



Higher National Unit specification

General information

Unit title: Marine Engineering: Electrical Machines (SCQF level 8)

Unit code: HJ4D 35

Superclass: XQ

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Unit purpose

This Unit is designed to enable learners to develop underpinning knowledge and understanding of Marine Electrical Distribution Systems. Unit covers various elementary shipboard electrical appliances and provides progression to other marine electrical units within HND Marine Engineering. This unit is designed for Merchant Navy Engineer Officer Cadet trainees and those who wish to achieve STCW Engineer certification at Management level.

Outcomes

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

- 1 Explain the layout and component parts of typical marine electrical distribution systems.
- 2 Explain the construction and operation of AC generators.
- 3 Explain the construction and operation of AC motors.
- 4 Explain the operation of electronic devices in power circuits.

Credit points and level

1 Higher National Unit 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 units *Marine Engineering: Electro-Technology*, *Marine Engineering: Electrical Power* and have a knowledge and understanding of Mathematics and/or Physics at SCQF level 6.

Higher National Unit Specification: General information (cont.)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

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.

Higher 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.

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 the layout and component parts of typical marine electrical distribution systems.

Knowledge and/or Skills

- ◆ Power distribution system
- ◆ Insulated and earthed neutrals systems
- ◆ Distribution circuit breakers
- ◆ Power and instrument transformers
- ◆ Circuit protection

Outcome 2

Explain the construction and operation of AC generators.

Knowledge and/or Skills

- ◆ AC generator construction and cooling
- ◆ AC generator operation
- ◆ Excitation methods
- ◆ Automatic Voltage Regulation
- ◆ Generators in parallel
- ◆ Emergency generators

Outcome 3

Explain the construction and operation of AC motors.

Knowledge and/or Skills

- ◆ Three phase induction and synchronous motors
- ◆ Construction of three phase induction and synchronous motors
- ◆ Characteristics of three phase induction and synchronous motors
- ◆ Starting of three phase induction motors
- ◆ Speed control of three phase induction and synchronous motors

Higher National Unit specification: Statement of standards (cont)

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Outcome 4

Explain the operation of electronic devices in power circuits.

Knowledge and/or Skills

- ◆ Operation and characteristics of a thyristor
- ◆ Phase shift control of a thyristor circuit
- ◆ Operation and characteristics of Zener diode
- ◆ DC stabilizer circuits

Evidence Requirements for this Unit

Written and/or Oral evidence for the Knowledge and/or Skills items in Outcome 1, 2, 3 and 4 should be provided on a sample basis. Outcomes 1, 2, 3, and 4 should be combined to form an holistic assessment lasting two hours and 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.

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, **four out of nine** 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 **four out of nine** Knowledge and/or Skills items are required each time the unit is assessed. Learners must provide a satisfactory response to items assessed.

- ◆ Describe, with the aid of sketch, a typical marine electrical distribution systems such as radial and ring system.
- ◆ Describe, with the aid of sketch, the characteristics of an insulated and an earthed neutral distribution system.
- ◆ Describe, with the aid of diagram, the earth fault monitoring schemes.
- ◆ Appraise the advantages and disadvantages of an insulated and an earthed neutral distribution system.
- ◆ Describe construction and operation of a circuit breaker.
- ◆ Differentiate between different types of circuit breakers.
- ◆ Describe the application of single and three phase transformers on board a ship.
- ◆ Explain the operation of instrument transformers including earthing.
- ◆ Explain different type electrical circuit protections.

Higher National Unit specification: Statement of standards (cont)

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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, **three 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 assessed on, a different sample of **three 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.

- ◆ Describe, with the aid of sketch, principle operation of a generator.
- ◆ Explain the construction of ac generators including cooling arrangements.
- ◆ Explains different excitation schemes.
- ◆ Explain automatic voltage regulation.
- ◆ Explain generator operation in parallel.
- ◆ Explain the shipboard application of an emergency generator.

Outcome 3

Written and/or oral evidence for the Knowledge and/or Skills items in Outcome 3 should be provided on a sample basis. In any assessment of this Outcome, **three 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 assessed on, a different sample of **three 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.

- ◆ Describe principle operation of a three phase induction or synchronous motor.
- ◆ Appraise the construction of a three phase induction or synchronous motor.
- ◆ Compare and appraise, with sketches, DOL, Star/Delta, auto-transformer, soft starters.
- ◆ Appraise methods of varying the speed of ac motors.
- ◆ Describe synchronous motor starting methods.
- ◆ Appraise the use of synchronous motor for power factor correction.

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 four** knowledge and/or Skills items should be sampled. When reassessment takes place an alternative sample should be used.

Higher National Unit specification: Statement of standards (cont)

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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 four** Knowledge and/or Skills items are required each time the unit is assessed. Learners must provide a satisfactory response to items assessed.

- ◆ Appraise characteristics/ operation of a thyristor.
- ◆ Sketch a thyristor circuit using variable phase shift control, and typical load current and voltage.
- ◆ Describe and appraise the operation of zener diodes with forward and reverse bias voltage applied.
- ◆ Analyse a simple dc stabiliser circuit by calculating values of voltages, currents and powers under change of load and supply voltage.



Higher National Unit Support Notes

Unit title: Marine Engineering: Electrical Machines (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:

- ◆ layout and component parts of typical marine electrical distribution systems
- ◆ construction and operation of AC generators
- ◆ construction and operation of AC motors
- ◆ operation of electronic devices in power circuits

This Unit is at SCQF level 8 and has been devised as a mandatory Unit within the Mandatory section of the HNC and HND Marine Engineering awards. 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

This Unit is best delivered subsequent to *Marine Engineering: Electro-Technology*, *Marine Engineering: Electrical Power* and *Marine Engineering: Electrical Distribution Systems*.

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 marine electrical/electronic context. The Unit has been designed to incorporate sufficient time to allow lecturers to teach all the core electrical principles in the Unit.

This Unit provides core electrical/electronic principles that underpin much of the studies in other areas of the HNC and HND Marine Engineering 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.

Higher National Unit Support Notes

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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 should be taken at a single assessment event lasting two hours and 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.

Questions used to elicit learner evidence should take the form of an appropriate balance of short answer, restricted response and structured questions. Each Outcome may also be assessed separately.

This assessment must include four of nine from Outcome 1, three of six from Outcome 2, three of six from Outcome 3, and two of four from Outcome 4.

An assignment based assessment may be applicable for Outcomes 1, 2 and 3 which would involve learners producing their assignments under controlled conditions.

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

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.

Higher National Unit Support Notes (cont)

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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 Outcome 4. It is also likely that the component Using Graphical Information at SCQF level 6 could also be developed in the context of Outcomes 1, 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 In Outcome 2, reference is made to the appraising the star and delta types of motor starter circuit. 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'.

History of changes to Unit

Version	Description of change	Date

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General information for learners

Unit title: Marine Engineering: Electrical Machines (SCQF level 8)

This Unit has been designed to allow you to develop knowledge, skills and understanding of marine electrical systems, AC generators and motors and basics of power electronics used on board ships.

The Unit will also allow you the opportunity to develop the fundamental knowledge and skills to appraise a typical marine electrical distribution system.

This unit is also designed to be studied in conjunction with one electrical unit from HNC Marine Engineering and two electrical units from HND Marine Engineering.

This unit is also designed to assist you with gaining deeper understanding of the knowledge and/or Skills covered *Marine Engineering: Electrical Distribution Systems*.

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 or observations.

The formal assessment for this Unit may 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.

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