



## National Unit Specification: general information

**UNIT** Earthing Systems (SCQF level 5)

**CODE** F5HE 11

### SUMMARY

This Unit is designed for candidates with little or no prior knowledge of earthing systems for electrical installations but who wish to gain a basic understanding of how such systems protect against the danger of electric shock.

The aim of this Unit is to introduce candidates to the various types of earthing system and enable them to recognise and use the terminology relating to earthing systems as given in the Wiring Regulations BS7671.

On successful completion of the Unit candidates will be able to carry out a simple earthing exercise on a simulated electrical installation.

This Unit may form part of a National Qualification Group Award or may be offered on a free-standing basis.

### OUTCOMES

- 1 Describe and draw types of earthing system for an electrical installation.
- 2 Describe and draw the component parts of a protective equipotential bonding arrangement in terms of the BS7671 Wiring Regulations.
- 3 Wire a TN-C-S earthing arrangement for a given installation specification to comply with the requirements of BS7671.

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### Administrative Information

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## **National Unit Specification: general information (cont)**

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### **RECOMMENDED ENTRY**

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following or equivalent:

- ◆ Standard Grade Mathematics — General Level
- ◆ Standard Grade Technological Studies — General Level
- ◆ Standard Grade Science — General Level

### **CREDIT VALUE**

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5\*).

*\*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 in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Problem Solving (SCQF level 5)
- ◆ Communication (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

## **National Unit Specification: statement of standards**

### **UNIT      Earthing Systems (SCQF level 5)**

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 SQA.

#### **OUTCOME 1**

Describe and draw types of earthing system for an electrical installation.

##### **Performance Criteria**

- (a) Describe correctly the need for earthing systems in an electrical installation.
- (b) Identify correctly TN-C, TN-S, TN-C-S and TT earthing systems from given diagrams.
- (c) Draw clearly diagrams to illustrate TN-C, TN-S, TN-C-S and TT earthing systems.

#### **OUTCOME 2**

Describe and draw the component parts of a protective equipotential bonding arrangement in terms of the BS7671 Wiring Regulations.

##### **Performance Criteria**

- (a) Describe clearly the meaning of earthing system terms.
- (b) Draw clearly a diagram showing the bonding of parts to create a protective equipotential zone.
- (c) Identify correctly the exposed and extraneous conductive parts of the bonding diagram.
- (d) Identify correctly the protective and bonding conductors of the bonding diagram.
- (e) Identify correctly the cross-sectional area of protective and bonding conductors for a given installation.

#### **OUTCOME 3**

Wire a TN-C-S earthing arrangement for a given installation specification to comply with the requirements of BS7671.

##### **Performance Criteria**

- (a) Select the correct cross-sectional area of protective and bonding conductors.
- (b) Carry out the correct installation of protective and bonding conductors.
- (c) Select the correct type and rating of protective device for the earthing arrangement.
- (d) Install the protective device correctly.

## National Unit Specification: statement of standards (cont)

### UNIT Earthing Systems (SCQF level 5)

#### EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence and performance evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria. The evidence should be produced under supervised, controlled conditions in a practical environment throughout the duration of the Unit.

Assessors must use a checklist to record candidate's achievement as they demonstrate the knowledge and skills set out in the Performance Criteria of each Outcome.

Outcomes may be assessed as a single, holistic practical assignment which incorporates all the Outcomes and Performance Criteria or on an individual basis or as a combination of Outcomes.

Candidates should be presented with a 'specification' for part of an electrical installation including the constructional features of the premises and its use. Items of exposed and extraneous conductive parts will be identified along with the electrical loading requirements and the method of installation, the type of wiring and the cross-sectional area of phase conductors. An appropriate earth fault loop impedance  $Z_s$  should be given.

From this information the candidate should, for a TN-C-S system:

- ◆ draw a diagram showing the bonding of parts to create a protective equipotential zone
- ◆ identify the exposed and extraneous conductive parts of the bonding diagram
- ◆ identify the protective and bonding conductors of the bonding diagram
- ◆ identify the cross-sectional area of protective and bonding conductors for a given installation
- ◆ select the correct cross-sectional area of protective and bonding conductors
- ◆ carry out the installation of protective and bonding conductors
- ◆ select the correct type and rating of protective device for the earthing arrangement
- ◆ install the protective device correctly

The installation of the earthing system should be accompanied with a report in which the candidate:

- ◆ describes the need for earthing systems in an electrical installation
- ◆ identifies correctly TN-C, TN-S, TN-C-S and TT earthing systems from given diagrams
- ◆ draws TN-C, TN-S, TN-C-S and TT earthing systems from given specifications
- ◆ explains the meaning of four earthing system terms

Candidates should be allowed access to the Wiring Regulations BS7671 for reference purposes.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the assessment support pack to ensure a comparable standard.

