C&G 2395 Exam Paper – June 2013

Section A-All questions carry equal marks. Answer all three questions. Show all calculations.

1. The electrical installation in an industrial unit is scheduled for a periodic inspection as a new tenant has acquired the building. The building is occupied and in use by other trades.

   a) There are no previous documents or circuit charts available for this installation.
   State the purpose of the survey which is undertaken by the inspector before the inspection and test can be carried out. (2 marks)

   b) Describe, in detail, the procedure to be followed when isolating the three-phase isolator controlling the whole installation. (13 marks)

2. A periodic inspection is to be carried out on an electrical installation forming part of a TN-C-S system in a 5 year old school building.

   a) The circuit protective devices, RCBOs and the circuit conductors contained within the metal clad distribution board are to be inspected. The installation is isolated and the distribution board cover is removed. State six checks to be made during the inspection of these items. (6 marks)

   b) State four further inspection items to be verified and recorded relating to the Distribution Network Operator's (DNO) equipment. (4 marks)

   c) An inspection item was found to be unsatisfactory.

      i) State all of the information that needs to be recorded. (3 marks)

      ii) State the documents on which this information is to be recorded. (2 marks)

3. a) A test is to be carried out to establish the resistance of a single three-metre long earth electrode for a generator providing an alternative supply to a rural ambulance station.

      i) State what must be agreed before the process can begin. (1 mark)

      ii) State the action to be taken with the earthing conductor for the generator before testing can begin. (2 marks)

      iii) State the action to be taken with the generator before the action in a) ii) above can be taken. (2 marks)

      iv) State the test instrument to be used for this test. (1 mark)

   b) Describe in detail, with the aid of a fully labelled diagram, how the test would be carried out. (7 marks)

   c) State the action to be taken with regards to the earthing conductor once

the test is complete. (2 marks)

SCENARIO (SECTION B - QUESTONS 4 TO 6)
(SOURCE DOCUMENT - DO NOT RETURN TO CITY & GUILDS)
DO NOT WRITE ON HERE.

The electrical installation in the fabrication workshop in a factory site is to undergo a periodic inspection and test for insurance purposes.

The supply and installation form part of a 10 year old, three-phase 400/230 V TN-S system having a Ze and PFC of 0.3 Ω and 4.1 kA respectively.

All circuits are installed using thermoplastic 70 °C thermoplastic insulated single core cables with copper conductors enclosed in surface mounted steel conduit and trunking.

There is no evidence of any alterations or additions to the installation. The certification from the initial verification of the original installation and suitable circuit charts are available to the inspector.

Metallic compressed air and water installation pipework is installed within the building and 10 mm^2 main protective bonding conductors are installed.

All testing will be carried out at a temperature of 20 °C.

Figure 1 shows the distribution arrangements for the three-phase compressor supplying the fabrication workshop.

Figure 2 shows the resistance of conductors in mΩ/m at 20°C.

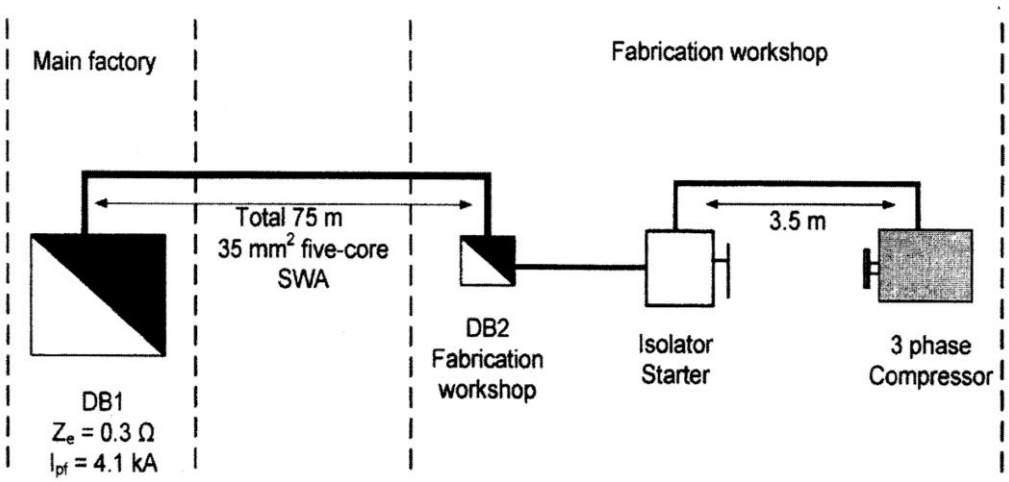

Figure 1
Distribution arrangements for the three-phase compressor

Conductor csa in mm²	Resistance in mΩ/m at 20 °C
1.5	12.1
2.5	7.41
6.0	3.08
10.0	1.83
25.0	0.727
35.0	0.524

Figure 2
Conductor resistance in mΩ/m at 20 °C

Section B - All questions carry equal marks. Answer all three questions. Show all calculations.

Questions 4 to 6 all refer to the above scenario, see source document. Ensure you read this scenario before attempting these questions. Answers you provide must reflect the detail and information given in the scenario.

