higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTALLATION RULES
(Second Paper)

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This marking guideline consists of 7 pages.

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QUESTION 1: SANS 1973-3 OF 2008: SAFETY OF ASSEMBLIES WITH A RATED PROSPECTIVE SHORT-CIRCUIT CURRENT OF UP TO 10 kA

1.1 A distribution board is a combination of one or more low-voltage switching devices together with associated control, measuring, signalling, protective and regulating equipment,✓ etc., completely assembled under the responsibility of the manufacturer✓ with all the internal electrical and mechanical interconnections and structural parts.✓ (3)

1.2 A zone in a distribution board or section of a distribution board comprises the conductors (including distribution busbars) between the main busbars and the supply side of the functional units,✓ in which, under normal operating conditions, the occurrence of a short-circuit fault is only a remote possibility✓ because of the reduced short-circuit stresses✓ that occur on the load side of the prospective short-circuit protective device.✓ (4)

1.3 It is conventional number-based on the amount of conductive or hygroscopic dust, ionised gas or salt✓ and on the relative humidity and its frequency of occurrence resulting in hygroscopic absorption or condensation of moisture,✓ leading to the reduction in dielectric strength or surface resistivity, or both.✓ (3)

[10]

QUESTION 2: SANS 10142-1 OF 2017: ANNEX E: CALCULATIONS OF VOLTAGE DROP

2.1 Select a 2,5 mm² conductor

A Current for 4 kW, I = 4 000/230
= 17,39 A

Vd = Mv/A/m × L × A
= 18/1 000 × 15 m × 17,39 A
= 4,69 V
Therefore use 2,5 mm² conductors because the Vd is less than 5% (2)

B. Try use 4 mm² conductor
Vd = Mv/A/m × L × A
= 11/1 000 × 4 m × 30
= 1,32 V
Therefore use 4 mm² conductors because the Vd is less than 5% (2)

C. Current for 1 500 W + 6 000 W, I = 7 500/230
= 32,61 A

Select a 6 mm² conductor
Vd = Mv/A/m × L × A
= 7,3/1 000 × 12 m × 32,61
= 2,857 V
Therefore use 6 mm² conductors because the Vd is less than 5% (2)

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2.2 Total voltage drop = 4,69 + 1,32 + 2,857
= 8,867 V
Acceptable because it is less than 5% of the total voltage. (2)

2.3 Total load = 4 V + 6,9 V + 7,5 V
= 18,4 kW (2)
[10]

QUESTION 3: SANS 10142-1 of 2017: CURRENT-CARRYING CAPACITY OF CONDUCTORS AND CABLES

3.1 **Is** is the standard rating in amperes (A)
F1 is the rating factor for depth of burial
F2 is the rating factor for soil temperature at depth of burial
F3 is the rating factor for thermal resistivity of soil
F4 is the rating factor for grouping of directly buried cables that are thermally interdependent (5)

3.2
- Unbalanced circuit conditions
- Harmonic current in three-phase circuits (2)

3.3 I = Is × F1 × F2 × F3 × F4✓
= 80 A × 0,96 × 0,94 × 0,93 × 0,81✓
= 73,932 A✓ (3)
[10]

QUESTION 4: SANS 10142-1 OF 2017: WIREWAYS

4.1
- All fittings other than bends and couplings shall be of the inspection type.
- The inner radius of a bend in a conduit shall be at least three times the external diameter of the conduit.
- Bends shall not distort the internal shape of a conduit or open any weld.
- There shall be no openings in the side of a conduit for cables to enter or leave the conduit. (4)

4.2 4.2.1
- Span not more than 2 m between supports
- Where it is accessible, fixed at intervals not more than 3 m

4.2.2
- Span not more than 1,5 m between supports
- Where it is accessible, fixed at intervals not more than 3 m

(2 × 2) (4)

4.3
- In a position where it is likely to be damaged, unless it is protected against damage
- For cables that have a normal operating temperature that is higher than the highest operating temperature of the wireway (2)

[10]

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QUESTION 5: SANS 10142-1 OF 2017: EARTHING

5.1 True
5.2 False
5.3 False
5.4 True
5.5 False
5.6 True
5.7 False
5.8 False
5.9 True
5.10 False

(10 × 1) **[10]**

QUESTION 6: SANS10142-1 OF 2017: LIGHTING

6.1 Supply any number of luminaires (1)

6.2 Controlled by a local multiphase disconnecting device (1)

6.3 Maintenance work can be carried out without switching off all the lights (1)

6.4
- The circuit is controlled by multipole switching disconnectors
- Any additional switches in the circuit are multipole switches (2)