## **National Unit Specification: support notes**

### **UNIT        Earthing Systems (SCQF level 5)**

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.

#### **GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT**

This is a restricted core Unit within the National Certificate in Electrical Engineering at SCQF level 5. This Unit can also be delivered on a free-standing basis.

The aim of this Unit is to introduce candidates to earthing systems and the terminology of earthing arrangements as given in BS7671.

The Unit will enable candidates to know the various types of earthing system and be able to wire a system to meet the requirements of a given specification.

Centres may wish to provide candidates with an induction session at the start of the Unit into safe working practices associated with electrical work. However, safety should be emphasised throughout the delivery of the Unit. Candidates must wear appropriate Personal Protective Equipment (PPE) while working in practical electrical environments.

This Unit should be delivered in a practical/workshop environment and candidates should be provided with practical examples of how earth faults occur and their dangers to personnel. The need for earthing systems should be fully appreciated by candidates and the methods of protecting the public against electric shock should be fully discussed.

Terms including the following should be described: bonding, earthing, main protective bonding conductor, supplementary protective bonding conductor, protective conductor, exposed conductive part, extraneous conductive part, protective bonding, equipotential zone, earth electrode, main earthing terminal, residual current device, earth fault loop impedance, fault protection, earth fault current.

This Unit is not intended to be mathematical and protective and bonding conductor sizes should be selected in accordance with the relevant sections of BS7671 wiring regulations. Similarly, the selection of protection devices should be from the relevant tables of BS7671 in relation to given earth loop impedance and disconnection time.

#### **GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT**

This Unit should be delivered in a practical environment and should encourage candidates to become familiar with the techniques and terminology of earthing systems.

Candidates should be presented with practical earthing arrangements as a means of protecting persons from electric shock due to indirect contact. The relative merits and weaknesses of each system should be discussed and candidates should be encouraged to participate fully in these discussions.

They should also be presented with diagrams showing the requirements of bonding and be provided with opportunities to carry out bonding exercises on real metalwork including water and gas pipes.

## National Unit Specification: support notes (cont)

### UNIT Earthing Systems (SCQF level 5)

Candidates are not expected to calculate the cross section of bonding and protective conductors or the ratings of protective devices but should be encouraged to use the BS7671 Wiring regulations to determine the relative values of component parts of the system.

Case studies, discussion groups and practical exercises are some of the methods which could be used to engage with candidates to emphasise the importance of the topics included in this Unit and reinforce the requirements of the BS7671 wiring regulations in respect of earthing.

The Outcomes should be delivered in the sequence given in the 'statement of standards'. The practical aspects of these Outcomes should be demonstrated to candidates with the reasons for particular techniques being fully explained. Candidates should then be given opportunities to practice these techniques as appropriate.

### OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates will develop skills in *Problem Solving*, that is in critical thinking, planning and organising and reviewing and evaluating as they undertake the Unit. They need to examine and take account of all issues affecting electrical wiring before starting practical work. This will include identifying earthing systems and considering the relative merits and weaknesses of each system. They will meet all health and safety requirements before deciding on an appropriate approach, and wire an earthing arrangement to comply with current regulations. Review and evaluation of achievement with assessor support and guidance should be a naturally occurring process in formative and summative work.

Group discussion of safety issues during formative work could enhance both problem solving and oral communication skills and would ensure opportunities to practise use of appropriate terminology and improve listening skills in a work related context.

Although skills in written communication are not formally assessed candidates should be given opportunities to develop their abilities to communicate to a standard acceptable in the vocational area. They need to read, understand and apply current BS7671 Wiring Regulations and could also be encouraged to refer to and evaluate a range of background information and advice on safety issues and equipment. Reports should be technically accurate, with attention to spelling and punctuation.

### GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

#### Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

The assessment of this Unit could take the form of a 'Practical Assignment' which extends over the duration of the Unit.

## **National Unit Specification: support notes (cont)**

### **UNIT        Earthing Systems (SCQF level 5)**

This assignment could contain the three elements specified in the Unit Outcomes ie

- ◆ identifying types of earthing system for an electrical installation
- ◆ identifying the component parts of a protective equipotential bonding arrangement in terms of the BS7671 Wiring Regulations
- ◆ wiring a TN-C-S earthing arrangement for a given installation specification to comply with the requirements of BS7671

These three elements could be integrated into one practical assignment with the achievements of each element being clearly recorded for each candidate.

The practical assignment could be conducted in a workshop environment under supervised and controlled conditions.

### **DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS**

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements)