

SQA Advanced Unit specification

General information

Unit title: Marine Engineering: Electrical Power (SCQF level 7)

Unit code: HW67 47

Superclass: XQ

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Unit purpose

This Unit is designed to enable learners to develop knowledge and understanding in Marine Electrical Power circuits. It is designed as part of the SQA Advanced Diploma in Marine Engineering 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 Resistive DC circuits connected in series and parallel.
- 2 Solve problems on Non-linear DC transient circuits, Resistive/Capacitive and Resistive Inductive circuits.
- 3 Solve problems on parallel single phase AC circuits comprising resistance, capacitance and inductance.
- 4 Evaluate Electronics in marine applications.

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 the learner has completed the unit *Marine Engineering: Electro-Technology* and have a knowledge and understanding of Mathematics and/or Physics 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 (<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.

SQA Advanced Unit specification: Statement of standards

Unit title: Marine Engineering: Electrical Power (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

Solve problems on Resistive DC circuits connected in series and parallel.

Knowledge and/or Skills

- ◆ DC radial feeders circuits involving no more than three unknowns
- ◆ DC ring mains circuits involving no more than three unknowns
- ◆ DC double-fed systems involving no more than three unknowns

Outcome 2

Solve problems on Non-linear DC transient circuits, Resistive/Capacitive and Resistive Inductive circuits.

Knowledge and/or Skills

- ◆ RC connected DC circuit transients during charge/discharge
- ◆ RL connected DC circuit transients during switch on and/or switch

Outcome 3

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

Knowledge and/or Skills

- ◆ Single phase parallel RLC AC circuits
- ◆ Phasor diagrams, impedance, resistance, capacitance
- ◆ Inductance, power factor
- ◆ Apparent power, true power, reactive power
- ◆ Power factor correction

SQA Advanced Unit Specification

Outcome 4

Evaluate Electronics in marine applications.

Knowledge and/or Skills

- ◆ Operations of p and n type diode
- ◆ Rectification of an ac single phase supply
- ◆ Rectifier circuits using one or two diodes; centre tapped transformer; bridge rectifier
- ◆ Rectifier voltage calculations
- ◆ Formation of a pnp and npn junction transistor
- ◆ Bipolar transistors as switches in marine applications
- ◆ Operation of small signal bipolar transistor amplifiers in marine applications
- ◆ Photo-electric effect

Evidence Requirements for this unit

The evidence for this unit 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 2 hours.

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.

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 any 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:

- ◆ calculate the current supplied, voltage across each load, the total power supplied for radial feeder systems.
- ◆ calculate the current supplied, voltage across each load, the total power supplied for ring mains systems.
- ◆ calculate the current supplied, voltage across each load, the total power supplied for double-fed systems.

SQA Advanced Unit Specification

Outcome 2

The assessment will sample **one out of two** 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 any 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:

- ◆ describe and sketch transient voltage and current relationships in simple R-L and R-C circuits when switching on and off.
- ◆ use exponential growth and decay formulae to calculate current or voltage values at a given time in R-L and R-C circuits.

Outcome 3

The assessment will sample **three out of five** 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 any 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:

- ◆ calculate impedance of R-L-C circuit combinations in parallel.
- ◆ calculate the resonant frequency of an R-L-C series circuit.
- ◆ solve problems relating to single phase active, apparent and reactive power.
- ◆ solve problems relating to pf correction in single phase circuit.
- ◆ use phasor diagrams to describe the voltage and current in single phase parallel circuits.

SQA Advanced Unit Specification

Outcome 4

The assessment will sample **four out of eight** 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 any 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 the operation of a p-n junction diode in forward and reverse bias conditions including the characteristic curves.
- ◆ explain and draw the circuit diagram and input and output waveforms for full-wave and half-wave rectifiers including smoothing.
- ◆ determine the dc rectified voltage for half and full wave single phase circuits given ac input supply and vice versa.
- ◆ explain the operation of a pnp and npn bipolar transistor in common base, common emitter and common collector connections.
- ◆ sketch the circuit diagram for a bipolar transistor used as a switch and explain its action with reference to marine applications.
- ◆ sketch a circuit diagram for a bipolar transistor small signal amplifier and explain its action, with reference to a marine application.
- ◆ calculate the current flow in a transistor switching circuit used for control or alarm purposes.
- ◆ explain the photo-electric effect and its application to photo-diodes and one use of the photo-diode in a marine application.

SQA Advanced Unit Support Notes

Unit title: Marine Engineering: Electrical Power (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. 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/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 learned 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 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. 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.

SQA Advanced Unit Specification

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.

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.

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

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

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

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.

Opportunities for developing Core and other essential skills

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.

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. This is likely to fit in with a variety of the topics in Outcomes 1, 2 and 3. 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'.

SQA Advanced Unit Specification

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

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This Unit is designed to enable you to develop knowledge and understanding in Marine Electrical Power circuits. It is designed as part of the SQA Advanced Diploma in Marine Engineering and should give the Marine Engineering learner a greater appreciation of electrical power circuits. You will be applying the theory of electrical problem solving to dc and ac circuits.

This unit is mainly theory based and will give you a broad understanding of the basic circuit theory 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 Resistive DC circuits connected in series and parallel.
- 2 Solve problems on Non-linear DC transient circuits, Resistive/Capacitive and Resistive Inductive circuits.
- 3 Solve problems on parallel single phase AC circuits comprising resistance, capacitance and inductance.
- 4 Evaluate Electronics in marine applications.

The assessment of this Unit could be a combined paper for all four Outcomes. This single assessment paper will last two hours and will be carried out under supervised, controlled conditions.

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.