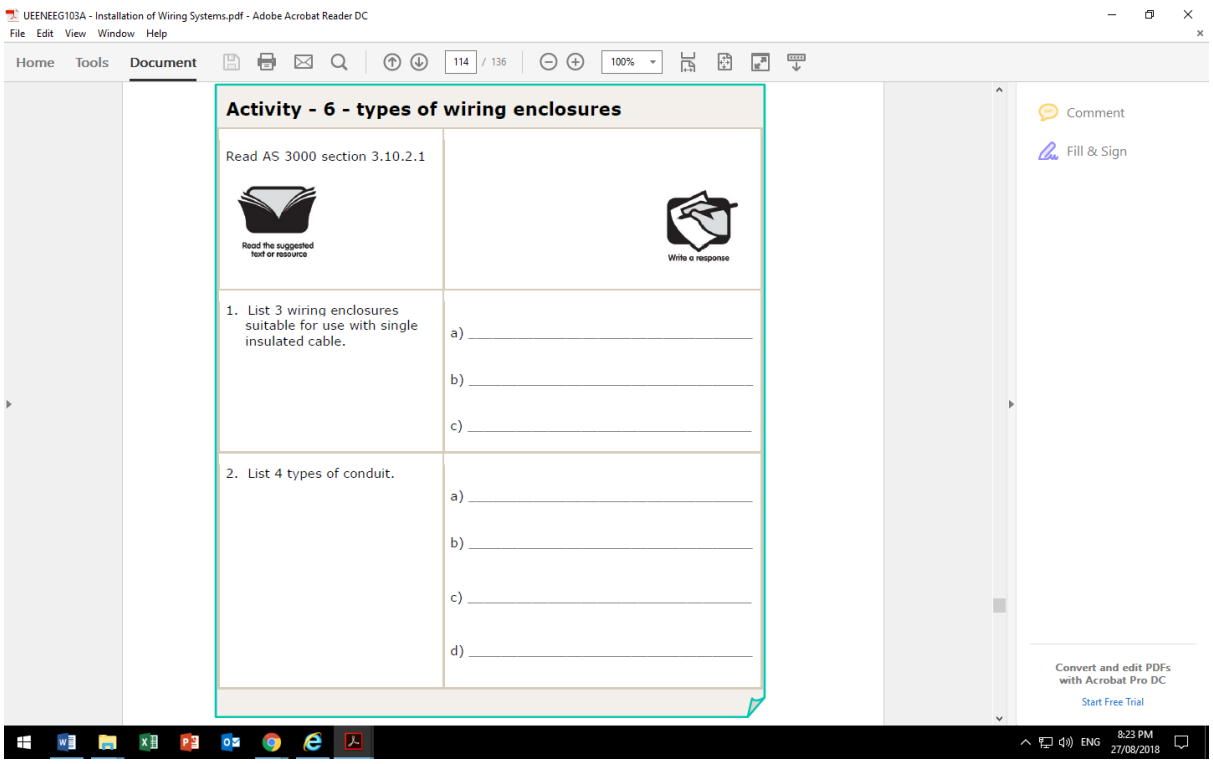
5 As an extra-low voltage circuit, in accordance with Clause 7.5.

3.10.1.2 Insulated and sheathed cables

Cables of a sheathed type need not be installed in a wiring enclosure.

Exception: Cables having insulation or sheath that does not meet the combustion propagation requirements of the AS/NZS 5000 series, e.g. polyethylene-insulated unsheathed cables, shall be installed in firerated

enclosures.
Where the sheath of a cable is removed, the exposed cores of the cable shall be enclosed in accordance with Clause 3.10.1.1.
3.10.2 Wiring enclosures
3.10.2.1 Types
The following types of wiring enclosures may be used for the protection of cables requiring enclosure as specified in Clause 3.10.1:
* (a) Conduits in accordance with AS/NZS 2053 series or the AS/NZS 61386 series, including—
(i) steel conduits or other metal tubing or conduit;
(ii) flexible metal conduit;
(iii) rigid and flexible insulating conduit; and
(iv) corrugated insulating conduit.
* NOTE: Refer to Appendix N for information on compatibility of conduit classifications in the AS/NZS 2053 series and AS/NZS 61386 series.

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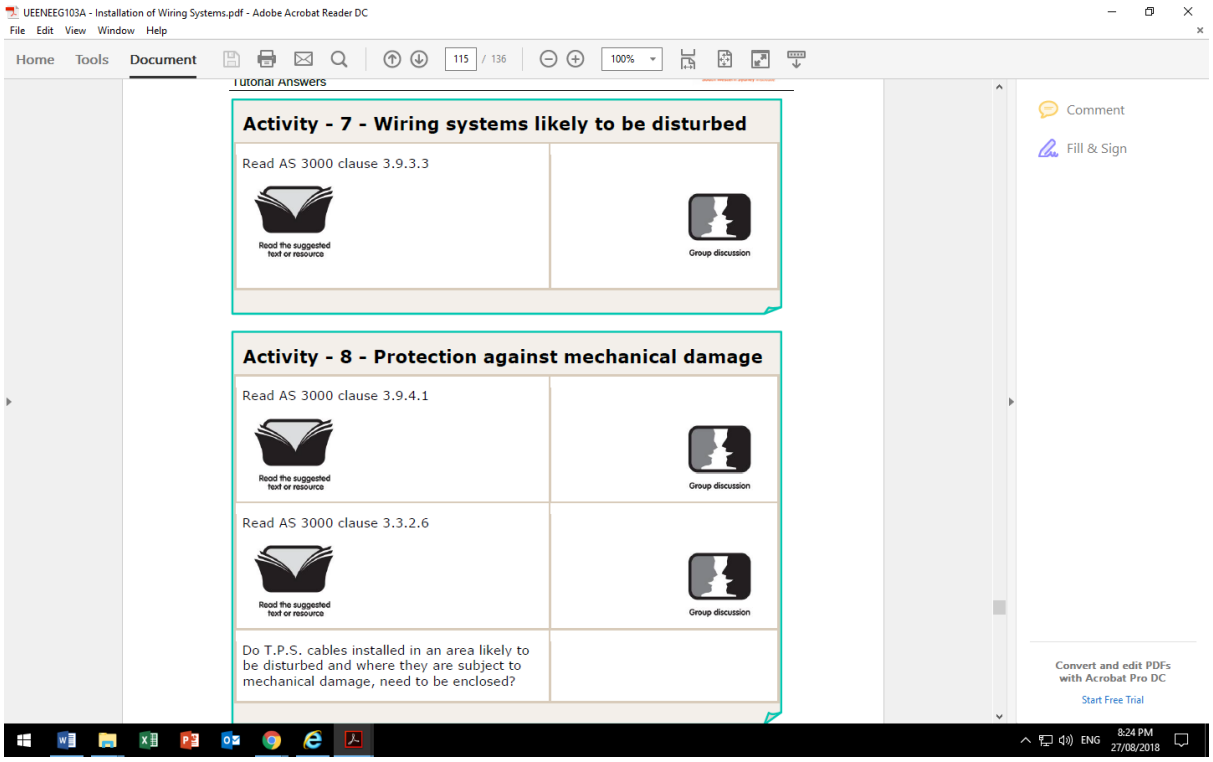
(i) steel conduits or other metal tubing or conduit;
(ii) flexible metal conduit;
(iii) rigid and flexible insulating conduit; and
(iv) corrugated insulating conduit.
* NOTE: Refer to Appendix N for information on compatibility of conduit classifications in the AS/NZS 2053 series and AS/NZS 61386 series

