education

Department:
Education
REPUBLIC OF SOUTH AFRICA

T1140 (E)(A4)T
AUGUST 2009

NON-NATIONAL CERTIFICATE: INSTALLATION RULES

INSTALLATION RULES
(Second Paper)

(11040432)

4 August (X-Paper)
09:00 – 12:00

Calculators may be used.

This question paper consists of 6 pages and 2-pages of tables.

DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

NON-NATIONAL CERTIFICATE: INSTALLATION RULES
INSTALLATION RULES
(Second Paper)
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Even though not explicity stated in a question, ALL the answers must comply with the relevant codes and/or requirements of the SABS Publications, Occupational Health and Safety Act Regulations.
5. The answers need NOT be word-perfect in ALL respects according to the publications, but show that the candidate fully understands the context of the relevant questions. (ANY meaningful answer will be marked.)
6. The necessary tables are supplied.
7. The candidates must pass PAPER 1 and PAPER 2 with 50%. Both examination papers may be written during the SAME examination period. However, candidates need NOT pass BOTH examinations during the same trimester, but the SECOND EXAMINATION must be passed within 12 months of the first, otherwise both examinations must be re-written. However, if a candidate obtains 75% of 100 marks in any one of the examinations, he/she will be permanently exempted from re-writing that examination. An appropriate statement will be issued. For accreditation purposes ALL candidates must meet the latest requirements prescribed by the Department of Labour.
8. NO condonation will be considered.
9. Candidates must attempt ALL COMPULSORY questions that may appear in the examination.
10. Start each question on a NEW page.
11. Write neatly and legibly.

QUESTION 1: SANS 10142 PART 1 OF 2008 (COMPULSORY)

A 4 core armoured, PVC, ECC copper cable with a total length of 95 metres, must supply the following resistive loads when the supply is 400/230 volts:

- Red phase 100 A
- White phase 90 A
- Blue phase 20 A
- Ignore volt drop after the main cable
- Ignore the installation method

Draw the circuit and then determine the following:

1.1 The minimum main cable size (4)

1.2 The actual % phase to neutral volt drop on the blue phase if the cable in QUESTION 1.1 is used (3)

1.3 The main protection tripping rating (1)

1.4 The current unbalanced factor (1)

1.5 The actual resistance of the ECC if it is the same size as one of the phase conductors (1)

NOTE: ALL calculations steps must be shown, use the following information where applicable:

- Cable depth 0,5 meters
- Thermal resistance of the ground 1,2 Km/w
- Soil temperature 25°C

[10]

QUESTION 2: SANS 10142 PART 1 OF 2008: GENERAL CIRCUIT ARRANGEMENTS

2.1 In a three-phase, four-wire circuit that supplies only single phase loads of electrical equipment that are connected between a phase conductor and the neutral conductor, may supply any number of points if the circuit is protected. Elaborate on ALL of the requirements to comply with the regulation. (8)

2.2 Fill in the missing words or phrases:

2.2.1 All the conductors of any circuit shall ... . (1)
2.2.2 A maximum of ... may be connected to ... . (1)
[10]

QUESTION 3: SANS 10142 PART 1 OF 2008

CURRENT CARRYING CAPACITY ON CONDUCTORS AND CABLES

The sustained current carrying capacity (I) measured in amps of a cable buried directly in the ground can be calculated by the following equation:

I = Is x F1 x F2 x F3 x F4 in amps.

3.1 Give the information of the factors used in the equation to enhance your answer in each case, together with an example. (5)

3.2 Explain in your OWN words how the area of a cable could be determined for a certain load by using the information in QUESTION 3.1.

NOTE: The answer MUST be summarized in POINT FORM. (5)
[10]

QUESTION 4: SANS 10142 PART 1 OF 2008: POSITIONING AND THE FIXING OF CABLES

Name FIVE cases where the installation or running of cables is prohibited.

