Higher National Unit specification

General information for centres

Unit title: Marine Engineering: Electrical and Electronic Devices

Unit code: F90W 34

Unit purpose: This Unit is designed to enable candidates to develop knowledge and understanding in Marine Electro-technology. The Unit will also provide the candidate with a base from which future advanced work in Marine Engineering may be undertaken.

On completion of the Unit the candidate should be able to:

1 Explain the physical construction and the characteristics of electrical/electronic components.
2 Solve problems relating to linear d.c. and a.c. electrical circuits.
3 Explain the characteristics and marine applications of semiconductor devices used in rectification and small signal circuits.
4 Explain Secondary Cells and Batteries for Marine applications.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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.*

Recommended prior knowledge and skills: It would be an advantage if candidates had 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: 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.

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.

Assessment: The assessment for all four Outcomes should be combined together into one assessment paper which candidates should sit at one single assessment event lasting no more than two hours. Assessment should be conducted under controlled, supervised conditions.

Higher National Unit specification: statement of standards

Unit title: Marine Engineering: Electrical and Electronic Devices

Unit code: F90W 34

Outcome 1

Explain the physical construction and the characteristics of electrical/electronic components.

Knowledge and/or skills

- Electrical charge, current, e.m.f., potential difference, electrical energy and power.
- Resistance, inductance and capacitance in terms of physical dimensions and materials
- Physical parameters of resistance, inductance and capacitance.
- Effects of temperature on conductors, semi-conductors and insulators.
- Temperature coefficient of resistance.

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 1 should be provided on a sample basis. Each candidate will need to demonstrate that they can answer correctly questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **two out of five** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of two out of five knowledge and/or skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

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

- Define and explain two of the following: electrical charge, current, e.m.f., potential difference, electrical energy or power.
- Explain resistance, inductance or capacitance in terms of physical dimensions and materials.
- Solve a numerical problem relating resistance, inductance or capacitance to their physical parameters.
- Explain the effects of temperature on conductors, semiconductors and insulators.
- Solve a problem using temperature coefficient of resistance.

Where calculations are performed the candidate 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 should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Assessment guidelines

The assessment of this Outcome could be combined together with that for Outcomes 2, 3 and 4 to form a single assessment paper, details of which are given under the Evidence Requirements for Outcome 4.

Outcome 2

Solve problems relating to linear d.c. and a.c. electrical circuits.

Knowledge and/or skills

- Series and parallel resistive d.c. circuits.
- Wheatstone Bridge
- A.C. sinusoidal waveforms
- Operation of circuits having R, L and C components.
- Ship board electrical equipment

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 2 will be provided on a sample basis. Each candidate will need to demonstrate that they can correctly answer questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **three out of five** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of **three from five** knowledge and/or skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

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

- Solve a problem on series and parallel resistive d.c. circuits including equivalent resistance, current, voltage, power and energy.
- Solve a problem on the Wheatstone Bridge.
- Solve a problem on sinusoidal waveforms using the equation $e = E_{max} \sin 2\pi ft$
- Apply a.c. theory to the solution of a problem on single phase R, L C circuits and components incorporating R and L, R and C or R,L and C in series or parallel.

Evidence Requirements (continued)

- Explain three of the terms true power, active power, reactive power, apparent power and power factor and their significance in shipboard electrical equipment.

Where calculations are performed the candidate 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 should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Assessment guidelines

The assessment of this Outcome could be combined together with that for Outcomes 1, 3 and 4 to form a single assessment paper, details of which are given under the Evidence Requirements for Outcome 4.

Outcome 3

Explain the characteristics and marine applications of semiconductor devices used in rectification and small signal circuits.

Knowledge and/or skills

- Operations of p and n type diode
- Explain how rectification of an a.c. single phase supply is achieved using: one diode; two diodes and a centre tapped transformer; bridge rectifier.
- 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

Evidence for the knowledge and/or skills items in Outcome 3 will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that they can correctly answer questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **two out of six** knowledge and/or skills items should be sampled.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical and Electronic Devices

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of **two from six** knowledge and/or skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

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

- Explain, with the aid of diagrams, the operation of a p-n junction diode in forward and reverse bias conditions.
- Determine the static characteristic curves for forward and reverse biasing of a p-n junction from test results.
- Explain and draw the circuit diagram and input and output waveforms for full-wave and half-wave rectifiers.
- Draw a circuit diagram for a bipolar transistor used as a switch and explain its action, with reference to marine applications.
- Draw a circuit diagram for a bipolar transistor small signal amplifier and explain its action, with reference to a marine application.
- Explain the photo-electric effect and its application to photo-diodes and one use of the photo-diode in a marine application.