(b) Cable trunking systems in accordance with AS/NZS 4296, with or without compound filling.
(c) Other wiring enclosures providing mechanical protection at least equivalent to those listed in Items (a) and (b).
Covers of wiring enclosures containing unsheathed cables shall be effectively retained in position and, where installed in a readily accessible position, shall not be removable without the use of tools.

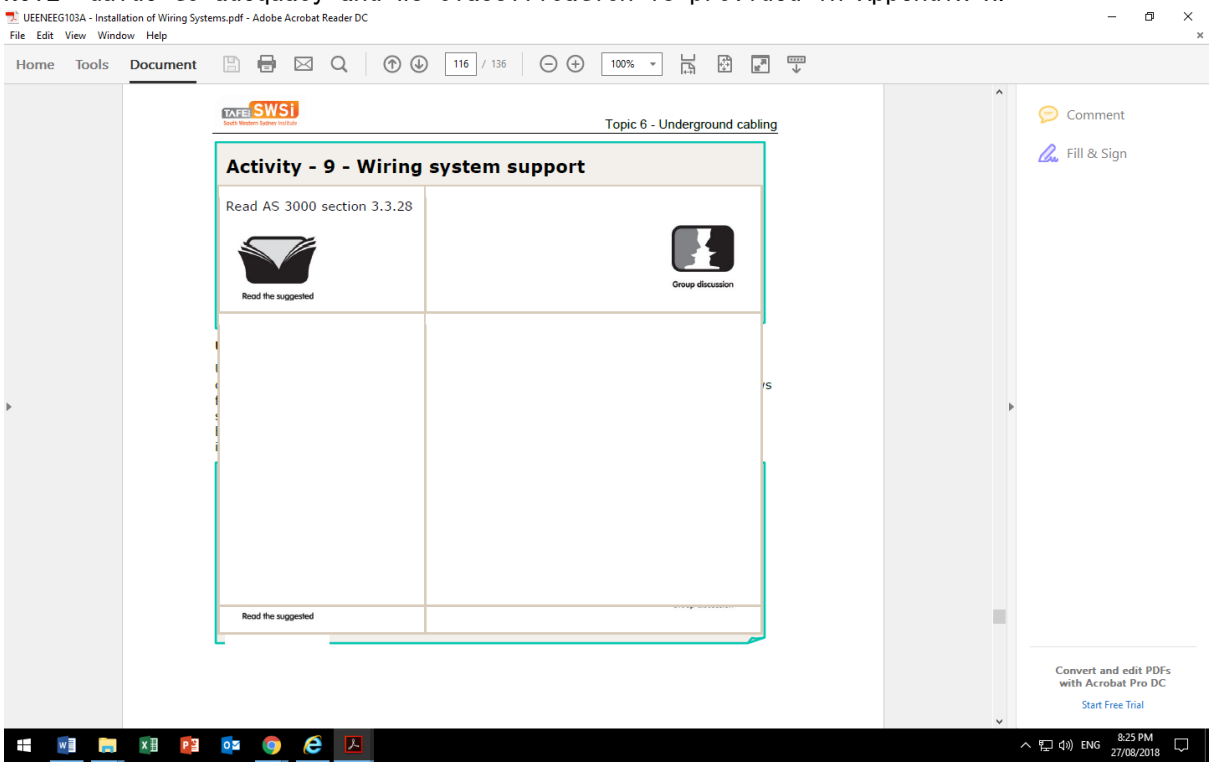



3.9.3.3 Wiring systems likely to be disturbed
3.9.3.3.1 Location
Wiring systems installed in the following locations are deemed likely to be disturbed:
(a) On the surface of a wall or on the underside of a ceiling or roof.
(b) In a space between a floor and the ground to which a person may gain entry.
(c) In parts of a ceiling space where access is greater than 0.6 m in height.
(d) Within 2.0 m of any access to any space to which a person may gain entry.
(e) Below raised floors.
3.9.3.3.2 Support and protection
Wiring systems installed in positions where they are likely to be disturbed shall be-
(a) supported at suitable intervals to prevent the undue sagging of cables; And
b) supported to prevent accidental withdrawal of cables from electrical equipment exposing single-insulated conductors; and
(c) protected from mechanical damage as specified in Clause 3.3.2.6.

* RCDs shall not be used in lieu of mechanical protection for wiring systems that are likely to be disturbed.

