SQA Advanced Unit specification

General information

Unit title: Marine Engineering: Stability and Structure of Merchant Ships (SCQF level 7)

Unit code: HW5G 47

Superclass: XQ

Publication date: November 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit is designed to enable learners to develop their knowledge and understanding of naval architecture and of ship construction. The unit will allow learners to apply the principles of naval architecture to vessel operations. This unit is designed to provide the underpinning knowledge to Merchant Navy Engineer Cadet Trainees and those who wish to achieve EOOW certification.

Outcomes

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

1 apply the principles of hydrostatics to solve problems relating to merchant navy vessels
2 determine small angle stability including free surface effect on typical merchant navy vessel
3 analyse basic ship construction of standard merchant ship types

Credit points and level

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

Recommended entry to the unit

While entry is at the discretion of the centre, it is recommended that learners should have relevant knowledge of mathematics and physics. This may be demonstrated by successful completion of NC Shipping and Maritime Operations at SCQF level 6 with Engineering options or equivalent, including a minimum Mathematics at SCQF level 5.

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 the unit specification.

Context for delivery

If 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**.

SQA Advanced Unit specification: Statement of standards

Unit title: Marine Engineering: Stability and Structure of Merchant Ships (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

Apply the principles of hydrostatics to solve problems relating to merchant navy vessels.

Knowledge and/or skills

- Principles of flotation, buoyancy and displacement
- Coefficients of form
- Tonnes per centimetre immersion TPC
- Small changes in draught over change in mass or density
- Hydrostatic forces

Outcome 2

Determine small angle stability including free surface effect on typical merchant navy vessel.

Knowledge and/or skills

- Centre of gravity
- Centre of Gravity when loading/discharging
- Transverse stability at small angles of heel
- Angle of list
- Free surface effect
- Effects on stability of transferring fluids within the vessel

Outcome 3

Analyse basic ship construction of standard merchant ship types.

Knowledge and/or skills

- Basic ship's geometry
- Ship’s cross sections
- Basic propeller terminology

Evidence requirements for this unit

Written and/or oral evidence should be generated through closed-book assessment in supervised conditions. Each outcome could be assessed separately in a paper which lasts no more than one hour. However, the assessment could take place as one assessment event which combines all outcomes.

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 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 five** knowledge and/or skills items are required each time the unit is assessed.

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:

- apply principles of flotation to calculate displacement of simple shaped vessels
- solve problems relating to Archimedes’ Principle for bodies floating in and descending vertically thorough a liquid
- apply coefficients of form to compare flotation of different shapes of vessels
- apply TPC to calculate changes in draught due to change in density or mass
- calculate resultant thrust and centre of pressure for vertical rectangular area wetted by two immiscible liquid, including when the free surface is subject to a gas pressure

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 should derive from the application of the formula and correct application of the principles of the calculation
- formula sheets may be used during this outcome

The use of scientific calculators is allowed.

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 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 six** knowledge and/or skills items should be sampled.

In order to ensure that learners will not be able to foresee what items they will be questioned on, a different sample of four from six knowledge and/or skills items are required each time the unit is assessed.

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:

- determine position of centre of gravity for different load conditions
- solve problems involving simple ship shapes to establish changes relating to the changes in vessel condition (KG,GM) when weights are added, removed or moved within the ship
- calculate small angle stability for wall sided vessels (new KG, new BM, new GM)
- determine the angle of list; apply formula $GM = md/\Delta\tan\theta$
- calculate free surface effect
- compare effects on stability (new GM) when fluids are transferred within the vessel

Where calculations are performed the learner must:

- apply appropriate formula
- apply the principles of the calculation
- show all working through a calculation
- ensure the answer should derive from the application of the formula and correct application of the principles of the calculation
- formula sheets may be used during this outcome
- use of scientific calculators is allowed

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 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 is required each time this outcome is assessed.

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:

- Identify and explain eight of the following general ship's terms including:
  Forward perpendicular, aft perpendicular, length between perpendiculars, length overall, midships, sections, moulded and extreme breadth, depth and draught, shear, camber, flare, rise of floor, bilge radius, parallel middle body, deadweight, lightweight, displacement, freeboard and load line marks.

- Identify, explain and sketch the midship section of one the following ship types:
  - general cargo
  - bulk carrier
  - crude oil tanker
  - petroleum, gas and chemical tankers
  - OBO carrier
  - container ship
  - LNG and LPG vessels

- Explain basic propeller terms.

SQA Advanced Unit Support Notes

Unit title: Marine Engineering: Stability and Structure of Merchant Ships (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 has been written in order to allow learners to develop knowledge, understanding and skills in the following areas:

1 Apply the principles of hydrostatics to solve problems relating to merchant navy vessels
2 Determine small angle stability including free surface effect on typical merchant navy vessel
3 Analyse basic ship construction of standard merchant ship types

Whilst it is not mandatory for a centre to use this list of topics it is strongly recommended that it does so to ensure continuity of teaching and learning across the Stability and Hydrostatics unit. The list of topics is given below. Lecturers are advised to study this list of topics in conjunction with the knowledge/skills section of this document so that they can get a clear indication of the standard of achievement expected of learners in this unit.