Where calculations are performed the candidate 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 should be generated through assessment in supervised conditions. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Assessment guidelines

The assessment of this Outcome could be combined together with that for Outcomes 1, 2 and 4 to form a single assessment paper, details of which are given under the Evidence Requirements for Outcome 4

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical and Electronic Devices

Outcome 4

Explain Secondary Cells and Batteries for Marine applications.

Knowledge and/or skills

- Lead-acid and alkaline (Nickel cadmium) cells.
- Charge/discharge graphs for both types.
- Efficiency of batteries.
- Batteries in series and parallel.
- Charging circuits for batteries.

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 4 will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that they can correctly answer questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **two out of five** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of **two from five** knowledge and/or skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

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

- Compare lead-acid and alkaline cells in terms of voltage per cell; performance under poor conditions of charge/discharge; retention of charge; effects of temperature; mechanical strength; weight and cost.
- Sketch and explain the charge/discharge graphs for lead-acid cells and explain how the state of charge may be assessed for lead-acid and alkaline cells.
- Solve a problem on efficiency of batteries in terms of ampere-hours or watt-hours.
- Solve a problem involving batteries in series or parallel combinations including internal resistance and current in a connected load.
- Sketch charging circuit from a d.c. supply.

Where calculations are performed the candidate 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.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Engineering: Electrical and Electronic Devices

Evidence should be generated through assessment in supervised condition. Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment. Candidates will be permitted to use scientific calculators during the assessment.

Assessment guidelines

The assessment of this Outcome could be combined together with that for Outcomes 1, 2 and 3 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.

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

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

Administrative Information

Unit code: F90W 34

Unit title: Marine Engineering: Electrical and Electronic Devices

Superclass category: XQ

Original date of publication: August 2010

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History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications

Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Marine Engineering: Electrical and Electronic Devices

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 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 candidates 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 HNC and HND 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 candidates to practise what they have learnt through appropriate formative assessments or laboratory work.

Guidance on the delivery and assessment of this Unit

Details on the approaches to assessment are given under Evidence Requirements and Assessment Guidelines in Outcome 4 of the Higher National Unit specification: statement of standards section. It is recommended that this section is read carefully before proceeding with assessment of candidates.

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.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions. This assessment must include two of the five Evidence Requirements for Outcome 1, three out of the five Evidence Requirements for Outcome 2, two out of the six Evidence Requirements for Outcome 3 and two out of the five Evidence Requirements for Outcome 4. In the case of a reassessment, different samples of the Evidence Requirements for each should be used.

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

Opportunities for developing Core Skills

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

The delivery and assessment of this Unit may contribute towards the Component 'Using Number' of the Core Skill of *Numeracy* at SCQF level 6 in Outcomes 1, 2 and 3. The specific skills required for the component at SCQF 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 a.c. theory to the solution of problems on R, L and C components in series or parallel in 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.

The component 'Critical Thinking' of the Core Skill of *Problem Solving* SCQF level 6 could also be developed in this Unit in the work for Outcomes 2, 3 or 4. Candidates in Outcome 4 have to understand the uses of both types of secondary batteries and are required to analyse their advantages and disadvantages. In Outcome 2, reference is made to the graphical solution of the addition of a.c. 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 candidates 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 candidates 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 candidates 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 candidates' 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'.

Open Learning

Although this Unit could be delivered by distance learning, it would require a considerable degree of planning by the centre to ensure the sufficiency and authenticity of candidate evidence. Arrangements would have to be made to ensure that the closed-book test for Outcomes 1, 2, 3 and 4 is delivered in a supervised environment.

Higher National Unit specification: support notes (cont)

Unit title: Marine Engineering: Electrical and Electronic Devices

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**

General information for candidates

Unit title: Marine Engineering: Electrical and Electronic Devices

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 electrical and electronic circuits in 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.