Higher National Unit Specification

General information for centres

Unit title: Celestial Navigation

Unit code: F0LS 35

Unit purpose: This Unit will introduce the candidate to the marine sextant and chronometer and will explain the correct procedures to obtain the time of observation and the observed altitude of celestial bodies. It will also introduce the concept of celestial navigation and enable the candidate to calculate the true bearing of any celestial object plus obtain a position line from a single observation of a celestial object. Finally it will introduce the procedure for determining the vessel's position at sea from two or more observations of celestial objects. The contents and use of the Nautical Almanac will also be examined.

It is primarily aimed at candidates intending to seek sea-going employment as a Merchant Navy Deck Officer. However it could also be studied by someone with an interest in the subject area.

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

1 Use instruments and apply corrections to obtain Observed Altitude and Universal Coordinated Time (UTC).
2 Calculate, from observations of celestial bodies, the error of the compass.
3 Calculate, from observations of celestial bodies, the direction of a position line and a point through which it passes.
4 Determine the vessel's position from simultaneous celestial observations.

Credit points and level: 1.5 HN Credits at SCQF level 8: (12 SCQF credit points at SCQF level 8*)

**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: Access to this Unit is at the discretion of the centre. However it would be beneficial if candidates had achieved the competence required in the following HN Units F0LV 34 *Chartwork and Tides* and F0M0 34 *Navigational Mathematics and Science.* In addition, it is recommended that candidates have a good grounding in spherical trigonometry before undertaking the Unit by successfully completing the *Marine Induction Course* associated with the HNC/D Nautical Science.

General information for centres (cont)

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.

Communication: Written at	SCQF level 5
Communication: Reading at	SCQF level 5
Communication: Oral at	SCQF level 6
Numeracy: Using Number at	SCQF level 6
Numeracy: Using Graphical Information at	SCQF level 6
Using Information Technology at	SCQF level 6
Problem Solving: Critical Thinking at	SCQF level 6

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.

Assessment: Outcome 1 will be assessed by a closed-book assessment under supervised conditions. Outcomes 2, 3 and 4 can be combined for assessment purposes and assessed by an open-book assessment under supervised conditions.

For Outcome 1 candidates should have access to a Marine sextant and a marine chronometer.
For Outcomes 2, 3 and 4 candidates must be supplied with the MCA extracts for the Nautical Almanac.

Higher National Unit specification: statement of standards

Unit title: Celestial Navigation

Unit code: F0LS 35

The sections of the Unit stating the Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

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. Candidates 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

Use instruments and apply corrections to obtain Observed Altitude and Universal Coordinated Time (UTC)

Knowledge and/or skills

- The marine sextant
- Sextant errors
- The marine chronometer
- Chronometer errors
- Universal Coordinated Time (UTC)
- Time systems
- Nautical Almanac

Evidence Requirements

All knowledge and skills are assessed. However there is sampling **within** each of the knowledge and skills.

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

(a) Identify the parts of a marine sextant.

Candidates must be able to identify the following:

- Index arm
- Index Mirror
- Horizon Mirror
- Sextant Arc
- Vernier/Micrometer Scale
- Adjustment screws

(b) Describe the causes of errors in a marine sextant and their correction.

Candidates should be able to describe the three correctable errors and how these are corrected plus all six non correctable errors.

(c) Measure angles using a sextant.

(d) Explain the use and care of a marine chronometer.

(e) Determine the correct UTC from knowledge of the Chronometer error.

(f) Use UTC and longitude to determine Local Mean Time (LMT) and Zone Time (ZT) and use the Nautical Almanac to determine Standard Time (ST).

Candidates may be either given UTC and asked to find each of the above or vice versa.

Assessment guidelines

Outcome 1 may be assessed by the candidate demonstrating to the assessor the parts of a marine sextant and also describing the causes and methods of correcting the instrumental errors of the sextant. The candidate should also demonstrate that they can measure angles with the sextant and read the instrument both on and off the arc.

It may be appropriate for elements e) and f) above to be assessed within the context of Outcomes 2, 3 and 4. Assessment for Outcome 1, should take place under closed-book conditions.

Outcome 2

Calculate, from observations of celestial bodies, the error of the compass

Knowledge and/or skills

- The Nautical Almanac
- Time Systems
- Greenwich Hour Angle (GHA)
- Local Hour Angle (LHA)
- Declination (Dec)
- Azimuth Calculations
- Polaris Tables
- Amplitude Calculations

Evidence Requirements

All knowledge and skills are assessed. However there is sampling **within** each of the knowledge and skills.