NOTE: The answer must be summarized in point form. **[10]**

QUESTION 5: SANS 10142 PART 1 OF 2008: MULTICORE CABLES IN WIREWAYS

5.1 Briefly describe the methods used to determine the minimum nominal size for PVC conduit and the maximum allowable % NOT to be exceeded for ducting, conduit and trunking. (4)

5.2 The following information is given:

- 25 mm PVC conduit
- 2 x 1,5 mm^2 PVC conductors
- 3 x 4 mm^2 PVC conductors
- 2 x 6 mm^2 PVC conductors

Determine how many 1 mm^2 single core PVC conductors may be added to the installation, according to the code. (4)

5.3 What are the earthing requirements regarding insulated flexible metal conduit? (2)
[10]

QUESTION 6: SANS 10142 PART 1 OF 2008: EARTH CONTINUITY CONDUCTORS

Fill in the missing word or words:

6.1 Earth continuity conductors shall be arranged ... with. (½)

6.2 A wireway shall not be used as an ... . (½)

6.3 Connections of earth continuity conductors shall not ... . (2)

6.4 A fuse or ... shall not be fitted in ... (joints which can only be disconnected by means of a ...). (2½)

6.5 Earth continuity conductors shall be suitably protected against ... chemical or ... electrodynamic forces and ... . (1½)

6.6 Where electrical monitoring of earthing is used, operating ... not to be ... . (1)

6.7 An ECC has an area of 2,5 mm with a total resistance of 0,2 ohms. Determine the maximum length of conductor by using TABLE E1 ONLY. (2)

[10]

QUESTION 7: SANS 10142 SECTION 8: INSPECTION AND TEST INSULATION RESISTANCE TESTS

7.1 Name SIX safety precautions that must be taken when the above test is conducted. (3)

7.2 Briefly explain how the accuracy of the test instrument can be verified.

NOTE: Give hypothetical values to enhance your answer. The answer should NOT exceed SIX LINES and must be summarized in point form. (3)

7.3 What is the minimum acceptable insulation resistance reading at 23°C, according to the code? (½)

7.4 If the insulation resistance reading test must be carried out on a three phase 4-wire system, which reading of the recorded values must be noted. Explain. (1)

7.5 What steps must be taken, if the insulation resistance test fails to comply? (1)

7.6 What measures could be taken if the readings fail when the test is carried out from the main DB to THREE other sub-DB's and does NOT comply according to the minimum requirements? (1)

7.7 Is a reading of 1,6 Giga-ohms acceptable when the test is done between the live and neutral conductors? (½)
[10]

QUESTION 8: SANS 10142 PART 1 OF 2008

Calculate the total length of a two-core PVC cable of a DC supply installation, if the following information is given:

- A 100 cell battery with a full load capacity of 250 a/h
- Total internal resistance per cell is 0,011 ohm
- Total resistance of the battery pole connectors is 1 ohm
- The PSCC of the DC supply is 92,522 ampere
- Cross-sectional area of supply is 16 mm^2 copper
- Ignore methods of installation **[10]**

QUESTION 9: SANS 10142 PART 1 OF 2008: VERIFICATION POLARITY AT POINT OF CONSUMPTION (COMPULSORY)

9.1 Name the FOUR main checks/tests to be observed to ensure that the polarity connections is correct in an installation. (4 x 2) (8)

9.2 Name any other TWO tests that can be performed simultaneously with the polarity test. (2)
[10]

QUESTION 10: SANS 62305/3/2007: PROTECTION AGAINST LIGHTING MAINTENANCE AND INSPECTION OF LPS (COMPULSORY)

10.1 Name THREE main objectives of LPS inspections. (4)

10.2 ORDER OF INSPECTIONS

10.2.1 Name FOUR inspections in sequence of importance. (4)

10.2.2 Name TWO important checks to be made during periodic inspection. (2)
[10]

TOTAL: 100

Table 6.23 — Values of *C* for conductor nominal cross-sectional area

1	2
Nominal cross-sectional area of conductor mm^2	Value of *C*
1	8
1,5	10
2,5	14
4	17
6	22
10	30
16	42
25	65
35	84
50	118
70	152