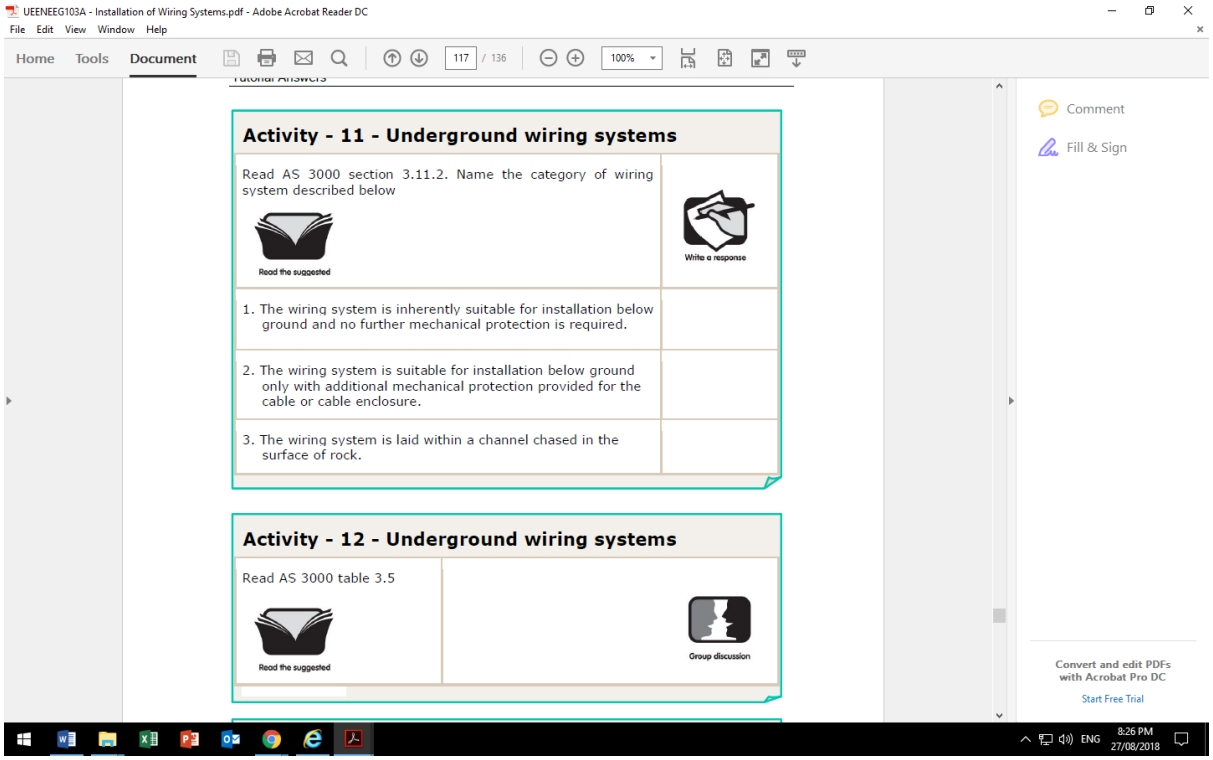
3.9.4.1 General
Wiring systems installed in positions where they may reasonably be expected to be subject to mechanical damage shall be adequately protected in accordance with Clause 3.3.2.6 and the applicable requirements of Clauses 3.9.4.2 to 3.9.4.4.

3.3.2.6 Mechanical damage
Wiring systems shall be selected and installed so as to minimize the risk of mechanical damage.
Protection against mechanical damage shall be provided by one or any combination of the following:
(a) Mechanical characteristics of the wiring system.
(b) Location selected.
(c) Provision of additional local or general mechanical protection.
NOTE: Guide to adequacy and WS classification is provided in Appendix H.




3.3.2.8 Other mechanical stresses
Wiring systems shall be selected and installed so as to minimize damage to the cable insulation, sheathing and connections during installation, operation and maintenance.
Measures undertaken to minimize damage may include the following:
(a) Provision of supports, continuous or at appropriate intervals suitable for the mass of the cable.
(b) Use of suitable fixings for the cable size and type that hold the cable in position without damage.

(c) Use of suitable connections for the cable size and type that reduce mechanical strain at joints and terminations.
(d) Attention to minimum bending radius limits of cables.
(e) Provision of flexibility to accommodate any movement or tension stresses.




3.11.2 Classification of wiring systems
Underground wiring systems are classified as one of three categories.
The type of cable and form of enclosure determine the category assigned to the underground wiring system.
Category A system–where the wiring system is inherently suitable for installation below ground and no further mechanical protection is required.
Category B system–where the wiring system is suitable for installation below ground only with additional mechanical protection provided for the cable or cable enclosure.
Category C system–where the wiring system is laid within a channel chased in the surface of rock.
Underground cables shall be–
(a) of a type specified in Column 1 of Table 3.5; and
(b) installed in accordance with a category specified in Columns 2 to 9 of Table 3.5.
NOTE: Underground wiring systems do not include those that are–
(a) embedded in a concrete floor, slab or pad;
(b) laid on the surface of the ground either within the building or in outdoor locations;
(c) enclosed in a ventilated cable tunnel; or
(d) enclosed in a trough with removable covers where air circulation is not restricted.

**TABLE 3.5**

**UNDERGROUND WIRING SYSTEM CATEGORIES**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Method of protection—Type of cable** | **Heavy-duty conduit*** | **Medium-duty conduit* encased in concrete** | **Heavy-duty fibre cement conduit** | **Fibre cement conduit encased in concrete** | **Medium- or heavy-duty galvanized pipe** | **Medium-duty, corrugated or flexible conduit*** | **Buried direct in the ground with no enclosure** | **Chased in rock with no enclosure** |
| Insulated, unsheathed conductors | A | A | NP | NP | NP | B | NP | NP |
| Insulated and sheathed conductors | A | A | A | A | A | B | B | NP |
| Sheathed, armoured and served cables | A | A | A | A | A | A | A | C |
| Neutral-screened cables suitable for underground | A | A | A | A | A | A | A | NP |
| Neutral-screened cables | A | A | A | A | A | B | B | NP |
| Served MIMS cables | A | A | A | A | A | B | B | C |
| Aluminium sheathed or strip armoured cables with PVC sheath | A | A | A | A | A | B | B | C |

* These conduits and any associated fittings consist of insulating material only and do not have any conductive components.

