



National Unit Specification: general information

UNIT Ship Construction and Stability: An Introduction (SCQF level 6)

CODE F7HC 12

SUMMARY

This Unit is suitable for candidates who aspire to a career in the Merchant Navy or in associated seagoing marine related occupations. This Unit has been designed to provide the candidates with an understanding and knowledge of the principles of a ship's transverse stability and the practical applications of these principles, and to acquire a basic knowledge of ship types, their uses, general construction details and methods of retaining the watertight integrity of the ship. Whilst the Unit is primarily intended for those who intend to seek employment in the Merchant Navy, it could be studied by someone with an interest in the subject area.

OUTCOMES

- 1 Demonstrate understanding of the basic principles of Hydrostatics.
- 2 Demonstrate understanding of statical stability.
- 3 Describe the significant features of a ship's structure.
- 4 Describe the General Structural Arrangements of a range of common ship types.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained the following:

- ◆ Standard grade in Mathematics and Physics at General/Credit level

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**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.*

Administrative Information

Superclass: ZF

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National Unit Specification: general information (cont)

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CORE SKILLS

There are opportunities to develop the following Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Numeracy: Using Number at SCQF level 5

Numeracy: Using Graphical Information at SCQF level 5

Problem Solving: Critical Thinking at SCQF level 5

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.

OUTCOME 1

Demonstrate an understanding of the basic principles of Hydrostatics.

Performance Criteria

- (a) Explains correctly the terms, light and load displacement, volume of displacement and buoyancy.
- (b) Demonstrates an understanding of Archimedes Principle, Mass, volume, density and relative density.
- (c) Explains correctly the terminology relating to the main dimensions of a vessel.
- (d) Explains correctly the function of Loadlines, and sketch their layout.

OUTCOME 2

Demonstrate an understanding of the principles of statical stability.

Performance Criteria

- (a) Describes accurately the terms Centre of Buoyancy, Centre of Gravity, Initial Transverse Metacentre, Righting Lever, Righting Moment.
- (b) Explains correctly the terms Stable, Neutral and Unstable equilibrium at small angles of heel.
- (c) Demonstrates an understanding of the concept of Metacentric Height and stiff and tender vessels.

OUTCOME 3

Describe the significant features of a ship's structure.

Performance Criteria

- (a) Explains correctly the standard terminology pertaining to ship construction.
- (b) Describe Longitudinal, Transverse and Combination framing systems.
- (c) Describe the main structural features of merchant vessels.

OUTCOME 4

Describe the General Structural Arrangements of a range of common ship types.

Performance Criteria

- (a) Describe the main features of Tankers.
- (b) Describe the main features of Cargo ships.
- (c) Describe the main features of Passenger Ships.
- (d) Describe the main features of Support vessels.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that the candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence is required to demonstrate that the candidate has achieved this Unit to the standard specified in the Outcomes and Performance Criteria. The evidence for this Unit should be obtained under controlled, supervised conditions. Assessment will be closed book and may be a single assessment event lasting no more than 2 hours, or two separate assessments each lasting no more than 1 hour, one on stability and one on construction. Candidates will be permitted to take standard formulae sheets, approved by the UK Maritime and Coastguard Agency (MCA) and non programmable scientific calculators into the assessment.

Appropriate instruments of assessment for this Unit would be question papers comprising of a balance of short answer, restricted response questions, calculations and sketches.

The evidence should be knowledge based with the candidate demonstrating that they can:

Outcomes 1 and 2

- ◆ Explain correctly the main principles of Hydrostatics; including the Law of Flotation and Archimedes Principle
- ◆ Recognise and define terms associated with vessels such as Displacement, Volume of Displacement, Buoyancy, Density, Relative Density, Reserve Buoyancy, Length overall (LOA) Length between perpendiculars (LBP), Waterline Length, Moulded Breadth, Moulded depth, Camber, Sheer, Flare, Rise of Floor, Rake, Beam, Draught, Freeboard.
- ◆ Demonstrate the use of the co-efficients C_b and C_w in simple calculations.
- ◆ Explain the reasons for Loadlines, and Sketch Loadline marks, their dimensions and spacing.
- ◆ Identify the Centre of Buoyancy (B), Centre of Gravity (G), Initial Transverse Metacentre (M), Righting Lever (GZ) and Metacentric Height (GM) on a sketch, and show the forces acting through them.
- ◆ Describe the relationship between GM and Stiff and Tender Ships.
- ◆ Explain Stable, Neutral and Unstable equilibrium with simple sketches.