Table 6.24 — Values of *K* for conduit diameter

1	2
Value of *K*	Conduit diameter mm
90	20
144	25
240	32
398	40
640	50

Table 6.4(b) — Multicore PVC insulated armoured cables (SANS 1507 (SABS 1507))
Voltage drop (per ampere per metre) copper conductors

Amdt 1

Conductor operating temperature: 70 °C

1	2	3			4		
Conductor cross-sectional area mm²	Two-core cable d.c. ‡ mV/A/m	Two-core cable, single-phase a.c. ‡ mV/A/m			Three-core or four-core cable, three-phase a.c. mV/A/m		
		r	x	z	r	x	z
1,5	29	29			25		
2,5	18	18			15		
4	11	11			9,5		
6	7,3	7,3			6,4		
10	4,4	4,4			3,8		
16	2,8	2,8			2,4		
25	1,75	1,75	0,170	1,75	1,50	0,145	1,50
35	1,25	1,25	0,165	1,25	1,10	0,145	1,10
50	0,93	0,93	0,165	0,94	0,80	0,140	0,81
70	0,63	0,63	0,160	0,65	0,55	0,140	0,57
95	0,46	0,47	0,155	0,50	0,41	0,135	0,43
120	0,36	0,38	0,155	0,41	0,33	0,135	0,35
150	0,29	0,30	0,155	0,34	0,26	0,130	0,29
185	0,23	0,25	0,150	0,29	0,21	0,130	0,25
240	0,180	0,190	0,150	0,24	0,165	0,130	0,21
300	0,145	0,155	0,145	0,21	0,135	0,130	0,185
400	0,105	0,115	0,145	0,185	0,100	0,125	0,160

‡ In the case of single-phase circuits, the return path has been accounted for in the values given.

Table E.1 – Impedance of 600/1 000 V conductors that comply with SANS 1507 (SABS 1507)

Ambient temperature: 30 °C
Conductor operating temperature: 70 °C

1	2	3	4	5	6	7
Nominal cross-sectional area of conductor mm²	Conductor resistance *R* for a.c. circuits Ω/km		Conductor reactance *X* for a.c. circuits Ω/km		Conductor resistance *R* for d.c. circuits Ω/km	
	Material of conductor					
	Copper Cu	Aluminium Al	Copper Cu	Aluminium Al	Copper Cu	Aluminium Al
1	21,9	36,0	0,107	0,107	21,9	36,0
1,5	14,6	24,0	0,100	0,100	14,6	24,0
2,5	8,7	14,4	0,095	0,095	8,7	14,4
4	5,5	9,0	0,093	0,093	5,5	9,0
6	3,6	6,0	0,090	0,090	3,6	6,0
10	2,2	3,6	0,084	0,084	2,2	3,6
16	1,4	2,3	0,080	0,080	1,4	2,2
25	0,86	1,44	0,079	0,079	0,87	1,44
35	0,63	1,03	0,076	0,076	0,62	1,03
50	0,44	0,72	0,076	0,076	0,44	0,72
70	0,31	0,52	0,074	0,074	0,31	0,51
95	0,23	0,38	0,073	0,073	0,23	0,38
120	0,18	0,30	0,072	0,072	0,18	0,30
150	0,15	0,24	0,072	0,072	0,15	0,24
185	0,12	0,20	0,072	0,072	0,12	0,19
240	0,095	0,156	0,072	0,072	0,091	0,150
300	0,077	0,127	0,071	0,071	0,073	0,120
400	0,060	0,099	0,071	0,071	0,055	0,090
500	0,050	0,083	0,070	0,070	0,044	0,072
630	0,043	0,071	0,069	0,069	0,035	0,057
800	0,037	0,061	0,058	0,058	0,027	0,045
1 000	0,033	0,054	0,049	0,049	0,022	0,036