KEY:

A = Category A wiring system
B = Category B wiring system
C = Category C wiring system
NP = Not permitted









These dimensions shall apply vertically between the upper surface of—

(a) the wiring system for a Category A or Category C system; or

(b) the additional mechanical protection of a Category B system,

and the surface of the ground or below any poured concrete laid on that surface (see Figures 3.10 to 3.17).

* Where cables are buried close to a sloping or vertical surface, these dimensions shall also apply perpendicular to that surface (see Figure 3.17).

**TABLE 3.6**

**UNDERGROUND WIRING SYSTEMS—MINIMUM DEPTH OF COVER**

| Location of wiring system | Covering on surface of ground above wiring system | Cat A system | Cat B system | Cat C system |
|---|---|---|---|---|
| Within confines of a building | Poured concrete of 75 mm minimum thickness | 0 mm (directly below) | 0 mm (directly below) | 0 mm (directly below) |
| | No surface covering or less than 75 mm thickness of concrete | 500 mm | 500 mm | 50 mm |
| Elsewhere external to a building | Poured concrete of 75 mm minimum thickness | 300 mm | 300 mm | 50 mm |
| | No surface covering or less than 75 mm thickness of concrete | 500 mm | 500 mm | 50 mm |

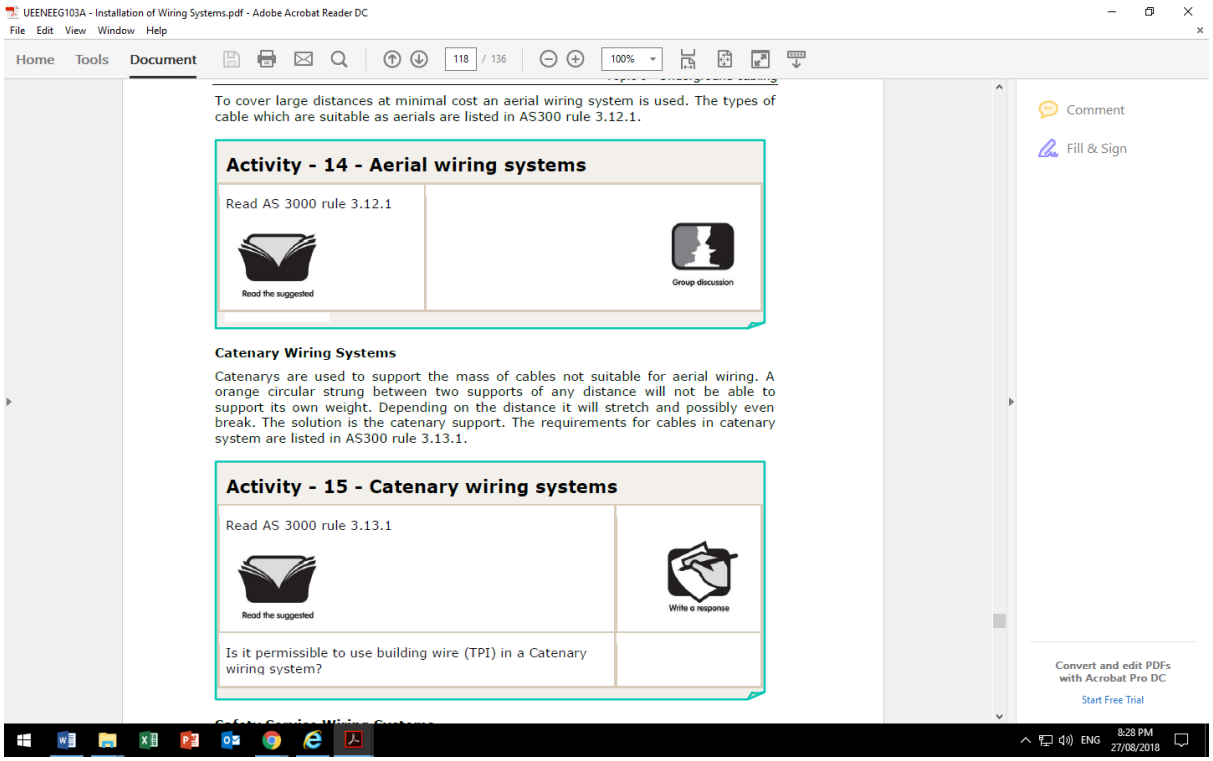
**3.11.4.5** *Identification of underground wiring*

Wiring systems installed underground shall be identified by an orange marker tape complying with AS/NZS 2648.1. In order to provide early detection of the presence of underground wiring during excavation work, marker tape shall be positioned at approximately 50% of the depth of cover above the wiring system or any additional mechanical protection provided for that system.

Where the wiring system is chased in rock, orange marker tape shall be laid directly on top of the wiring system before the concrete is poured.

*Exception: Marker tape may be omitted where an underground wiring system is installed by boring provided that—*

*(a) the location of the wiring system is marked and recorded in a suitable*




3.12.1 Types of conductor

Conductors used as aerial conductors shall be—

(a) hard-drawn bare conductors;

(b) polymeric insulated cables;