Outcome 1 — Apply the principles of hydrostatics to solve problems relating to merchant navy vessels

- Explain the principles of flotation by problem solving examples applying relative density, displacement and buoyancy calculations for simple shapes submerged or floating in different density liquids.
- Solve problems relating to Archimedes' Principle for bodies floating in and descending vertically thorough a liquid.
- Solve simple tasks using TPC in calculating displacement and effect of addition of masses on draught.
- Calculate change in draught due to change in water density.
- Differentiate applications of formulae for change in draught due to change in mass and change in draughts due to change in water density, calculate complex examples composed of two to three changes in draught.
- Apply coefficients of form to compare flotation of different shapes of vessel. Use models or calculations to demonstrate difference in buoyancy and draught btw. Full and fine form.
- Apply TPC to calculate changes in draught due to change in density or mass. Problem solve examples to differentiate between causes of change of draught.
- Calculate resultant thrust and centre of pressure for vertical rectangular area wetted by two immiscible liquid, including when the free surface is subject to a gas pressure.
- Solve problems relating to the resultant thrust and centre of pressure for immersed areas (rectangular, circular, triangular and trapezoidal) positioned vertically and inclined, including when the free surface is subject to a gas pressure.

Outcome 2 — Determine small angle stability and free surface effect on typical merchant navy vessel

- Calculate position of centre of gravity for loading, unloading and removal of mass.
- Solve problems involving simple ship shapes to establish changes relating to the changes in vessel condition when weights are added, removed or moved within the ship.
- Calculate small angle stability for wall sided vessels (new KG, new BM, new GM).
- Determine the angle of list; apply formula $GM = md/\Delta \tan\theta$.
- Calculate free surface effect.
- Compare effects on stability (new GM) when fluids are transferred within the vessel.

Outcome 3 — Analyse Basic Ship Construction of standard merchant ship types

- Identify basic ship geometry terms on a diagram and using definition or sketch.
- Identify, explain and sketch the midship sections of one the following ship types:
  - container ship
  - bulk carrier
  - general cargo
  - crude oil tanker
  - LNG and LPG vessels

  Sketch could be validated 50% mark and explanation of construction elements 50% mark.
- Explain four propeller terms, using sketch and definitions.

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 context. The unit has been designed to incorporate sufficient time to allow lecturers to teach all the core naval architecture and ship construction principles.

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 in such a way that there is sufficient time built in to allow learners to practise what they have learnt through formative assessments.

Details on the approaches to assessment are given under evidence requirements and assessment guidelines of the SQA Advanced Unit specification: statement of standards section. It is recommended that this section is read carefully before proceeding with assessment of learners.

Guidance on approaches to assessment of this unit

Written and/or oral 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.

Assessment should be carried out in supervised conditions. Each outcome could be assessed separately in a paper which lasts no more than one hour. However, the assessment could take place as one assessment event which combines all outcomes. Each outcome could comprise of four questions or assignments taken on a sample basis as laid out in the evidence requirements for each outcome.

Assessment Guidelines

Outcome 1

Outcome 1 could comprise of four calculation questions taken on a sample basis as laid out in the evidence requirements for each outcome.

Outcome 2

Outcome 2 could comprise of four problem solving questions taken on a sample basis as laid out in the evidence requirements for each outcome. Questions could be given as calculation or workshop tasks, and can be assessed as written exam or report.

Outcome 3

Outcome 3 could comprise of four questions which are a combination of sketching, diagrams drawing and labelling and explanation taken on a sample basis as laid out in the evidence requirements for each outcome.

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

In all outcomes each of the assessments require the learner to be able to solve problems. This will give the learner the opportunity to develop the component Using Number of the Core Skill Numeracy at SCQF level 6. The specific core skill elements that the learner will have to complete are 'Decide on the steps and operations to be carried out to solve a complex problem' and 'Carry out a number of sustained, complex calculations'.

In completing each outcome learners may have the opportunity to develop the component Problem Solving and Working with Others at SCQF level 6. In Outcome 2 learners will have the opportunity to simulate problems using laboratory work and develop a strategy. The specific core skill elements that the learner may have to complete are 'Develop a plan' for stability of a vessel.

In Outcome 3 learners will explain basic elements of ship construction. This will allow learners to develop the component 'Written Communications' of the Core Skill Communication at SCQF level 6. Learners will develop the specific elements 'Present all essential ideas/information and supporting detail in a logical and effective order' and 'Use conventions which are effective in achieving the purpose of the piece and adapted as necessary for the target audience'.

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.

History of changes to unit

Version	Description of change	Date

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: Stability and Structure of Merchant Ships (SCQF level 7)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This unit has been designed to allow you to develop knowledge, skills and understanding in Naval Architectural and Ship Construction principles and concepts as used in Marine Engineering and it will provide the underpinning knowledge in naval architecture for those learners who wish to achieve EOOW certification. Knowledge and skills will include calculation of the centre of gravity of the merchant ship and stability calculations involved to enable safe loading and unloading. You will learn basic ship's terminology and get the essential understanding of ship's structure.

The unit may consist of three assessment papers lasting no more than one hour per paper. However, the assessment could take place as one assessment event which combines all outcomes. 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 and formula sheets for first two outcomes. You may sit assessment papers at the end of each outcome.

This unit will enable you to:

1 apply the principles of hydrostatics to solve problems relating to merchant navy vessels
2 determine small angle stability including free surface effect on typical merchant navy vessel
3 analyse basic ship construction of standard merchant ship types

There are opportunities to develop the core skills of Numeracy, Communication, Problem Solving and Working with Others at SCQF level 6 in this unit. In all outcomes each of the assessments require the learner to be able to solve problems.

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.