6.5
- Complies with SANS 164-3
- Supplies one luminaire only and does not exceed the rating of the socket outlet
- Is accessible for maintenance purposes
- Is within 3 m of a luminaire that it supplies (4)

6.6 Protected by a circuit-breaker of not exceeding 20 A (1)
[10]

QUESTION 7: SANS 10142-1 OF 2017: FIXED APPLIANCES

7.1
- Forms part of equipment that has built-in overcurrent protection
- Has an integral thermal protector with an accessible reset button
- Has an automatic resetting thermal protector and there is no likelihood of mechanical damage
- of injury to persons when the motor restarts
- Is of a high impedance type that can stall without overheating (5)

7.2
- Have a tripping value that is as near to the full-load rated current of the motor as is practicable
- Have sufficient time delay to allow the motor to start and accelerate under normal conditions
- Prevent a multiphase motor from continuing to operate under load if single phasing occurs
- In the case of an automatically controlled motor, have to be manually reset after operation
- before allowing automatic restarting of the motor (5)

[10]

QUESTION 8: SANS 10142-1 OF 2017: PROSPECTIVE SHORT-CIRCUIT CURRENT, DC

8.1 PSCC = Eb/Rbbr

Eb = 1,05 × (120 × 2)
= 252 V✓✓

Rbbr = 0,9 × (Rb + Rbl + Ry)✓
= 0,9 × (0,3 + 0,8 + 1,4)
= 2,25 ohms✓✓

PSCC = 252/2,25
= 112 A✓✓ (7)

8.2 8.2.1 Open-circuit voltage of the batteries (1)

8.2.2 Total resistance of the upstream network in ohms including the internal resistance of the battery and the resistance of the conductors (2)

[10]

QUESTION 9: SANS 10142-1 OF 2017: VERIFICATION AND CERTIFICATION; SANS 10142-1 OF 2008: TEST REPORT: INSPECTIONS

- Accessible components are correctly selected
- All protective devices are of the correct rating
- All protective devices are capable of withstanding the prospective short-circuit current
- Conductors are of the correct rating and current-carrying capacity for the protective devices and connected load
- Components have been correctly installed and are accessible where necessary
- Disconnecting devices (isolators) are correctly located and all switchgear switches the phase conductors
- Different circuits are separated electrically. Circuits for control communication, security, detection, safety and the like, should be electrically separated and, where specified, physically separated
- Connections of conductors and earthing and bonding are mechanically sound
- Connections of conductors and earthing and bonding are electrically continuous
- Circuits, fuses, switching devices, terminals, earth-leakage units, circuit breakers and distribution boards are correctly and permanently identified, marked or labelled
- The integrity of the fire barrier has been maintained where an electrical system passes through a fire barrier
- Safety lighting, emergency lighting and safety signs function correctly
- In the case of new installations or additions or alterations to existing installations, the new, added or altered installation complies with this part of SANS 10142, or
- In the case of installations that existed before the publication of this edition of this part of SANS 10142, the installation complies with the general safety principles of this edition of this part of SANS 10142 and is reasonably safe
- Where an alternative supply is installed, it complies with all the requirements in 7.12, and
- The position of the readily accessible earthing terminal for the earth connection of other services made by installers of such services (see 6.11.5) is indicated on all distribution boards. (Any 10 × 1) **[10]**

QUESTION 10: SANS 10142-1 OF 2017: ANNEX I: INSTALLATION OF SURGE PROTECTION DEVICES (SPDs) IN VOLTAGE SYSTEMS

10.1
- Protection against SPD short-circuits shall be provided by overcurrent protective devices that are selected according to the SPD manufacturer's instructions.
- The cross-sectional areas of the conductors that connect the overcurrent protective devices to the line conductors shall be rated according to the maximum possible short-circuit current. (2 × 2) (4)

10.2 They should enter in close proximity of one another and not on opposite sides of the building or structure. (1)

10.3
- Air-termination system
- Down conductors
- Earth electrode system (3)

10.4
- Risk analysis type R4 (economic loss)
- Risk analysis type R1 (risk to human life) (2)

[10]

TOTAL: 100

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