(c) neutral-screened cables; or

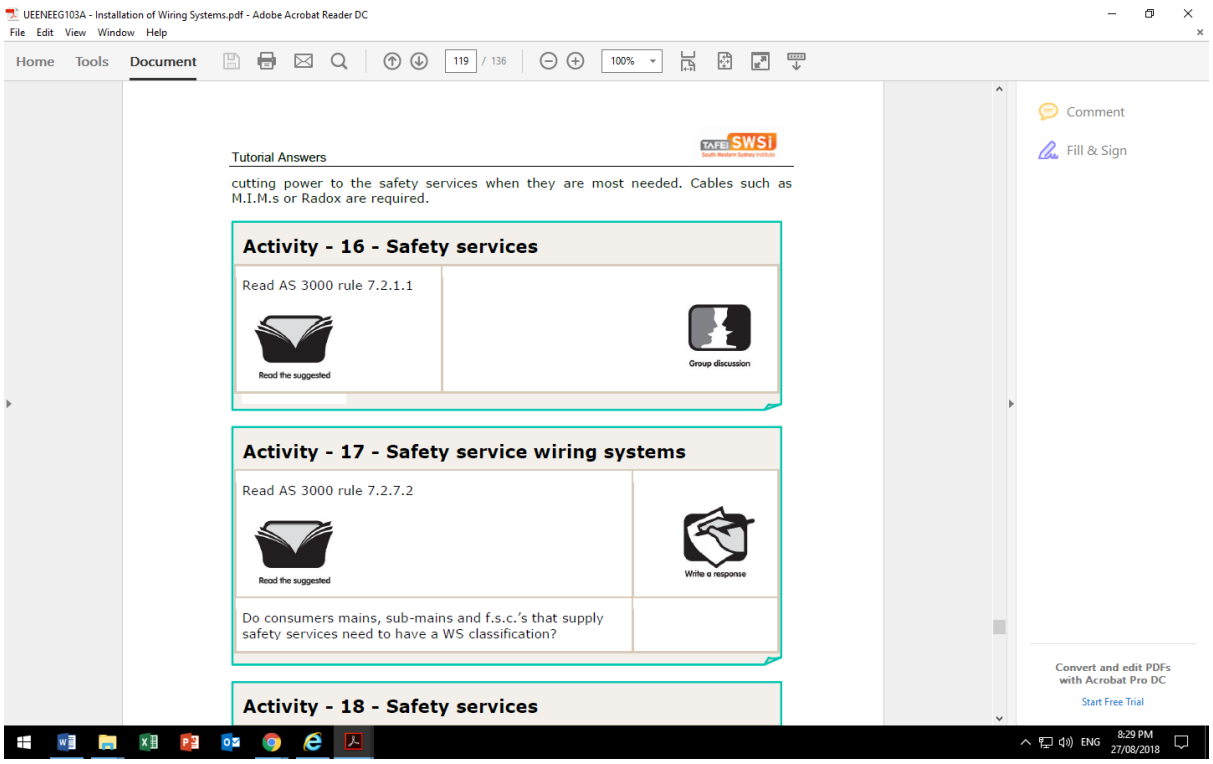
(d) parallel-webbed, twisted or bundled insulated cables.

3.13.1 Types of cables

Cables supported by means of a catenary shall be stranded cables affording double insulation or the equivalent of double insulation.

Cables and catenary supports installed out of doors shall be suitable for exposure to direct sunlight.

NOTE: Cables are considered to be adequately supported if supported by a catenary and thereby relieved from excessive mechanical stresses.




7.2.1.1 Scope

The particular requirements of this Clause (Clause 7.2) apply to the electrical installation of building services that are essential for the safe operation of safety services consisting of fire detection, warning and extinguishing systems, smoke control systems, evacuation systems and the safety of persons using lifts.

7.2.7.2 Wiring systems for air-handling systems

7.2.7.2.1 Types of wiring system for air-handling systems

Wiring systems supplying air-handling systems shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment.

NOTE: See Appendix H for further information regarding the application of the WS classification system.

Where the relevant Standard does not specify a WS classification, the wiring system shall be of a type that is–

(a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or

(b) capable of maintaining supply to the equipment when exposed to fire and protected against mechanical damage by–

(i) installation in an effective enclosure; or

(ii) installation in a location where the system will not be exposed to mechanical damage.

Exception: The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to the following:

Wiring systems in an enclosure or location that provides protection against fire and mechanical damage.

Example: Cables or enclosed wiring systems installed in underground

locations, buried enclosed in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.

7.2.7.2.2 Segregation of cables for air-handling systems

Conductors supplying air-handling systems shall not be enclosed with different safety services or with conductors of any other system.

For the purposes of this Clause, the following applies:

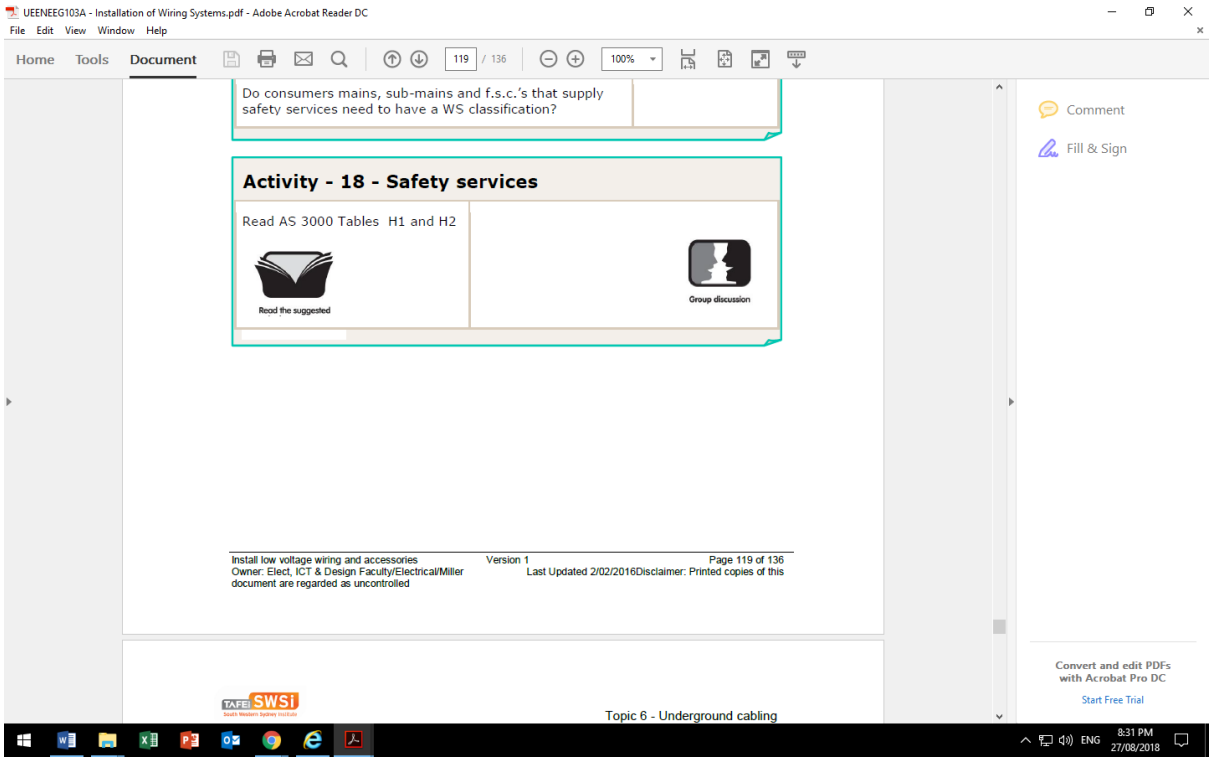
(a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure.

