

## **SQA Advanced Unit Specification**

### **General information**

**Unit title:** Marine Engineering: Electro-Technology (SCQF level 7)

**Unit code:** HW5H 47

**Superclass:** XQ

**Publication date:** November 2017

**Source:** Scottish Qualifications Authority

**Version:** 01

### **Unit purpose**

This unit is designed to enable learners to develop knowledge and understanding in marine Electro-technology. It is designed as part of the SQA Advanced Diploma in Marine Engineering award and will give the Marine Engineering learner a greater appreciation of electrical engineering.

### **Outcomes**

On successful completion of the unit the learner will be able to:

- 1 explain fundamental electrical concepts and quantifying their electrical units
- 2 solve problems on DC circuits with resistances in parallel and series
- 3 solve problems on series single phase AC circuits comprising resistance, capacitance and inductance
- 4 explain high voltage at operational level in marine electrical practice

### **Credit points and level**

1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

## SQA Advanced Unit Specification

### Recommended entry to the unit

Access to this unit is at the discretion of the centre. However, it would be beneficial if learners have a knowledge and understanding of Mathematics and/or Physics at SCQF level 6 or a National Certificate in Marine Engineering at SCQF level 6.

### Core Skills

Achievement of this unit gives automatic certification of the following core skills component:

Complete core skill	None
Core skill component	Using Number at SCQF level 6 Critical Thinking at SCQF level 5

There are also opportunities to develop aspects of core skills which are highlighted in the support notes of this unit specification.

### Context for delivery

As this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

The Assessment Support Pack (ASP) for this unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website.

### Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements).

### SQA Advanced Unit Specification: Statement of standards

**Unit title:** Marine Engineering: Electro-Technology (SCQF level 7)

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.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

#### Outcome 1

Explain fundamental electrical concepts and quantify their electrical units.

##### Knowledge and/or skills

- ◆ Electrical charge, current, voltage, energy, power
- ◆ Potential difference, emf, resistance, inductance, and capacitance
- ◆ Temperature coefficient of resistance

#### Outcome 2

Solve problems on DC circuits with resistances in parallel and series.

##### Knowledge and/or skills

- ◆ Series resistive DC circuits
- ◆ Parallel resistive DC circuits
- ◆ Combination Series and Parallel resistive DC circuits
- ◆ Wheatstone bridge

#### Outcome 3

Solve problems on series single phase AC circuits comprising resistance, capacitance and inductance.

##### Knowledge and/or skills

- ◆ Basic use of polar and rectangular forms of complex number
- ◆ RLC series AC circuits
- ◆ Power factor, apparent power, true power, and reactive power
- ◆ Phasor diagrams

## SQA Advanced Unit Specification

### Outcome 4

Explain high voltage at operational level in marine electrical practice.

#### Knowledge and/or skills

- ◆ High voltage marine generators and systems
- ◆ High voltage protection devices and circuit protection
- ◆ Insulated and earthed neutral distribution systems and earthing requirements
- ◆ Safety requirements necessary for HV installations
- ◆ Safe working practice and permit to work

#### Evidence requirements for this unit

The evidence for this unit, with the exception of Outcome 4 where all of the knowledge and skills will be assessed will be gathered using a sampling approach to the knowledge and/or skills detailed below. Written and/or oral evidence for Outcomes 1–4 should be assessed using one single holistic closed-book assessment held under supervised conditions; it is recommended that the assessment be completed within two hours.

Learners will be permitted to use scientific calculators during the assessment.

In any instance of assessment where calculations are performed the learner must:

- ◆ apply appropriate formulae
- ◆ apply the principles of the calculation
- ◆ show all working through a calculation
- ◆ ensure the answer derives from the application of the formula and correct application of the principles of the calculation

### Outcome 1

The assessment will sample **two out of three** knowledge and/or skills items. Learners will not have prior knowledge of which items are being assessed. Those which are not sampled must be covered in the alternative (re-sit) assessment.

Where sampling takes place, a learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the learner is able to:

- ◆ define two of the following: electrical charge, current, voltage, energy, power, emf, potential difference, resistance, inductance, capacitance, temperature coefficient of resistance
- ◆ explain the effects of temperature on conductors, semiconductors and insulators
- ◆ solve a problem using temperature coefficient of resistance

## SQA Advanced Unit Specification

### Outcome 2

The assessment will sample **two out of four** knowledge and/or skills items. Learners will not have prior knowledge of which items are being assessed. Those which are not sampled must be covered in the alternative (re-sit) assessment.

Where sampling takes place, a learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the learner is able to:

- ◆ solve a problem on series resistive DC circuits including equivalent resistance, current, voltage, power and energy
- ◆ solve a problem on parallel resistive DC circuits including equivalent resistance, current, voltage, power and energy
- ◆ solve a problem on series/parallel resistive DC circuits including equivalent resistance, current, voltage, power and energy
- ◆ solve a problem on the Wheatstone bridge

### Outcome 3

The assessment will sample **two out of four** knowledge and/or skills items. Learners will not have prior knowledge of which items are being assessed. Those which are not sampled must be covered in the alternative (re-sit) assessment.

Where sampling takes place, a learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the learner is able to:

- ◆ explain three of the terms true power, active power, reactive power, apparent power and power factor and their significance in shipboard electrical equipment
- ◆ solve a problem on a single phase RLC circuit, involving power factor, apparent power, true power, reactive power involving the phasor diagram of the circuit
- ◆ solve a problem on a single phase RLC circuit, involving power factor, apparent power, true power, reactive power involving the phasor diagram of the circuit, using complex notation

## SQA Advanced Unit Specification

### Outcome 4

All knowledge and/or skills items for this outcome should be assessed. Learners will not have prior knowledge of which items are being assessed. In the case of alternative assessments, different questions or question context must be used to present a different examination. Learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the learner is able to:

- ◆ state what is considered to be high voltage and typical values found on ship
- ◆ outline the reasons why modern vessels are equipped with high voltage generators
- ◆ state which circuits will operate at high voltage
- ◆ explain the function of the protective devices and their sequence of operation
- ◆ explain the difference between insulated and earthed neutral distribution systems
- ◆ explain the importance of Circuit Main Earth
- ◆ describe the hazards associated with high voltage
- ◆ outline the requirements outlined in the HSE publication 'Electricity at Work' safe working practices
- ◆ explain the terms Authorised person and Competent person
- ◆ identify the difference between ordinary and high voltage permit to work
- ◆ describe the isolation process required to produce a high voltage permit to work

## **SQA Advanced Unit Specification**

### **SQA Advanced Unit Support Notes**

**Unit title:** Marine Engineering: Electro-Technology (SCQF level 7)

Unit Support Notes are offered as guidance and 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 unit is primarily aimed at learners who intend to seek sea going employment as a Merchant Navy Engineering Officer.

#### **Guidance on approaches to delivery of this unit**

This unit could be delivered by a combination of class teaching, tutorial work and practical laboratory work where appropriate. Practical laboratory work is seen as particularly important as it provides learners with an opportunity to relate theoretical knowledge to a practical electrical/electronic context. The unit has been designed to incorporate sufficient time to allow lecturers to teach all the core electrical/electronic principles in the unit.

As this unit provides core electrical/electronic principles that underpin much of the studies in other areas of the SQA Advanced Certificate and SQA Advanced Diploma in marine engineering awards, it is recommended that the unit be delivered towards the start of these awards.

Where this unit is incorporated into other group awards it is recommended that it be delivered in the context of the specific occupational area(s) that the award is designed to cover.

The unit has been written such that there is sufficient time built in to allow learners to practise what they have learnt through appropriate formative assessments or laboratory work.

#### **Guidance on approaches to assessment of this unit**

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

The assessment of this unit could be combined together with that for Outcomes 1, 2, 3 and 4 to form a single assessment paper. This single assessment paper could be taken at a single assessment event lasting two hours and will be carried out under supervised, controlled conditions.

Questions used to elicit learner evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

## **SQA Advanced Unit Specification**

In the case of a reassessment of Outcomes 1–3, different samples of the evidence requirements for each outcome should be used. In the case of an alternative assessment for Outcome 4, different questions or question context must be used to present a different assessment.

The structure of the assessment is at the discretion of the centre in that any combination of individual outcome assessment or grouped outcome assessment is valid.

Assessment should be conducted under closed-book conditions and as such learners should not be allowed to bring any textbooks, handouts or notes to the assessment. Learners will be permitted to use scientific calculators during the assessment.

If Outcome 4 is assessed individually at the discretion of the centre a suitable form of assessment should be multiple-choice questions.

Learners will need to provide evidence to demonstrate their knowledge and/or skills across all outcomes.

### **Opportunities for 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 Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at [www.sqa.org.uk/e-assessment](http://www.sqa.org.uk/e-assessment).

### **Opportunities for developing core and other essential skills**

There are opportunities to develop the Core Skills of Numeracy SQCF level 6 and Problem Solving in this unit.

The delivery and assessment of this unit contributes towards the component Using Number of the Core Skill of Numeracy at SQCF level 6 in Outcomes 1, 2 and 3. The specific skills required for the component at SQCF 6 include: working confidently with a numerical/statistical concept; deciding on the numerical operations to be carried out; and carrying out complex calculations on a number of sustained calculations. This is likely to fit in with a variety of the topics in Outcomes 1, 2 and 3 (eg solving problems with coefficient of resistance, applying AC theory to the solution of problems on R, L and C components in series single phase circuits, etc). It is also likely that the component Using Graphical Information at SCQF level 6 could also be developed in the context of Outcomes 2, 3 and 4. The specific skills of: analysing and interpreting complex graphical information; and selecting an appropriate form and communicating information can be found in Outcomes 2 and 3. This core skill could be developed here without formal certification.



## SQA Advanced Unit Specification

The component Critical Thinking of the Core Skill of *Problem Solving* SQCF level 6 could also be developed in this unit in the work In Outcome 2, reference is made to the graphical solution of the addition of AC voltages and currents using the phasor method. In formative assessments for this outcome, it may be possible to develop this skill. This core skill could be developed without formal certification. The specific core skill element that may be developed is 'Assess the relevance of these factors to the situation or issue'.

The unit may allow learners to complete laboratory work which may allow them to develop the component Oral Communication of the Core Skill *Communication* at SCQF level 6. In a marine engineering laboratory when learners are set a problem they may have the opportunity to develop the specific core skill elements 'Use vocabulary and a range of spoken language structures consistently and effectively at an appropriate level of formality' and 'Respond to others, taking account of their contributions'.

This unit may allow learners to complete laboratory work and formative assessment which may allow them to develop Reviewing Co-operative Contribution of the Core Skill *Working with Others* at SCQF level 5. Through the learners' laboratory work and formative assessments this may allow them to develop the specific skills 'Evaluate overall co-operative working, considering own involvement and the involvement of others, referring to supporting evidence', 'Draw conclusions and justify them with reference to supporting evidence' and 'Identify own learning and objectives for future co-operative working'.

This unit has the Using Number component of Numeracy and the Critical Thinking component of Problem Solving embedded in it. This means that when learners achieve the unit, their core skills profile will also be updated to show they have achieved Using Number at SCQF level 6 and Critical Thinking at SCQF level 5.

## SQA Advanced Unit Specification

### History of changes to unit

Version	Description of change	Date

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

**FURTHER INFORMATION:** Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

### General information for learners

This unit has been designed to allow you to develop knowledge, skills and understanding in electrical and electronic principles and concepts as used in marine engineering. This unit will also allow you the opportunity to develop the necessary knowledge and skills to evaluate the operation of simple AC and DC circuits applied to marine applications.

You will also learn to apply electrical and electronic principles to marine equipment in order to assess its overall performance.

It is good to gain sound theoretical knowledge and understanding but it is also important that you are able to set your theoretical knowledge within a practical electrical context. Thus, it is likely during the unit you will be provided with the opportunity to relate theory to practice by doing practical experiments.

There are opportunities in this unit to gather evidence towards the Core Skill of *Numeracy* at SCQF level 6 although there is no automatic certification of core skills or core skills components.

The formal assessment for this unit could consist of a single assessment paper lasting no more than two hours. The assessment will be conducted under closed-book conditions in which you will not be allowed to take notes, textbooks etc. into the assessment. However, you will be allowed to use a scientific calculator. You may sit this assessment paper at the end of the unit.

This unit has the Using Number component of Numeracy and the Critical Thinking component of Problem Solving embedded in it. This means that when you achieve the unit, your core skills profile will also be updated to show you have achieved Using Number at SCQF level 6 and Critical Thinking at SCQF level 5.