



National Unit Specification: general information

UNIT Cable Ratings and Overcurrent Protection Devices (SCQF level 6)

CODE F5H3 12

SUMMARY

This Unit is intended for candidates with little or no prior knowledge of electrical installations but who wish to progress to employment in the Electrical Installation Industry.

The aim of this Unit is to develop the candidate's awareness of the dangers of overcurrent in a circuit and the measures required to minimise its effects. Candidates will be introduced to the need for cables to have sufficient current capacity to carry the load current safely and will develop the techniques of calculating cable sizes for given loads and given working conditions in compliance with the requirements of the Wiring Regulations BS7671. They will also be introduced to the relationship between the design current of a circuit, the current-carrying capacity of the cable and the rating of the protective device for a particular set of load conditions. Candidates will develop knowledge and understanding of the construction and operation of overcurrent protection devices and be able to select the most appropriate device for given circuit conditions.

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

OUTCOMES

- 1 State the effects of overcurrent in an electrical circuit.
- 2 Describe the factors relating to cable selection in compliance with the requirements of BS7671.
- 3 Determine the minimum cable size for given load conditions and installation methods, in compliance with the requirements of BS7671.
- 4 Describe overcurrent protection devices and select a device for a given load condition and installation method in compliance with the requirements of BS7671.

Administrative Information

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RECOMMENDED ENTRY

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

- ◆ Standard Grade Mathematics — Credit level
- ◆ Standard Grade Technological studies — Credit level
- ◆ Standard Grade Physics — Credit level
- ◆ NQ Unit *Electrical Principles* (SCQF level 5)

CREDIT VALUE

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

**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 Skill:

- ◆ Numeracy (SCQF level 6)

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

National Unit Specification: statement of standards

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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

State the effects of overcurrent in an electrical circuit.

Performance Criteria

- (a) Define correctly the terms overcurrent, overload current and short-circuit current.
- (b) State clearly the effects of overload in a circuit.
- (c) State clearly the effects of short-circuit current in a circuit.

OUTCOME 2

Describe the factors relating to cable selection in compliance with the requirements of BS7671.

Performance Criteria

- (a) Describe clearly the need to select a cable having a current rating sufficient for its load conditions.
- (b) State clearly the relationship between design current ' I_b ', protective device nominal current rating ' I_n ' and cable current-carrying capacity ' I_z '.
- (c) Describe clearly 'rating factors' and their effect on the current-carrying capacity of a cable.
- (d) Describe clearly the effects of voltage drop in relation to cable selection.
- (e) Describe clearly the effects of earth-fault loop impedance ' Z_s ' and cross-sectional area of the circuit protective conductor ' S ' on cable selection.

OUTCOME 3

Determine the minimum cable size for given load conditions and installation methods, in compliance with the requirements of BS7671.

Performance Criteria

- (a) Determine correctly the required current-carrying capacity ' I_z ' of a cable for given load and installation conditions.
- (b) Select correctly the minimum size of cable to satisfy the current-carrying capacity requirements.
- (c) Determine correctly the voltage drop for the selected cable over its length and determine whether the voltage drop requirement of BS7671 is satisfied.
- (d) Calculate correctly the earth-fault loop impedance ' Z_s ' and the cross-sectional area of the circuit protective conductor ' S ' and determine whether the thermal and shock constraints are met in compliance with the requirements of BS7671.
- (e) Re-select correctly the minimum size of cable for the given load conditions and installation methods, as required, to meet the requirements of BS7671.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Describe overcurrent protection devices and select a device for a given load condition and installation method in compliance with the requirements of BS7671.

Performance Criteria

- (a) Describe clearly the construction and operation of fuses and circuit-breakers.
- (b) Identify correctly, overcurrent protection devices in terms of their name and British Standard 'BS' number.
- (c) State clearly the advantages and limitations of fuses and circuit-breakers.
- (d) Select correctly the most appropriate overcurrent protection device for a given load condition and installation method in terms of its type and rating in compliance with the requirements of BS7671.

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 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.

Candidates should be permitted to use the Wiring Regulations BS7671 as a reference document during the assessment.

An appropriate form of assessment could be a single, holistic exercise, lasting not more than 2 hours 30 minutes, incorporating all the Outcomes and Performance Criteria.

