higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T890**(E)**(A4)T

NON-NATIONAL CERTIFICATE

INSTALLATION RULES
(Second Paper)

(11040432)

4 April 2018 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 6 pages and 3 addenda.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NON-NATIONAL CERTIFICATE
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 according to the numbering system used in this question paper.
4. Even though NOT explicitly stated in a question, ALL answers must comply with the relevant codes and/or requirements of the SANS publications (latest edition) and the Occupational Health and Safety Act regulations.
5. The answers need NOT be word-perfect in all aspects according to the publications, but must show that the candidate fully understands the context of the relevant questions.
6. The necessary tables are supplied.
7. The candidates must pass PAPER 1 and PAPER 2 with 50% each. 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. If a candidate obtains 75 out 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 requirements prescribed by the Department of Labour.
8. NO condonations will be considered.
9. Answers must be calculated to 2 decimal places
10. Start each question on a NEW page.
11. Write neatly and legibly.

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QUESTION 1: SANS 1973 OF 2008: LV SWITCHGEAR AND CONTROLGEAR ASSEMBLIES PART 3: SAFETY OF ASSEMBLIES WITH A RATED PSSC OF UP TO 10 kA

1.1 State the *scope* for the above code. (5)

1.2 Name, and give an explanation of, the FOUR degrees of pollution for switching devices and components fitted inside an enclosure. (5)
[10]

QUESTION 2: SANS 10142–1 OF 2008: ANNEXURE C: PROSPECTIVE SHORT-CIRCUIT CURRENT

To calculate the impedance of a phase conductor the following formula is used:

$$Z = \frac{\ell\sqrt{R^2 + X^2}}{1000}$$

Explain the representation of the following:

2.1 L (2)

2.2 R (2)

2.3 X (2)

To calculate the PSCC of batteries the following formula is used:

$$PSCC = \frac{Eb}{RBBr}$$

Explain the representation of the following:

2.4 Eb (1)

2.5 RB (1)

2.6 RBL (1)

2.7 Ry (1)
[10]

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QUESTION 3: SANS 10142–1 OF 2008: CALCULATION OF VOLTAGE DROP

A single-phase 10 kW motor is connected 50 m from the distribution board by an underground armoured copper cable.

3.1 Use different cable sizes to determine the correct cable suitable for this motor, starting with the smallest cable for the load given, and calculate the correct cable that can be used.

Show ALL calculations. (8)

3.2 Give a reason why the cable in QUESTION 3.1 was selected. (1)

3.3 Calculate the % voltage drop of the correct cable. (1)
[10]

QUESTION 4: SANS 10142–1 of 2008: VERIFICATION AND CERTIFICATION

4.1 Explain how the earth leakage unit test is performed. (6)

4.2 How is the insulation resistance test performed where there are sub-distribution boards of which the total insulation resistance is less than 1,0 MΩ? (4)
[10]

QUESTION 5: SANS 10142–1 OF 2008: VERIFICATION AND CERTIFICATION

Name TEN inspections that must be carried out during the inspection of a new or existing installation. **[10]**

QUESTION 6: SANS 10142–1 0F 2008: INSTALLATION REQUIREMENTS – GENERAL CIRCUIT ARRANGEMENTS

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (6.1–6.10) in the ANSWER BOOK.

6.1 In a multiphase installation the circuit shall be so arranged that the total load is balanced, as closely as is practicable, between phases of the supply.

6.2 Throughout the circuit, the neutral conductor shall have the same nominal cross-sectional area as the earth conductor.

6.3 A maximum of THREE conductors may be connected to any one terminal provided that the terminal has the correct rating.

6.4 The neutral conductor may be connected directly to the earth or to the earth continuity conductor on the supplier side of the installation.

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6.5 All the conductors of any circuit shall originate at the same distribution board.

6.6 If conductors that operate at different voltages run in the same wireway, the insulation of each conductor shall be able to withstand the lowest conductor voltage in the wireway.

6.7 If a luminaire is used as a wireway (through-wiring), heat-resistant cable that complies with SANS 529 shall be used.

6.8 The continuity of neutral and earth shall be ensured at all times, and except where the luminaire is used as a wireway for through-wiring, the continuity may be disturbed during the repair, replacement or removal of any appliance.

6.9 A conductor that forms part of a DC installation can be run in the same wireway as a conductor that forms part of an AC installation, provided that the voltage rating is the same.