(b) Wiring systems of air-handling systems shall be physically separated from all other wiring systems by at least 50 mm or by effective barriers.

(c) Conductors of different safety services shall not be incorporated with each other within a multi-core cable or incorporated with conductors of any other wiring system within a multi-core cable.

7.2.7.2.3 Interposing switches for air-handling systems

No switch shall be interposed between a main switch and downstream switchboards supplying air-handling systems.



## Activity - 19 - Safety service wiring systems

| Read AS 3000 section H2 | |
|---|---|
| Read the suggested | Write a response |
| What is the required WS classification for a wiring system that supplies; | |
| 1. residential sprinkler pumpsets. | |
| 2. Smoke venting equipment | |
| 3. Passenger and goods lifts. | |

**Busbar Trunking (Busway) Systems**

Busbar trunking has several key advantages over conventional wiring systems. On-







be assigned the associated characteristic numeral.

**TABLE H1**

**DEGREE OF PROTECTION INDICATED BY THE FIRST CHARACTERISTIC NUMERAL**

| Degree of protection indicated by the first characteristic numeral (Protection against exposure to fire) | |
|---|---|
| **First characteristic numeral** | **Minimum time for which the circuit integrity of the wiring system is maintained min** |
| X | Degree of protection does not apply |
| 1 | 15 |
| 2 | 30 |
| 3 | 60 |
| 4 | 90 |
| 5 | 120 |

### H1.4 Second characteristic numeral

The second characteristic numeral represents the degree of mechanical impact and cutting load to which the wiring system can be subjected without losing circuit integrity.

Table H2 indicates the degree of impact for which the wiring system needs to maintain circuit integrity when tested in accordance with AS/NZS 3013.

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**TABLE H2**

**DEGREE OF PROTECTION INDICATED BY THE SECOND CHARACTERISTIC NUMERAL**

| Degree of protection indicated by the second characteristic numeral (Protection against mechanical damage) | |
|---|---|
| **Second characteristic numeral** | **Protected against (see Paragraphs H4.2 and H5)** |
| X | Degree of protection does not apply |
| 1 | Light impact |
| 2 | Moderate impact |
| 3 | Heavy impact |
| 4 | Very heavy impact |
| 5 | Extremely heavy impact |

**H1.5 Supplementary letter W**

The addition of the supplementary letter W to a wiring system designation means that the wiring system is able to maintain circuit integrity when—

(a) tested for protection against exposure to fire for the period specified by the first characteristic numeral; and

(b) then hosed with water.

**H1.6 Supply and installation**

**H1.6.1** *Components*

All components of a wiring system assigned a particular classification should comply with AS/NZS 3013.

**H1.6.2** *Instructions*

Wiring system suppliers should provide installers with complete, concise details of methods of fixing and support for the wiring system required to achieve its classification in accordance with AS/NZS 3013, including instructions on the correct orientation of the wiring system.

Comment

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**Busbar Trunking (Busway) Systems**

Busbar trunking has several key advantages over conventional wiring systems. On-site installation times are reduced compared to hard-wired systems, thus leading to cost savings. It provides increased flexibility in design and versatility with regard to future modifications.

**Activity - 20 - Busbar Trunking (Busway) Systems**

Read AS 3000 Section 3.15

Read the suggested

Group discussion

Distribution busbar distributes power along its length through tap-off points along the busbar at typically at 0.5 or 1 m centres. Tap-off units are plugged in along the length of the busbar to supply a load; this could be a sub distribution board or, in a factory, to individual machines. Tap-offs can normally be added or removed with busbar live, eliminating production down time.



