

National Unit Specification: general information

UNIT:	Electrical Installation Practices
NUMBER:	DH59 10
COURSE:	Scottish Progression Award in Engineering

SUMMARY

This unit is intended to provide candidates with a basic introduction to electrical installation practices. It emphasises the need for safe working practices to be carried out during the installation of electrical systems within a premises and the need for electrical circuits to be designed and constructed in a safe manner. The unit also highlights the dangers of working with and using electrical energy and the steps taken to minimise these risks.

The candidate is provided with the opportunity to design, construct and test a simple electrical system.

OUTCOMES

1. Identify the dangers of using electrical energy and installing electrical systems.
2. Draw circuit and wiring diagrams for electrical systems.
3. Construct electrical wiring systems and circuits
4. Test electrical circuits

RECOMMENDED ENTRY:

While entry is at the discretion of the Centre, candidates are expected to have achieved the unit 'Application of Electrical Installation Hand-tools and Accessories'.

Administrative Information

Superclass:	XJ
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National Unit Specification: general information (cont)

CREDIT VALUE

1 credit at Intermediate 1 (6 SCQF credit points at SCQF level 4*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS:

There is no automatic certification of core skills or core skill components in this Unit.

Information on the automatic certification of any core skills in this unit is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT: Electrical Installation Practices

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Identify the dangers of using electrical energy and installing electrical systems.

Performance criteria:

- a) A knowledge of electric shock risk is clearly demonstrated.
- b) A knowledge of heat generation risk is clearly demonstrated.
- c) A knowledge of measures to minimise electric shock and overheating risks is clearly demonstrated.
- d) The identification of risks during the installation of wiring systems is accurate.
- e) The identification of control measures to ensure safe systems of work is accurate.

Evidence requirements:

The candidate should provide performance evidence to satisfy PCs (a)-(e) of this outcome. The candidate should

- complete a short-answer assessment to provide evidence of a knowledge of the risks associated with electrical energy and the measures required to minimise these risks.
- produce a risk assessment for the installation of a given wiring system.

OUTCOME 2

Draw circuit and wiring diagrams for electrical systems.

Performance criteria:

- a) The identification of circuit and wiring diagrams is correct.
- b) The drawing of circuit diagrams for 1-way and 2-way controlled lighting is correct.
- c) The drawing of wiring diagrams for 1-way and 2-way controlled lighting by the junction box method with pvc sheathed multi-core cables is correct.
- d) The drawing of a wiring diagram for 1-way to 2-way lighting control conversion using the loop-in method with pvc multi-core cables is correct.
- e) The drawing of a wiring diagram for 2-way controlled lighting using single pvc cables in plastic conduit is correct.

Evidence requirements:

The candidate should provide performance evidence to satisfy PCs (a)-(e) of this outcome. An awareness of the difference between circuit and wiring diagrams should be demonstrated. Circuit and wiring diagrams should be drawn for 1-way and 2-way controlled lighting systems using loop-in and joint box methods with multi-core and single pvc cables as appropriate.

National Unit Specification: statement of standards (cont)

UNIT: Electrical Installation Practices

OUTCOME 3

Construct electrical wiring systems and circuits

Performance criteria:

- a) A knowledge of factors relating to the choice of wiring system is clearly demonstrated.
- b) The construction of a 1-way controlled lighting system using the loop-in method with pvc multi-core cables is in compliance with safe working practices.
- c) The conversion of a 1-way controlled loop-in lighting system to 2-way control using pvc multi-colored cables is in compliance with safe working practices.
- d) The construction of a 2-way controlled lighting system using the joint-box method with pvc multi-colored cables is in compliance with safe working practices.
- e) The construction of a 2-way controlled lighting system using single pvc cables in plastic conduit is in compliance with safe working practices.

Evidence requirements:

The candidate should provide performance evidence to satisfy PCs (a)-(e) of this outcome. An awareness of the factors relating to the choice of wiring systems for a given situation should be demonstrated and wiring systems for 1-way and 2-way controlled lighting should be constructed.

OUTCOME 4

Test electrical circuits

Performance criteria:

- a) The selection of the instrument for continuity testing is correct.
- b) The selection of the instrument for insulation resistance testing is correct.
- c) The appropriate procedure for continuity testing of circuits is carried out correctly.
- d) The appropriate procedure for insulation resistance testing of circuits is carried out correctly.
- e) The appropriate procedure for polarity testing of circuits is carried out correctly.
- f) The interpretation of test results obtained from testing procedures is correct.
- g) Functional testing of circuits is in compliance with safe working practices and carried out correctly.

Evidence requirements:

The candidate should provide performance evidence to satisfy PCs (a)-(g) of this outcome. An awareness of the factors relating to the choice of test instruments for continuity, insulation resistance and polarity testing should be demonstrated and these tests should be carried out on the circuits for 1-way and 2-way controlled lighting systems. Functional testing of these circuits should also be carried out.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence for this unit should be integrated in a project which assesses all outcomes.

National Unit Specification: support notes

UNIT: Electrical Installation Practices

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

These support notes provide the guidance required for candidates to achieve the knowledge and skills to carry out basic electrical installation practices in compliance with safe working procedures.

The unit would normally be taken by candidates who have no experience of electrical installation practices and is designed as a progression from the unit 'Application of Electrical Hand-tools and Accessories'. It may be also used as a base unit for candidates wishing to progress to other electrical installation units.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1:

- (a) **Knowledge of electric shock risk**
 - the physiological nature of electric shock.
 - the effects of electric shock on the body.
 - how the body can become part of the electric circuit.

- (b) **Knowledge of heat generation risk**
 - how current flowing through a conductor generates heat.
 - the balance between heat generation and heat dissipation to keep the conductor at a steady temperature.
 - how heat dissipation rate depends on cable factors such as cross sectional area.
 - the importance of choosing a cable rating adequate for the circuit current.