Outcomes 3 and 4

- ◆ Describe the role and functions, and sketch the general layout, of a sample of common ship types.
- ◆ Describe the main features of Longitudinal, transverse and combination framing systems using a sketch of a transverse section.
- ◆ Identify the major structural components of merchant vessels.
- ◆ Describe the main structural features of Tankers, Cargo, Passenger and support Vessels.

National Unit Specification: support notes

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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 has been developed as a core Unit in the National Certificate in Shipping and Maritime Operations. This Unit is intended to introduce the candidate to the basic principles of Ship Stability, and to the design features and construction of a range of common ship types. It is intended for delivery to new entrants to the Merchant Navy; however it can also be taken as a free standing Unit.

Successful completion will give access to further study at HN level, where the concepts studied will underpin further development of knowledge in Units, FOLF 34, Naval Architecture, Ship Construction, and FOLD 34, Ship Stability, An Introduction.

Outcome 1 introduces the candidate to the main principles of hydrostatics; Archimedes Principle and Laws of flotation, and to the use of simple hydrostatic data and data sheets. Significant terms such as displacement, buoyancy, density, and reserve buoyancy should be defined. Candidate should recognise the terms Waterline length, Breadth, Draught, Freeboard, Coefficients C_b , C_w , and show the ability to relate these to Box Shaped and Ship shaped Vessels. The effects of density, Fresh Water Allowance (FWA) and Dock Water Allowance (DWA), and the changes in draught due to changes in density should be demonstrated by simple calculation on Box and Ship Shaped Vessels. It also explains the reasons for Loadlines on vessels, and requires the candidate to reproduce the layout and dimensions of common Loadlines markings on a vessel.

Outcome 2 requires the candidate to understand the terms Centre of Buoyancy (B), Centre of Gravity (G), Initial Transverse Metacentre (M), Righting Lever (GZ), Forces affecting the vessel (gravity and buoyancy), and to produce sketches clearly labelled showing these, and their relationship. Candidates should have an understanding of the three stages of equilibrium; Stable, Neutral and Unstable, at small angles of heel, and be able to explain them with the aid of sketches. The candidate should understand the relationship between Metacentric height (GM) and stability, and be able to recognise its significance with respect to Stiff and Tender ships.

Candidates should understand how G moves when weights are added, removed or shifted onboard, including being suspended from above.

Outcome 3 requires the candidates to identify terms associated with vessels such as Displacement, Volume of Displacement, Buoyancy, Density, Relative Density, Reserve Buoyancy, Length overall (LOA) Length between perpendiculars (LBP), Waterline Length, Moulded Breadth, Moulded depth, Camber, Sheer, Flare, Rise of Floor, Rake, Beam, Draught, Freeboard.; and explain their purpose where appropriate.

Candidates are required to identify with the aid of sketches, the main construction features such as hatchways and coamings, hatch covers, weathertight and watertight doors, side shell doors, bow and stern doors, watertight bulkheads, liquid cargo tanks, cargo holds, double bottom and peak tanks, including longitudinal, transverse and combination framing where appropriate.

National Unit Specification: support notes (cont)

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Outcome 4 requires the candidates to understand the role, function and general layout of common ship types, including Tankers, cargo ships, passenger ships, and support vessels, and to be able to sketch simple side elevations of them, including accommodation, cargo and machinery spaces, cargo gear, and peak tanks.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is important that the delivery of this Unit is related to common practice in the marine industry. Where candidates have no prior seagoing experience, it would be useful if they could be taken on ship visits, shown relevant video programmes, and exposed to some of the concepts discussed in a practical manner, such as the use of models to show the effects of weight transfer on stability. The main aim of this Unit should be to give the candidates a sound grounding in basic ship construction and stability which will be of use in the work place, and which will provide a firm foundation for further study in the area should they move on to higher maritime qualifications, such as the HNC/HND in Nautical Studies.

Active learning and teaching approaches should be used wherever possible, and the teaching should be used largely to stimulate discussion, with candidates being encouraged to work in small groups and to contribute to the lesson actively. The importance of safety should be emphasised at every opportunity.

Outcome 1

Emphasis should be on main principles of Hydrostatics and applied in the first instance to box shaped vessels, including Archimedes principle, and the law of flotation. Light and load Displacement, Buoyancy, Density, and Reserve Buoyancy should be discussed and definitions given of Waterline Length, Breadth, Draught and Freeboard. Simple calculations using Length, Breadth and Draught on box shaped vessels for different densities should be carried out to show the relationship between weight and volume at different densities, and to reinforce the simple formula displacement = volume x density. The definition of C_b , C_w should be given, as they apply to ship shapes, and their use demonstrated in simple calculations to find the displacement of ship shape vessels.