6.10 Flexible cords can be used as part of the electrical installation, when used in an authorised wiring system.

(10 × 1) **[10]**

QUESTION 7: SANS 10142–1 OF 2008: INSTALLATION REQUIREMENTS – INSTALLATION OF CONDUCTORS AND CABLES

7.1 Give FOUR requirements when joints and terminations are made in an installation. (4)

7.2 Give FOUR measures to be taken when fixing cables. (4)

7.3 What are the requirements when unarmoured, insulated and sheathed cables are buried at a depth of at least 0,5 m? (2)

[10]

QUESTION 8: SANS 10142–1 OF 2008: INSTALLATION REQUIREMENTS – WIREWAYS

Complete the following sentences by providing the missing information. Write only the missing information next to the question number (8.1–8.10) in the ANSWER BOOK.

8.1 A wireway shall be installed such that …

8.2 Joints other than expansion joints …

8.3 Expansion joints …

8.4 All inspection joints and boxes …

8.5 All boxes and expansion joints that could be splashed with liquid …

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8.6 It shall be able to withstand …

8.7 Any cable, other than a high-voltage cable for a discharge lamp installation, may …

8.8 No part of the wireway …

8.9 Metal doors, covers or hinged panels …

8.10 Cable entry points, exit points, and the internal surface of the wireway …

(10 × 1) **[10]**

QUESTION 9: SANS 10142–1 of 2008: INSTALLATION REQUIREMENTS – PROTECTION

9.1 Give FOUR conditions on which conductors that form part of an installation, may be protected by the supplier's overcurrent protective device. (4)

9.2 Give THREE instances where every socket outlet circuit shall be fitted with warning labels. (3)

9.3 What are the installation requirements for an earth-leakage protection device that is not provided with integral overcurrent protection? (3)

[10]

QUESTION 10: SANS 10142–1 OF 2008: INSTALLATION REQUIREMENTS – SOCKET OUTLETS

10.1 What are the requirements regarding a single-phase socket outlet for general use? (3)

10.2 State FOUR requirements regarding socket outlets that supply voltages other than the standard voltage. (4)

10.3 Give THREE types of mixed load that a single-phase circuit that has overcurrent protection rated at not more than 20 A, may supply. (3)

[10]

TOTAL: 100

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SANS 10142-1:2003
Edition 1.1
(As amended 2005)

Table 6.8 — Multicore PVC insulated armoured cables buried directly in the ground (SANS 1507) Current-carrying capacity

Soil temperature: 25 °C
Maximum conductor temperature: 70 °C

1	2	3	4	5
Nominal conductor size mm^2	**Standard rating[a] – Copper cables** A			
	Cables buried in the ground		**Cables in pipes or ducts buried in the ground**	
	Two-core	**Three-core or four-core**	**Two-core**	**Three-core or four-core**
	Cu	**Cu**	**Cu**	**Cu**
1,5	29	24	23	20
2,5	37	32	31	26
4	50	42	41	34
6	62	53	51	43
10	83	70	68	58
16	107	91	88	75
25	142	119	116	96
35	171	143	139	116
50	203	169	165	138
70	249	210	203	171
95	299	251	244	205
120	339	285	278	234
150	380	320	311	263
185	430	361	354	298
240	496	416	410	344
300	554	465	459	385
400	624	522	517	441

NOTE See table 6.4(b) for voltage drop.

[a] Standard conditions of installation:

Depth of burial: 0,5 m
Thermal resistivity of soil: 1,2 K·m/W
Each cable is thermally independent.

Amdt 4

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Table E.1 – Impedance of 600/1 000 V conductors that comply with SANS 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	0,88	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

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Edition 1.1

Table E.2(b) — Maximum lengths, in metres, of copper cables/circuits at a given circuit-breaker current rating for three-phase (F_V = 1 balanced)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Nominal cross-sectional area mm²	Circuit-breaker current rating A																
	10	15	20	25	30	40	50	60	80	100	125	150	200	225	250	300	350
1	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,5	78	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2,5	132	88	66	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	209	139	104	83	69	–	–	–	–	–	–	–	–	–	–	–	–
6	319	212	159	127	106	79	–	–	–	–	–	–	–	–	–	–	–
10	522	348	261	209	174	130	104	–	–	–	–	–	–	–	–	–	–
16	–	547	410	328	273	205	164	136	–	–	–	–	–	–	–	–	–
25	–	–	660	528	440	330	264	220	165	–	–	–	–	–	–	–	–
35	–	–	–	741	618	463	370	309	231	185	–	–	–	–	–	–	–
50	–	–	–	–	–	653	522	435	326	261	209	174	–	–	–	–	–
70	–	–	–	–	–	–	741	618	463	370	296	247	–	–	–	–	–
95	–	–	–	–	–	–	–	–	625	500	400	333	250	222	–	–	–
120	–	–	–	–	–	–	–	–	798	638	511	425	319	283	255	–	–
150	–	–	–	–	–	–	–	–	–	766	613	511	383	340	306	255	–
185	–	–	–	–	–	–	–	–	–	–	766	638	479	425	383	319	273

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