

## SQA Advanced Unit specification

### General information

**Unit title:** Marine Engineering: Electrical Distribution Systems  
(SCQF level 8)

**Unit code:** HW63 48

**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 Electrical Power. It is designed as part of the SQA Advanced Diploma in Marine Engineering award and should give the Marine Engineering learner a greater appreciation of electrical power circuits.

### Outcomes

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

- 1 Solve problems on three phase balanced and unbalanced AC circuits.
- 2 Solve problems on three phase AC motors.
- 3 Solve problems on Distribution systems and load sharing.
- 4 Explain and solve problems on AC transformers.

### Credit points and level

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

### Recommended entry to the Unit

Access to this Unit is at the discretion of the centre. However, it would be beneficial if learners have completed the *Marine Engineering: Electro-Technology and Marine Engineering: Electrical Power* and have a knowledge and understanding of Mathematics and/or Physics at SCQF level 6 SQA Advanced Unit.

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### 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

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 (<http://www.sqa.org.uk/sqa/46233.2769.html>).

### 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**

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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.

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**

Solve problems on three phase balanced and unbalanced AC circuits.

#### **Knowledge and/or Skills**

- ◆ Balanced star and/or delta connected three phase AC loads
- ◆ Phasor diagrams
- ◆ Unbalanced three phase AC loads

### **Outcome 2**

Solve problems on three phase AC motors.

#### **Knowledge and/or Skills**

- ◆ Induction motors
- ◆ Synchronous motors

### **Outcome 3**

Solve problems on Distribution systems and load sharing.

#### **Knowledge and/or Skills**

- ◆ Distribution system load sharing
- ◆ Power factor including its correction

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### Outcome 4

Explain and solve problems on AC transformers.

#### Knowledge and/or Skills

- ◆ Principle of operation and construction.
- ◆ EMF equation, transformer ratio and VA ratings.
- ◆ Phasor diagrams.
- ◆ Transformer losses and efficiency.
- ◆ Principle of operation of an autotransformer including applications and circuit diagrams.
- ◆ Solve problems on autotransformers, involving voltages, turns ratio, and tapping points.

#### Evidence Requirements for this Unit

Written and/or Oral evidence for the Knowledge and/or Skills items in Outcomes 1, 2 and 4 should be provided on a sample basis. For Learning Outcome 3 all of the Knowledge and Skills are required.

Outcomes 1, 2, 3, and 4 should be combined to form a holistic assessment lasting two hours and carried out under supervised, controlled conditions.

Written and or oral evidence should be generated through assessment in supervised conditions. 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.

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

#### Evidence Requirements — Outcome 1

Written and/or oral evidence for the Knowledge and/ or Skills items in Outcome 1 should be provided on a sample basis. In any assessment of this Outcome, **two out of three** knowledge and/or Skills items should be sampled. When reassessment takes place an alternative sample should be used.

In order to ensure that learners will not be able to foresee what items they will be assessed on, a different sample of **two out of three** Knowledge and/or Skills items are required each time the unit is assessed. Learners must provide a satisfactory response to items assessed.

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- ◆ Solve problems for balanced star and/or delta connected three phase AC loads comprising RLC elements in relation to: Phase voltages and line voltages, Phase currents and line currents, Power factor and Power factor correction.
- ◆ Explain phasor diagrams in relation to star and/or delta connected balanced three phase AC circuits.
- ◆ Solve problems on unbalanced three phase AC loads in relation to the magnitude and angular orientation of the neutral conductor current.

### Evidence Requirements — Outcome 2

Written and/or oral evidence for the Knowledge and/ or Skills items in Outcome 2 should be provided on a sample basis. In any assessment of this Outcome, **one out of two** knowledge and/or Skills items should be sampled. When reassessment takes place an alternative sample should be used.

In order to ensure that learners will not be able to foresee what items they will be questioned on, a different sample of **one out of two** Knowledge and/or Skills items are required each time the unit is assessed. Learners must provide a satisfactory response to items assessed.

- ◆ Solve three phase AC induction motor problems involving slip, frequency of rotor EMF, Synchronous speed, Rotor speed, Stator losses, Rotor copper losses, Output and input power, power flow diagram, motor torque, Motor current, power factor and Efficiency.
- ◆ Solve problems relating to synchronous motors being used for power factor correction.