The development of formulae for Tonnes Per Centimeter (TPC), and FWA should be shown and how Dock Water Allowance is calculated from the FWA. Candidates should be introduced to simple hydrostatic tables, and practice extracting information from them, and using it in calculations to find cargo to load or discharge, final draught or freeboard. We should discuss the reasons for the allocation of freeboard and Loadlines, and introduce candidates to the dimensions and spacing of loadline marks commonly allocated to vessels.

Outcome 2

The transverse centres of Buoyancy and Gravity and their relationship with initial transverse metacentre should be described using diagrams. This should be clearly understood before progressing to the next stage which is Statical Stability. How the righting lever (GZ) is formed should be shown, and the forces acting through G and B should be explained. Stable, Neutral and Unstable equilibrium at small angles should be discussed with the aid of sketches. In this same context the metacentric height (GM) and its effect on stability should be introduced and linked to the terms Stiff and Tender ships, with diagrams to show the metacentric height (GM) in each case. Changes in the position of the Centre of Gravity (G) due to moving, adding or discharging a weight will be introduced next, with an explanation of how G moves in each case.

National Unit Specification: support notes (cont)

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Outcome 3

Common terms used in ship construction, such as Displacement, Volume of Displacement, Buoyancy, Density, Relative Density, Reserve Buoyancy, Length overall (LOA) Length between perpendiculars (LBP), Waterline Length, Moulded Breadth, Moulded depth, Camber, Sheer, Flare, Rise of Floor, Rake, Beam, Draught, and Freeboard should be introduced with the aid of sketches, diagrams and videos, and explanations given of the function and importance of each item. Next, we should introduce the main construction features of hatchways and coamings, hatch covers, weathertight and watertight doors, side shell doors, bow and stern doors, watertight bulkheads, liquid cargo tanks, cargo holds, double bottom and peak tanks, including longitudinal, transverse and combination framing where appropriate, and explain the reasons for the methods and construction shown.

Outcome 4

The main features of a variety of common ship types should be described to the candidates, with the aid of diagrams and videos. We should discuss the roles of the ships described, and explain how they have developed to meet the needs of that role, and the special features which make them suitable for that role. Candidates should sketch a profile of each type of vessel, label all the relevant spaces, and identify the reasons for their special features. This may be an ideal opportunity to split the class into smaller groups and give each group a particular class or type of vessel to research, and then describe to the other groups as a class activity. Visits to different types of ships would also be very valuable if they were available. Outcome 4 could be delivered in conjunction with Outcome 3 of the Unit 'Shipboard Operations: An Introduction' (F7HB 12) to prevent duplication of information and deliver the knowledge holistically.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

There are opportunities to develop the following Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Numeracy: Using Number at SCQF level 5

Numeracy: Using Graphical Information at SCQF level 5

In Outcome 1 candidates will be required to use hydro static data and terminology to perform calculations regarding the displacement and underwater volume of a box shaped vessel. They will also have to interpret the loadline and draught marks found on vessels.

Problem Solving: Critical Thinking at SCQF level 5

In Outcome 2 candidates will be expected to determine from sketches whether a vessel is in a stable, unstable or neutral state, dependant of the relative positions of the vessels centre of gravity, centre of buoyancy and the initial transverse metacentre.

National Unit Specification: support notes (cont)

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GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of 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 Communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Assessment for this Unit should be by a single assessment event lasting no more than 2 hours, or two separate assessments each lasting no more than 1 hour, comprising a mix of short answer questions, restricted response questions, calculations and sketches, designed to sample the candidate's knowledge of all four learning Outcomes, and may also include pre-printed diagrams of structural features or side elevations of vessels, where the candidate has to name identified structural features. Part of the assessment could be provided in an electronic format such as Blackboard, but should always include the candidates completing calculations and drawing at least one sketch manually.

Centres involved in the delivery of this Unit may wish to collaborate to produce a bank of questions or papers to be used, or to produce an assessment support pack for this Unit, with sample assessment materials of a suitable standard.

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.

History of changes:

Version	Description of change	Date
02	Amendments made to clarify assessment and Guidance on Learning and Teaching Approaches in Support Notes	23/08/2010