10/8 3/1

QUESTION 1

SANS 10142 PART 1 OF 2003 - VOLTDROP CALCULATIONS

In order to select components that are rated to comply with the installation requirements of SANS 10142- 1 Certain information is required. Study the attached diagram together with the tables then calculate the following:

QUESTION 1

(i)

$$Z_c = \frac{L\sqrt{R^2 + X^2}}{1000}$$

$$PSCC = \frac{V}{\sqrt{3}} \times Z_{TOTAL}$$

$$Z_c = \frac{100\sqrt{0,63^2 + 0,76^2}}{1000}$$

$$Z_c = 0,0636\Omega$$

$$PSCC = \frac{400}{\sqrt{3} \times 0,0636}$$

$$PSCC = 3,639kA$$ (2)

(ii)

$$PSCC = \frac{V}{2 \times Z_{LINE}}$$

$$PSCC = \frac{400}{2 \times 0,0636}$$

$$PSCC = 3,144kA$$ (2)

(iii)

$$\%VOLTDROP$$

$$VD = mV \times A \times L$$

$$VD = \frac{1.1}{1000} \times 130 \times 100$$

$$VD = \frac{14,3}{400} \times 100$$

$$VD = 3,575\%$$ (2)

(iv) **Actual minimum ECC size**

Lets assume a cable size of 25 mm² copper √

$$TV = 2 \times 160 \times \frac{0,88}{1000} \times 100$$

$$TV = 28,16\ v$$

Note: 28.16V is just less than 30V

Check 1. From table 6.28 page 182 using 25 mm² ECC you can go up to 126 m maximum

Check 2. Ohms/km is 0,096 from 160 A (2)

$$\Omega/km = \frac{0,096}{1000} \times 100$$

$$\Omega/km = 0,096$$

Therefore, falls between 16 mm² and 25² mm see page 307 table D1.

(v) TV=28.16V see above (iv) (2)

10/8

QUESTION 2

SANS 10142 PART 1 OF 2003- Installation Requirements (Joints and Terminations)

2.1 Name FOUR requirements where joints and terminations are prohibited. (6)

2.2 WIREWAYS(CONDUIT INSTALLATIONS)
Name the requirements in the following cases only:

2.2.1 Fittings (1)
2.2.2 Inner radius (1)
2.2.3 Bends (1)
2.2.4 Openings (1)
[10]

2.1 Joints and terminations shall not

a) adversely affect the current-carrying capacity, the insulation resistance or the earth continuity of the cable, core or conductor in which they are made,

b) be made in any connector, bend, elbow or tee-piece of a conduit,

c) allow the strands of a stranded conductor to spread, or

d) require strands of a stranded conductor to be cut away to allow connection of the conductors (for example, to terminals).

2.2 In the case of conduits,

a) all fittings other than bends and couplings shall be of the inspection type;

b) the inner radius of a bend in a conduit shall be at least three times the external diameter of the conduit;

c) bends shall not distort the internal shape of a conduit or open any weld; and

d) there shall be no openings in the side of a conduit for cables to enter or leave the conduit.

QUESTION 3

SANS 10142 OF 2003. (PROTECTION) IT SUPPLY SYSTEM EARTHING

3.1 Fill in the correct missing words from the following information and write the answer next to each question.

3.1.1 be automatically disconnected

3.1.2 double the rated current

3.1.3 point of control

3.1.4 earth loop impedance

3.1.5 25 V for a period not exceeding 5 s.

3.2 **Fill in the correct missing words from the following information and write the answer next to each question.**

3.2.1 Each instaliation shall

3.2.2 consumer's earth terminal.

3.2.3 to an earth continuity conductor

3.2.4 the consumer's earth terminal.

3.2.5 earthed

3.2.6 supplier's earth terminal

3.2.7 protective conductor

3.2.8 the earth electrode.