### Evidence Requirements — Outcome 3

Written and or/oral evidence is required. In any assessment of this Outcome, **all** knowledge and/or Skills items should be covered. When reassessment takes place an alternative variant of the numerical problem should be used.

Learners must provide a satisfactory response to all items.

- ◆ Solve AC distribution system load sharing problems involving active power, reactive power, and apparent power.
- ◆ Solve AC distribution system load sharing problems involving power factor and power factor correction.

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### Evidence Requirements — Outcome 4

Written and/or oral evidence for the Knowledge and/ or Skills items in Outcome 4 should be provided on a sample basis. In any assessment of this Outcome, **two out of six** knowledge and/or Skills items should be sampled. When reassessment takes place an alternative sample should be used.

In order to ensure that learners will not be able to foresee what items they will be questioned on, a different sample of **two out of six** Knowledge and/or Skills items are required each time the unit is assessed. Learners must provide a satisfactory response to items assessed.

- ◆ Explain the principle of operation/construction/shipboard application of power transformers.
- ◆ Solve problems involving transformer EMF equation/transformer ration/VA ratings.
- ◆ Solve problems involving transformer phasor diagrams.
- ◆ Solve problems involving transformer losses and efficiency.
- ◆ Describe the principle of operation of an autotransformer including applications and circuit diagrams.
- ◆ Solve problems on autotransformers, involving voltages, turns ratio, and tapping points.

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### SQA Advanced Unit Support Notes

**Unit title:** Marine Engineering: Electrical Distribution Systems  
(SCQF level 8)

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 has been written in order to allow learners to develop knowledge, understanding and skills in the following areas:

- ◆ three phase balanced and unbalanced AC circuits
- ◆ three phase AC motors
- ◆ Distribution systems and load sharing
- ◆ AC transformers

This Unit is at SCQF level 8 and has been devised as a mandatory Unit within the mandatory section of the SQA Advanced Certificate and SQA Advanced Diploma in Marine Engineering. However this does not preclude the use of this Unit in other awards where award designers feel this to be appropriate.

#### Guidance on approaches to delivery of this Unit

The unit is best delivered in conjunction with *Marine Engineering: Electro-Technology*.

This Unit could be delivered by a combination of class teaching, tutorial work and practical laboratory work where appropriate. The latter 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 principles that underpin much of the studies in other areas of the SQA Advanced Certificate and SQA Advanced Diploma in Marine Engineering, 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

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

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 should be a combined paper for all four Outcomes. This single assessment paper could be taken at a single assessment event lasting two hours and should 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.

This assessment must include two of the three Evidence Requirements for Outcome 1, one of the two of the Evidence Requirements for Outcome 2, all Evidence Requirements for Outcome 3 and two out of six Evidence Requirements for Outcome 4.

In the case of a reassessment, different samples of the Evidence Requirements for each should be used.

- ◆ Outcome 1: **two out of three**
- ◆ Outcome 2: **one out of two**
- ◆ Outcome 3: **all**
- ◆ Outcome 4: **two out of six**

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.

Learners will need to provide evidence to demonstrate their Knowledge and/or skills across all Outcomes.

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.

### 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

This unit has the Using Number component of Numeracy 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.

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 may contribute 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. It is also likely that the component Using Graphical Information at SCQF level 6 could also be developed in the context of Outcome 4.

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'.

## 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

**Unit title:** Marine Engineering: Electrical Distribution Systems  
(SCQF level 8)

This Unit is designed to enable you to develop knowledge and understanding in Marine Electrical Power. It is designed as part of the SQA Advanced Diploma in Marine Engineering award and should give the Marine Engineering learner a greater appreciation of electrical power circuits.

The unit is mainly theory and will give you a broad understanding of the basic circuit components and systems incorporated in a maritime environment.

There are four learning outcomes in this unit and you will be expected to explain, solve problems and sketch diagrams on the four topics listed.

- 1 Solve Problems on three phase balanced and unbalanced AC circuits.
- 2 Solve problems on three phase AC motors.
- 3 Solve problems on Distribution systems and load sharing.
- 4 Explain and solve problems on AC transformers.

The assessment of this Unit could be a combined paper for all four Outcomes. This single assessment paper could be taken at a single assessment event lasting two hours and should be carried out under supervised, controlled conditions.

There are opportunities to develop the Core Skills of Numeracy, Problem Solving and Communication at SCQF level 6 and Working with Others at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

This unit has the Using Number component of Numeracy 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.