- (c) **Knowledge of measures to minimise electric shock and overheating risks**
 - the need for overload and short-circuit protection devices in the circuit.
 - the need to choose cables and equipment of appropriate design and adequate current rating.
 - the need to comply with appropriate earthing procedures.

- (d) **Identification of risks during the installation of wiring systems**
 - identification of possible hazards involved in electrical installation work to include:
Working at height, using sharp tools, materials/tools left on floor, lifting heavy equipment, equipment/materials falling from height, dust/swarf from rotating machinery, working with 'live' systems etc.
 - identification of risks due to potential hazards to include:
Slips, trips and falls, muscular strain, head and eye injuries, electric shock etc.

National Unit Specification: support notes (cont)

UNIT: Electrical Installation Practices

(e) Identification of control measures ensure safe systems of work

- identification of control measures to minimise risks to include:
Good housekeeping, securing ladders/scaffolding etc, use of PPE, application of correct material handling techniques, safe working voltage levels etc.

Outcome 2:

- the difference between circuit diagrams and wiring diagrams should be clearly distinguished
- the wiring diagrams for the listed circuits should clearly relate to the wiring method i.e. PVC multi-core cables OR PVC single-core cables in conduit.
The PVC multi-core cable diagrams should also relate to the loop-in OR joint-box wiring method as appropriate.

Outcome 3:

- factors which influence the choice of an appropriate wiring system should be discussed and highlighted: e.g. weather (temperature, humidity, rain etc.) presence of water, corrosion, impact, vibration etc.
- the correct use of tools and safe working practices should be stressed throughout the construction of the listed installations.
- good working practices should be highlighted: e.g. adequate support for wiring system and accessories, proper assembly techniques, appropriate c.s.a. of cables, adequate cable lengths at terminations, electrically and mechanically sound joints and terminations, appropriate radius of bends, cable cores identifiable throughout their length, earthing arrangements appropriate, aesthetically acceptable installation.

Outcome 4:

- the importance of selecting the correct instrument for a specific test and the factors which determine the selection should be highlighted.
- the need for inspecting and testing electrical installations should be emphasised from a safety perspective.
- candidates should be taught the test methods for the listed tests and should be able to recognise whether the test results are acceptable or not acceptable.
- it should be emphasised that functional testing should only be carried out after the satisfactory results for the continuity and insulation resistance tests have been obtained and the visual inspection of the installation has been accepted.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This unit should be delivered in a practical manner, ideally in a workshop environment.

The construction of the wiring systems should reflect a realistic working environment. These systems should, ideally, be mounted on a vertical surface or an actual wall.

National Unit Specification: support notes (cont)

UNIT: Electrical Installation Practices

Candidates should be encouraged to use good and safe working practices throughout the unit and a realisation of the dangers of using electrical energy and of installing electrical systems should be emphasised throughout.

The delivery of this unit should be seen as a coherent whole rather than 4 separate outcomes and, to this end, the outcomes should be taught in an integrated manner as much as possible.

The importance of safe working practices should be emphasised at all times and ALL candidate's work MUST be checked BEFORE any supply voltage is CONNECTED.

A safe working voltage level should be used to energise candidate's exercises.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

The assessment of this unit may be considered in two parts (i) the short-answer assessment to test the candidate's awareness of the knowledge aspects of the unit, i.e. health and safety issues, and the factors influencing the choice of a wiring system for a given set of conditions; and (ii) the practical assessment of the candidate's ability to assemble, wire and test the lighting control circuits and systems listed.

Both parts of the assessment of this unit should be seen as part of the same assessment process i.e. the overall assessment of the design and installation of wiring systems in compliance with safe working practices.

Observation checklists should be used to record the salient points of the candidate's performance during the practical installation assessments.

APPROACHES TO GENERATING EVIDENCE

The evidence required for assessment of this unit will be generated:

1. By means of a practical project during which the candidate will construct three wiring systems as follows:
 - (i) a 1-way controlled lighting system using the loop-in method with pvc multi-core cables followed by the conversion of the system from 1-way to 2-way control in compliance with safe working practices
 - (ii) a 2-way controlled lighting system using the joint-box method with pvc multi-cored cables in compliance with safe working practices
 - (iii) a 2-way controlled lighting system using single pvc cables in plastic conduit in compliance with safe working practices.

The wiring systems should be fixed to a wooden board or a wall to provide a realistic environment. For each wiring system the candidate should form two right-angle bends. The plastic conduit system should also contain two 'T' boxes and one 'END' box

National Unit Specification: support notes (cont)

UNIT: Electrical Installation Practices

As part of the installation of the wiring systems as described, the following additional activities should be carried out and assessment evidence generated:

- (a) A risk assessment exercise should be carried out and documented prior to the installation work commencing.
- (b) Appropriate circuit and wiring diagrams should be drawn for each wiring system.
- (c) Continuity, insulation resistance and polarity tests should be carried out on each installed wiring system and the results correctly interpreted.
- (d) On achieving satisfactory test results, a safe working voltage should be applied to each system and functional tests carried out.

(NOTE: ALL CIRCUITS AND TEST RESULTS MUST BE CHECKED BY THE LECTURER WHO MUST ALSO SUPERVISE THE CONNECTION OF THE SUPPLY VOLTAGE AND THE FUNCTIONAL TESTING.)

2. By means of two short-answer assessments to (i) demonstrate the candidate's awareness of the risks of electric shock and overheating of cables and (ii) demonstrate the candidate's awareness of how factors such as weather, mechanical forces etc, determine the type of wiring system required for a given environment.

Observation Checklists should be used to record evidence of the practical project work.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).