3.2.9 effectiveness

3.2.10 the supplier's protective conductor [10]

QUESTION 4

SANS 10142 PART 1 OF 2003 - (DISTRIBUTION BOARDS) (GENERAL)

4.1 **Each distribution board shall be controlled by a switch disconnector. Name FIVE applicable requirements regarding the switch connector.** [10]

General

Each distribution board shall be controlled by a switch-disconnector. The switch-disconnector shall

a) be mounted in or next to the distribution board,

b) in the case of the main or first distribution board of an installation, be labelled as "main switch",

c) in the case of a sub-distribution board, be labelled as "sub-main switch" or "main switch" if the board is labelled "sub-board ..."

d) in the case where an alternative supply is instalied (emergency supply, uninterruptible power systems (UPS), etc.), be labelled as required

e) have a danger notice on or near it. The danger notice shall give instructions that the switch-disconnector be switched off in the event of inadvertent contact or leakage

QUESTION 5
SANS 10142 PART 1 OF 2003 (LUMINAIRES)

5.1 **Name the FIVE places a suspended luminaire shall be mounted out of arms reach from the floor if it is installed.** (5)

A suspended luminaire shall be out of arm's reach from the floor if the luminaire is installed in a

a) washroom,

b) change room,

c) laundry,

d) cupboard or other enclosure, or

e) position exposed to wind and the weather.

A suspended luminaire that is likely to be exposed to wind shall be specially designed for such conditions and so installed that it cannot be damaged or come into contact with flammable material.

5.2 LAMP HOLDERS

5.2.1 **A lamp holder shall be shrouded in insulating material or shall be earthed unless it meets with simultaneous installation requirements. Name FOUR such simultaneous instances.** (4)

Lamp holders

A lamp holder shall be shrouded in insulating material or shall be earthed, unless it is simultaneously

a) out of arm's reach from the floor or walkway level,

b) out of arm's reach from a structure that is bonded to earth,

c) protected from the weather and the splashing, dripping, or accumulation of water, and

d) not touching a conductive surface.

5.2.2 Name the connecting requirements regarding Edison screw type Lamp holders. (1) [10]

The outer contact of an Edison-screw type lamp holder shall be connected to the neutral conductor.

QUESTION 6
SANS 10142 PART 1 OF 2003
EARTHING OF EXPOSED CONDUCTIVE PARTS

(5)

6.1 Name SEVEN conductive parts that shall be earth according to the code. (7)

Earthing of exposed conductive parts

The following conductive parts shall be earthed:

a) all exposed conductive parts of an installation other than those described in 6.12.3.2;

NOTE Metal enclosures on PVC conduit should be earthed if they can become live and can be touched.

b) all conductive cable sheaths and armouring, wireways and catenary wires;

c) the earthing terminal of a socket-outlet;

d) the secondary winding of a transformer if it is not a safety transformer;

e) earthing terminals of all permanently connected electrical equipment and appliances;

f) conductive parts of discharge luminaires and equipment that need special earthing arrangements; and

g) all class I equipment.

BONDING

6.2 Name the bonding requirements regarding water pump motors (3)

Water pumps [10]

All accessible extraneous conductive parts associated with a water pump motor shall be bonded to the earth continuity conductor. These parts include the suction pipe, delivery pipe and pump casing.

QUESTION 7
SANS 10142 PART 1 OF 2003

7.1 Table 8.1 of the Code refers to the maximum resistance of the earth continuity conductor, with reference to a known protective device. Derive from basic principals the approximate resistance value for the following protective devices.

7.1.1 $_{\cdot 40} = \frac{30}{80} = 0{,}375 ohm$ (1)

7.1.2 $_{\cdot 63} = \frac{30}{126} = 0{,}238 ohm$ (1)

7.1.3 $_{\cdot 80} = \frac{30}{160} = 0{,}1875 ohm$ (1)

7.1.4 $_{\cdot 315} = \frac{30}{630} = 0{,}0476 ohm$ (1)

7.2 Annexure K

NOTIFCIATIONS OF POTENTIAL DANGERS

7.2.1 Briefly describe how the potential dangers could be detected and the action to be taken in each case of danger.

(6)
[10]

Annex K

Notification of a potential danger
(See 8.7.6 and 8.7.10)

Elevated voltage on supply neutral

With the main switch off, measure the voltage between the supply neutral and any earth external to the installation. Notify the supplier if the reading exceeds 25 V.