4. a) List all the interested parties who need to be involved in determining the extent and limitations of the periodic inspection. (3 marks)

b) Explain, giving reasons, why it would be permissible for a sample inspection and test to be carried out on this installation. (4 marks)

c) The inspection and test is to be undertaken during normal working hours. Describe four actions the inspector may take to prevent danger to the employees using the installation during the inspection and test. (4 marks)

d) BS 7671 identifies the classification codes to be used to describe the severity of any non-compliances identified during the inspection process. State, giving reasons, the appropriate code to be recorded for each of the following.

i) An exposed live part at an over-bench luminaire. (2 marks)

ii) Corrosion evident on the steel conduit supplying socket outlets. (2 marks)

5. The distribution circuit to the fabrication workshop comprises a 35 mm^2 five-core XLPE, SWA cable with copper conductors, one of which is used as the cpc.

a) Using the information provided in the scenario determine the expected measured value of Zs at the incoming terminals of DB2, showing all calculations. (8 marks)

b) Explain, giving reasons, why the actual measured value of Zs at DB2 may be lower than the value calculated in a) above. (2 marks)

c) The main factory cannot be isolated whilst the inspection and test is carried out.

i) State what comment needs to be made on the report regarding Ze. (2 marks)

ii) State what effect this would have on the test result for Zs at DB2. (1 mark)

d) State two specific inspection items that would need to be considered at the termination of the distribution cable related to the earthing arrangement used. (2 marks)

6. A test of insulation resistance is to be carried out on the entire compressor circuit.

a) State what must be obtained from the client before the test can be undertaken. (1 mark)

b) State the action to be taken with the

i) circuit breaker in DB2 (3 marks)

ii) isolator/starter in the fabrication workshop in order to test the complete circuit (2 marks)

iii) compressor in order to test the complete circuit. (1 mark)

c) State

i) the test voltage to be applied (1 mark)

ii) the minimum acceptable resistance. (1 mark)

d) Describe, in detail, how the insulation resistance test is carried out. (5 marks)

e) State one live test, other than earth fault loop impedance, to be carried out at the compressor isolator. (1 mark)

Answers:

Section A-All questions carry equal marks. Answer all three questions. Show all calculations.

A.1 a) In the absence of information a survey will be necessary to identify switchgear, control gear and the circuits they control before testing can be safety carried out. Any dangers can be identified and equipment requiring additional safety precautions can be noted with appropriate steps being taken.

b) Safe isolation procedure including ten point test for dead.

A.2 a)
- equipment complies with recognised standards
- Installed correctly and securely fixed
- no visible damage
- protective devices identified indicating the circuits protected
- circuit protective devices connected to line conductors
- protective devices rated correctly
- connections secure and correctly terminated
- conductors correctly identified
- manual operation of switches
- adequacy of lighting and access
- presence of quarterly test notice
- presence of diagrams and charts at or near equipment
- rating of protective devices for fault current
- presence and adequacy of circuit protective conductors
- provision of barriers
- condition of enclosure
- signs of thermal damage or overheating

b)
- service cable condition
- service head condition
- distributors tails condition
- condition of metering equipment
- condition of isolator, if applicable

c) i) Identify the item and its location, if necessary. Record the damage, deterioration, defect, dangerous condition or other non-compliance relating to the item. Give the item a classification code. Indicate whether further investigation is required.

ii) The information above is to be recorded in Section K ‘Observations’ of the Electrical Installation Condition Report. Record in the appropriate box within the ‘schedule of inspections’. Also comment in the ‘Remarks’ column on the ‘schedule of test results’.

A.3 a) i) Agree the extent of the installation to be tested and any limitations. Agree a suitable time to do the work and any isolation and/or disconnection of equipment that may be required.

ii) The installation main protective earth conductor must be disconnected from the electrode.

iii) The generator will have to be isolated so as not to supply the installation as long as the electrode is disconnected.

iv) A dedicated earth electrode tester.

b) See GN3 or OSG.

c) Reconnect the earthing conductor to the earth electrode before re-instating the supply.

Section B - All questions carry equal marks. Answer all three questions. Show all calculations.

A.4 a)
- the inspector (competent person)
- the person ordering the inspection (client or clients representative)
- the user of the installation (if applicable)

b) If a detailed inspection is carried out and there are no serious signs of defects then a full test is not likely to be required. Initial sampling sizes can be selected, from experience, depending on the apparent condition and maintenance history of the installation. The sampling may be increased if necessary. If details of previous inspections, maintenance and documentation is available then it should be possible to base the extent of testing on that information.

c)
- Agree limitations, for example, if a full isolation is not possible the main earthing conductor should not be disconnected during the Ze test.
- Limited isolation within areas as appropriate.
- Parts of the installation may be excluded from the scope completely.
- Times of particular tests may be agreed with the user, for example, during insulation resistance testing.
- Observation of particular safety requirements regarding some items of equipment are to be observed.

d) i) Code 1 Immediate danger of electric shock.

ii) Code 3 No immediate danger or potential danger, improvement required.

A.5 a) $Zs = Ze + (R1 + R2)$ $Ze = 0.3\ \Omega$

$R1 = \frac{0.524 \times 75 \times 1.2}{1000} = 0.047\ \Omega$ $R2 = \frac{0.524 \times 75 \times 1.2}{1000} = 0.047\ \Omega$

$Zs = 0.3 + (0.047 + 0.047) = 0.394\ \Omega$

b) The measured value would be at ambient temperature, assume 20°C. The calculated value includes the 70°C correction factor of 1.2 to raise the expected value of Zs during current flow and higher conductor temperature.

c) i) In the limitations section it will be noted that the main protective earth conductor was not disconnected from the installation due to safety reasons.

ii) The recorded test value is therefore likely to be lower than the actual value due to parallel earth paths.

d) i) The armoured cable should be ‘glanded’ to DB2, preferably with surrounding paint/finish removed for good electrical continuity.

ii) There should also be an earth (flying) lead connected between the gland bolt and the earth terminal within DB2. Earth and neutral separated.

A.6 a) Permission to switch off and isolate the compressor circuit.

b) i)
- Identified
- switched off
- locked off

ii)
- switch off
- lock off

iii)
- load disconnected

c) i)
- 500V d.c.

ii)
- 1 MΩ

d) See GN3 or the OSG. Include the ten point test of the 3-phase system.

e)
- phase rotation