Alternatively, a series of assessment events may be used to produce evidence for each Outcome on an individual basis or any combination of Outcomes.

The total assessment time should be no more than 2 hours 30 minutes.

The assessment parameters are as follows:

With regard to Outcome 1:

- ◆ the effects of overload and short-circuit should show clearly the difference between the two overcurrent conditions

With regard to Outcome 2:

- ◆ rating factors for cable Grouping (C_g) Thermal Insulation (C_i) Ambient Temperature (C_a) should be included
- ◆ the rating factor of 0.725 should also be included for semi-enclosed fuse protection

National Unit Specification: statement of standards (cont)

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With regard to Outcome 3:

- ◆ the design parameters used to determine the cable size should be such as to result in a cable selection which does NOT meet all the BS7671 requirements. This will require a further cable selection and recalculation of volt-drop, thermal and shock constraint conditions until the cable selected meets all the BS7671 requirements.

With regard to Outcome 4:

- ◆ two advantages and two limitations should be stated for each type of protection device

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

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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 Qualification Group Award in Electrical Engineering at SCQF level 6 but may also be offered on a free-standing basis.

The aim of this Unit is to develop the candidate's awareness of the dangers of overcurrent in a circuit and the measures required to minimise its effects.

Candidates should be introduced to the need for cables to have sufficient current capacity to carry a load current safely and will develop the techniques of calculating cable sizes for given loads and given working conditions in compliance with the requirements of the Wiring Regulations BS7671.

They should also be introduced to the relationship between the design current ' I_b ' of a circuit, the current-carrying capacity ' I_z ' of the cable and the nominal rating ' I_n ' of the protective device for a particular set of load conditions.

Candidates should be presented with opportunities to develop knowledge and understanding of the construction and operating principles of overcurrent protection devices and be able to select the most appropriate device for given circuit conditions.

The content and context of this Unit should provide candidates with an overview of the cable selection and overcurrent protection and set this topic in a practical context for given loads and installation conditions.

Candidates should be made aware of the need to comply with the requirements of BS7671 in terms of cable selection, including the need to ensure that voltage-drop, thermal and electric shock constraints are fully satisfied.

The advantages and limitations of fuses and circuit-breakers should be investigated and candidates should take these into account, along with current rating, when selecting the most appropriate overcurrent device for a particular application.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The Outcomes should be delivered in the sequence given in the 'statement of standards'. Although much of the content of this Unit is of a descriptive nature, it should be delivered in an electrical installation environment. This could be in a classroom, laboratory or workshop in which the environmental emphasis is placed on electrical installation systems.

Delivery of the Unit content could utilize relevant industrial case studies, and drawings/layouts and specifications of electrical installations. The use of relevant videos or DVD recordings illustrating the dangers of overheating and fire due to overcurrent conditions in a circuit and the measures required to minimize these risks should be encouraged. Visual examination of protective devices is recommended.

National Unit Specification: support notes (cont)

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Candidates should be encouraged to search the internet for information relating to the design and construction of circuit protection devices.

The use of BS7671 as a working document should be encouraged and candidates should be given exercises which provide opportunities for them to use the relevant sections of this publication.

Candidates should be encouraged to discuss and debate the various issues raised by the subject content in order that this interaction might stimulate their thought processes and reinforce the learning.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates interpret, perform and present a series of complex calculations and measurements as they produce diagrams and describe systems for given load and installation conditions. Numeracy skills will be naturally enhanced, with a focus on the practical interpretation and application of data. Formative activities should be designed to develop accuracy and confidence in handling graphic and numerical concepts in a practical electrical engineering context.

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 holistic exercise of short-answer or structured questions, covering the Performance Criteria specified in the Unit Outcomes ie:

- ◆ the effects of overcurrent in an electrical circuit
- ◆ the factors relating to cable selection in compliance with the requirements of BS7671
- ◆ determination of the minimum cable size for given load and installation conditions, in compliance with the requirements of BS7671
- ◆ selection of an overcurrent protection device for given load and installation conditions in compliance with the requirements of BS7671

Alternatively, separate exercises may be produced, to cover all of the Performance Criteria contained within the Outcomes. It may be appropriate to assess the descriptive PCs in one assessment and the cable selection PC in a second assessment.

The total assessment time for this Unit should be no longer than 2.5 hours.

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

National Unit Specification: support notes (cont)

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CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).