Disconnect the installation and notify the supplier (see annex K) if the reading exceeds 50 V.

Voltage, main distribution board — no load

With all load switched off, measure the voltage at the point of control. Notify the supplier (see annex K) if the voltage is outside the standard voltage limits (see 5.3.2).

Voltage, main distribution board — on load

Switch on the maximum available load and measure the voltage at the point of control. Notify the supplier (see annex K) if the voltage is outside the regulatory limits (see 5.3.2).

The voltage drop from the point of supply to the point of consumption shall not exceed 5 % (see annex E).

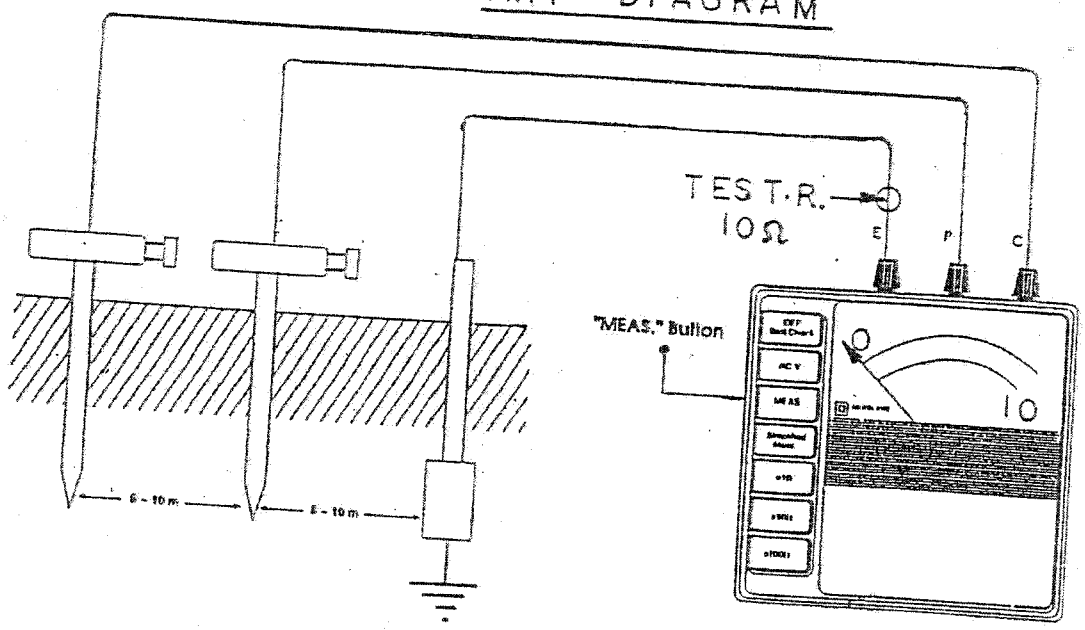
QUESTION 8
SANS 10142 PART 1 OF 2003
VERTIFCATION AND CERTIFICATION

8.1 Describe with the aid of a diagram how the earth electrode resistance test is carried out .

(4)

Earth Resistance Measurement

ANY DIAGRAM



8.2 Give the formula to enchance your answer.

(1)

It is accepted that a circuit should carry a fault current of twice the rated circuit current. To calculate what the maximum acceptable value of measurement is proceed as per the following formula:

$$Rmax = \frac{V}{2I}$$

Where Rmax = Maximum earth electrode resistance
V = System Voltage
I = Rated Circuit Current

Example: 60 Amp Circuit (I)
220 VAC System (V)

$$Rmax = \frac{V}{2I}$$

$$= \frac{220}{(2x60)}$$

$$= 1.83\ \Omega$$

Therefore the earth electrode resistance must be below 1.83 Ω to allow a fault current of 120 amps to flow.

8.3 According to regulation 8.7.1 all test measuring instruments shall be accurate to be within 5% or better
Describe by making use of the answer in 8.1, how the accuracy of the instrument could be verified.

Step 1. Select a scale on the instrument 0 to 10 ohm range (½)
Step 2. Short circuit all three leads & press the measuring button, reading should be ±0 ohm (½)
Step 3. Insert a 10 ohm resistor in lone with the instrument common at the meter while the leads are still shorted out. Press the measuring button again, the reading should be ±10 ohms (1)
Step 4. Record both readings in the instrument log book & work out the instrument percentage error whenever the instrument is used. (½)
Note: The first reading of 0 ohms is undefined & no error can be worked out here if zero is taken as the reference point. One ohm or any other small value could be used as the alternative reference point.

Calculation to work out percentage error at say, 10 ohm range using hypothetical reading on the meter of say 10,2 ohms.

8.4 Give practical hypothetical values to illustrate your answer.

$$\%\cdot error = \frac{10}{10{,}2} \times 100\% = 98\%$$

$$actual = 100\% - 98\% = +2\% \quad (1)$$

Conclusion: The instrument thus reads 2% high which is less than 5% according to the code.

QUESTION 8
SANS 10142 PART 1 OF 2003
SECTION 8 VERIFICATION

8.1 Calculate the PSCC for a three phase fault if the following is given:

- Transformer capacity 200KVA at 400/250volt
- Transformer protection 200amp per phase
- 70mm² 4 core copper cable + ECC of 100 meters.
- Z % of the transformer 5% (ohm).

(8)

$$PSCC = \frac{V}{\sqrt{3} \times Z_T}$$

$$Z_T = Z_1 + Z_2$$

$$Z_2 = \frac{L\sqrt{R^2 + X^2}}{1000}$$

$$Z_1 \ of \ transformer = \frac{V^2}{KVA} \times \frac{5}{100}\%$$

$$Z_1 \ of \ transformer = \frac{400^2}{200 \times 10^3} \times \frac{5}{100}$$

$$\underline{Z_1 \ of \ transformer = 0{,}04\Omega}$$

$$Z_2 = \frac{100\sqrt{0{,}31^2 + 0{,}074^2}}{1000}$$

$$\underline{Z_2 = 0{,}03187\Omega}$$

$$Z_T = Z_1 + Z_2 : Z_T = 0{,}041 + 0{,}03187 : \underline{= 0{,}07187\Omega}$$

$$PSCC = \frac{400}{\sqrt{3} \times 0{,}07187}$$

$$\underline{PSCC = 3213{,}39A}$$

$$\underline{PSCC = 3{,}213kA}$$

8.2

$$TV = 2 \times 200 \times \frac{0{,}31}{1000} \times 100$$

$$\underline{TV = 12{,}44V}$$

8.3 (1)

$$Z_{LOOP} = 0{,}04 + 0{,}031 + 0{,}031$$

$$\underline{Z_{LOOP} = 0{,}102\Omega}$$

QUESTION 10

SABS 0313 : PROTECTION OF STRUCTURE AGAINST LIGHTNING

State al the criteria that need to be complied with when installing earth Electrodes, in the following cases.

10.1 External horizontal ring earth electrodes. (2)

10.2 Radial or vertical earth electrodes. (3)

10.3 Insulation depth and type of earth electrode. (3)

10.4 Joints (1)

10.5 Inspections (1)

[10]

TOTAL 100

Installation of earth electrodes

(1) An external horizontal ring earth electrode should be buried at a depth of at least 0,5 m but not within 1 m of the walls of the structure.

(2) The radial or vertical earth electrodes shall be installed outside the space to be protected at a depth of at least 0,5 m and distributed as uniformly as possible to minimize electrical coupling effects in the earth.

(5) Earth electrodes shall be so installed as to allow inspection during construction.

(3) The installation depth and the type of the earth electrode shall be such as to minimize the effects of corrosion, soil drying and freezing and thereby stabilize the equivalent earth resistance (see 3.13). It is recommended that the first metre of a vertical earth electrode should not be regarded as being effective under frost conditions.

(4) All joints shall be made in accordance with good engineering practice.