Tutorial Answers

TAFE SWSI South Western Sydney Institute

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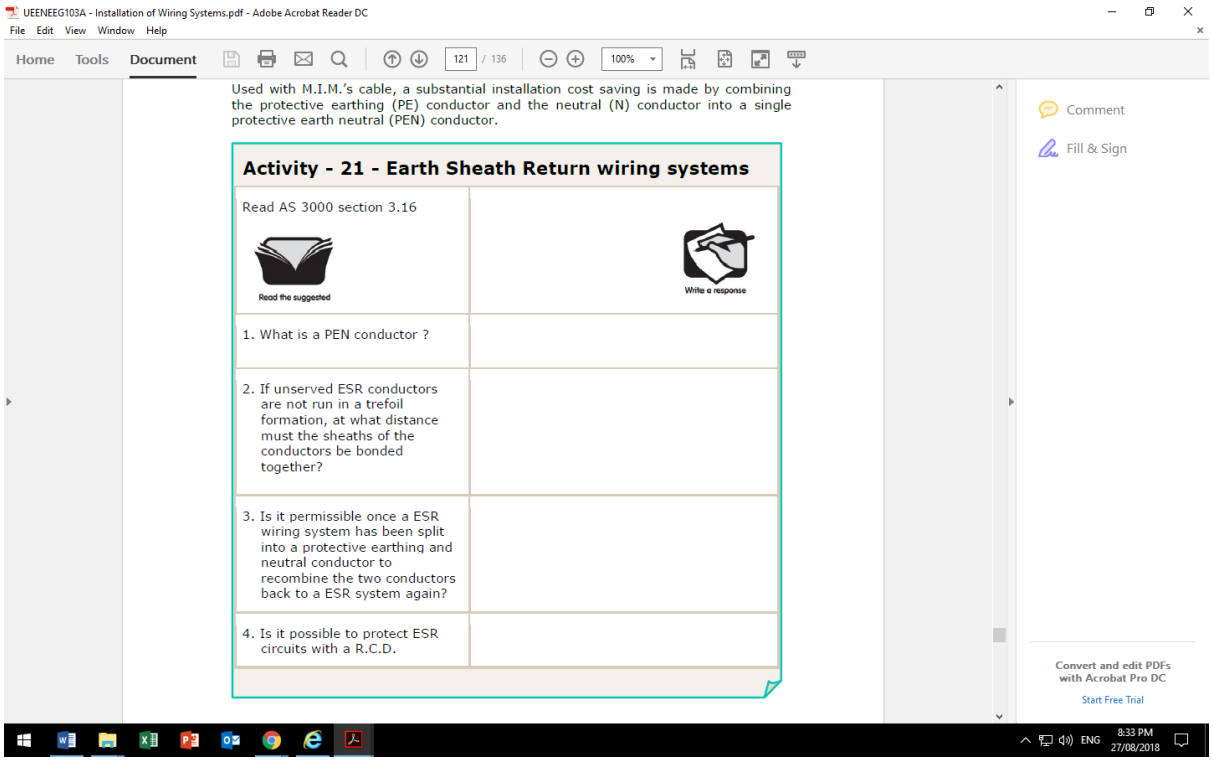
3.15 BUSWAYS, INCLUDING RISING MAINS SYSTEMS

Busbar trunking systems (busways) shall comply with AS/NZS 3439.2 or AS/NZS 61439.6, and shall be installed in accordance with the manufacturer's instructions.

Where used as a wiring system, the installation shall be in accordance with the relevant requirements of Clause 3.9.

NOTE: See Clause 3.9.9.3 for requirements for penetration of fire-rated constructions.




## 3.16 EARTH SHEATH RETURN (ESR) SYSTEM

The earth sheath return (ESR) system is one where the copper sheath of a MIMS cable forms a single conductor that is used as both a protective earthing (PE) conductor and a neutral (N) conductor simultaneously.

Only a copper sheath may be used as a combined protective earthing and neutral (PEN) conductor.

These cables shall be installed in accordance with Clause 3.9.7.3 and the following:

(a) The sheath shall be of adequate cross-sectional area and conductivity.

(b) The ESR system shall be used only in electrical installations where the MEN earthing system is used. It shall commence at the location where the neutral and earthing conductors are connected to form the MEN connection.

(c) Where the combined protective earthing and neutral (PEN) conductor is changed to provide a separate neutral and protective earth to electrical equipment, then the neutral and protective earth shall not be combined again to form a combined protective earthing and neutral (PEN) conductor.

(d) The ESR system shall not be installed in hazardous areas.

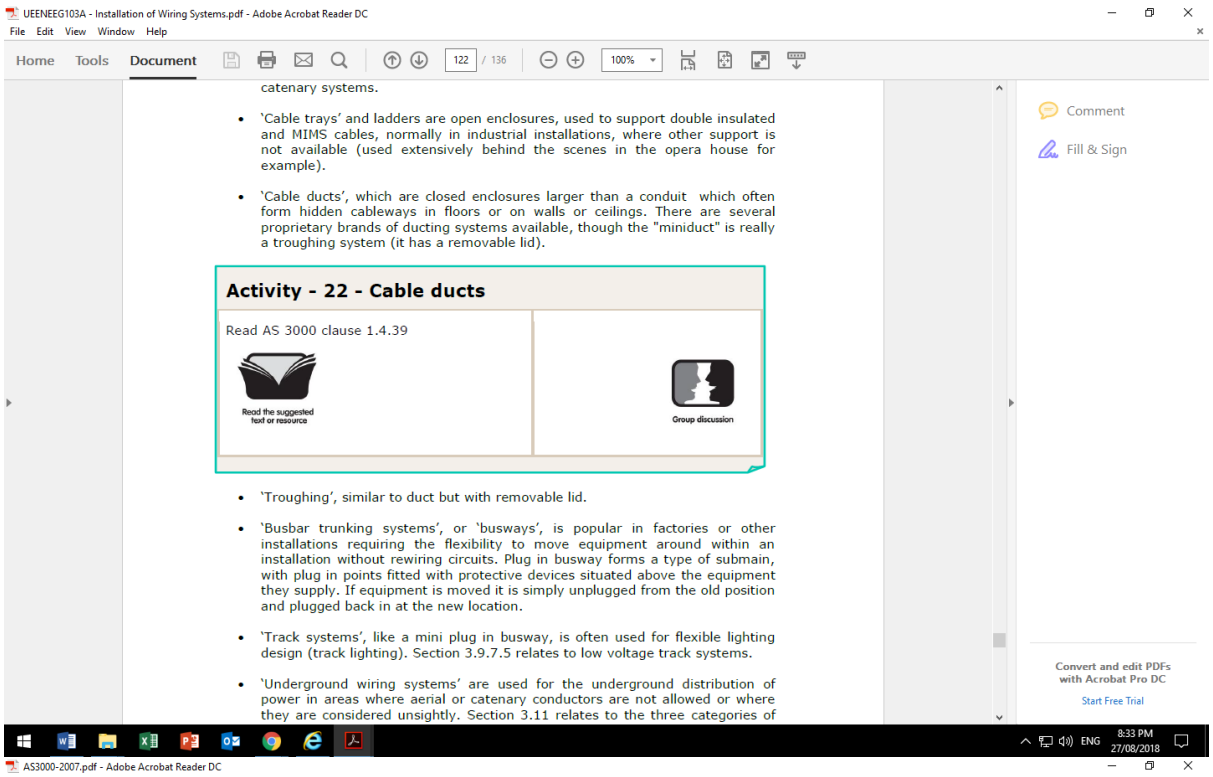
(e) Conductors used in an ESR system shall not be smaller than 2.5 $mm^2$.

(f) At every joint in the sheathing, and at terminations, the continuity of the combined protective earthing and neutral (PEN) conductor shall be ensured by a bonding conductor in addition to the means used for sealing and clamping the external conductor.

The resistance of the bonding conductor at joints shall not exceed that of the cable sheath.

(g) Two conductors, one for protective earthing and one for the neutral,

shall be used at terminations. The minimum size for the protective earthing conductor shall be in accordance with Clause 5.3.3 and Table 5.1, and the minimum size for the neutral conductor shall be 6 mm2, or in accordance with Clause 3.5.2.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catenary systems.

- 'Cable trays' and ladders are open enclosures, used to support double insulated and MIMS cables, normally in industrial installations, where other support is not available (used extensively behind the scenes in the opera house for example).
- 'Cable ducts', which are closed enclosures larger than a conduit which often form hidden cableways in floors or on walls or ceilings. There are several proprietary brands of ducting systems available, though the "miniduct" is really a troughing system (it has a removable lid).

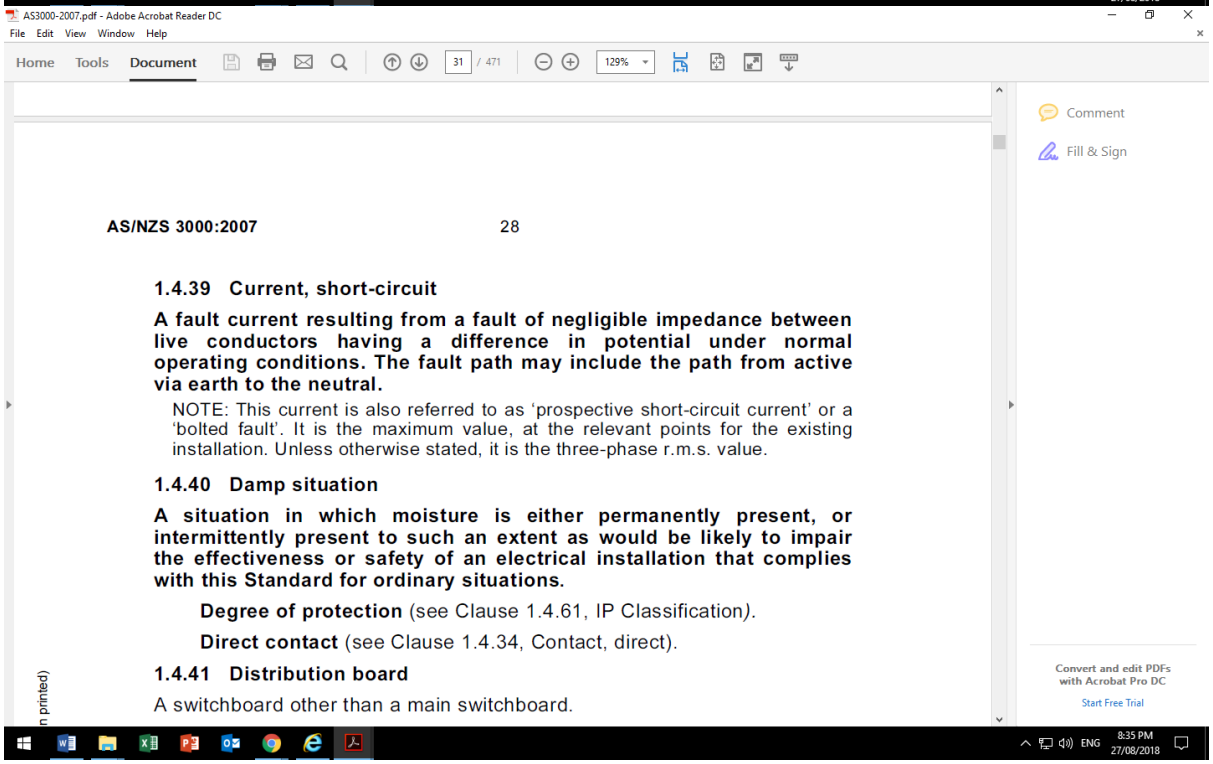
**Activity - 22 - Cable ducts**

Read AS 3000 clause 1.4.39

Read the suggested text or resource

Group discussion

- 'Troughing', similar to duct but with removable lid.
- 'Busbar trunking systems', or 'busways', is popular in factories or other installations requiring the flexibility to move equipment around within an installation without rewiring circuits. Plug in busway forms a type of submain, with plug in points fitted with protective devices situated above the equipment they supply. If equipment is moved it is simply unplugged from the old position and plugged back in at the new location.
- 'Track systems', like a mini plug in busway, is often used for flexible lighting design (track lighting). Section 3.9.7.5 relates to low voltage track systems.
- 'Underground wiring systems' are used for the underground distribution of power in areas where aerial or catenary conductors are not allowed or where they are considered unsightly. Section 3.11 relates to the three categories of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**1.4.39 Current, short-circuit**

**A fault current resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions. The fault path may include the path from active via earth to the neutral.**

NOTE: This current is also referred to as 'prospective short-circuit current' or a 'bolted fault'. It is the maximum value, at the relevant points for the existing installation. Unless otherwise stated, it is the three-phase r.m.s. value.

**1.4.40 Damp situation**

**A situation in which moisture is either permanently present, or intermittently present to such an extent as would be likely to impair the effectiveness or safety of an electrical installation that complies with this Standard for ordinary situations.**

**Degree of protection** (see Clause 1.4.61, IP Classification).

**Direct contact** (see Clause 1.4.34, Contact, direct).

**1.4.41 Distribution board**

A switchboard other than a main switchboard.