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

Higher National Unit specification: statement of standards (cont)

Unit title: Celestial Navigation

(a) Describe briefly, the contents and use of the Nautical Almanac.

(b) Given the vessel's position and the UTC determine the GHA, LHA and Dec of any celestial body.

(c) Using a method acceptable to the UK Maritime and Coastguard Agency, determine the Azimuth and hence true bearing of any celestial object at any time.

In (c) above candidates must produce evidence from a sample of two of the following:

- Venus
- Mars
- Jupiter/Saturn
- Sun or any star

A different sample should be used on each assessment occasion.

(d) Use the Polaris Tables in the Nautical Almanac to determine the true bearing of Polaris at any time.

(e) Using the Amplitude formula, determine the true bearing of the sun when rising or setting. Candidates should also comment on the accuracy of the calculation.

(f) In each of (c), (d) or (e) above compare the true bearing of the celestial body with the observed magnetic and gyrocompass bearing and hence determine the error of the compass.

Assessment guidelines

Outcome 2 may be assessed by means of an open-book assessment under supervised conditions, consisting of structured questions relating to the calculation of the true bearing of a celestial object and comparing this with an observed bearing to determine the error of the compass. The relevant MCA extracts for the Nautical Almanac and MCA formulae sheet will be supplied to the candidate. Elements of Outcomes 1, 3 and 4 may be combined with Outcome 2 for assessment purposes. Acceptable methods of solution for c) above could include the following:

- Azimuth tables using the ABC method
- Calculation of azimuth using spherical trigonometrical formulae
- Use of short method sight reduction tables

Higher National Unit specification: statement of standards (cont)

Unit title: Celestial Navigation

Outcome 3

Calculate, from observations of celestial bodies, the direction of a position line and a point through which it passes

Knowledge and/or skills

- Correction of sextant altitude to true altitude
- Relationship between position circles and position lines
- Latitude by Meridian Altitude
- Latitude by Polaris
- Marc St. Hilaire method of sight reduction
- Alternative methods of sight reduction

Evidence Requirements

All knowledge and skills are assessed. However there is sampling **within** each of the knowledge and skills.

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

(a) Determine the true altitude of any celestial object from a sample of two of the following:

- Sun
- Star or planet

(b) Describe the relationship between true altitude and a position circle or position line.

(c) Calculate the observed latitude from an observation of a heavenly body on the observers meridian from a sample of one of the following:

- Sun
- Star or planet

(d) Calculate the direction of the position line and a point through which it passes from a sample of one of the following:

- Sun
- Star or planet

The Marc St Hilaire method of sight reduction or other method acceptable to the UK Maritime and Coastguard Agency may be used in the above calculation.

(e) Calculate the direction of the position line and a point through which it passes from an observation of Polaris.

In (c) and (d) above the object chosen for (c) must be different from that chosen in (d).

In each calculation only the following information should be given to the candidate:

- The date at the ship
- Approximate time at the vessel, or in the case of a star sight, whether it is AM or PM twilight
- The chronometer reading (12 hr format) and the chronometer error
- The Dead Reckoning (DR) or Estimated (EP) position of the vessel
- The sextant altitude of the object.
- The index error of the sextant

A different sample should be used on each assessment occasion.

Assessment guidelines

Outcome 3 may be assessed by means of an open-book assessment under supervised conditions consisting of structured questions covering the topic of sight reduction methods. The relevant MCA extracts for the Nautical Almanac and MCA formulae sheet will be supplied to the candidate. Elements of Outcomes 1, 2 and 4 may be combined with Outcome 3 for assessment purposes.

Outcome 4

Determine the vessel's position from simultaneous celestial observations

Knowledge and/or skills

- Position Line plotting
- Plan celestial observations at twilight
- Nautical Publication (NP) 323 (Selected Stars)
- Star Identifiers

Evidence Requirements

All knowledge and skills are assessed. However there is sampling **within** each of the knowledge and skills.

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

(a) Determine the position of the vessel, at a given time, by plotting at least two position lines on graph paper or an appropriate plotting sheet.

In producing evidence for (a) **one** of the following situations should be sampled:

(i) two sights with a run in between
(ii) two simultaneous sights
(iii) three or more stars involving transferring two or more position lines

(b) Select suitable stars for observation at evening/morning twilight.

Higher National Unit specification: statement of standards (cont)

Unit title: Celestial Navigation

Candidates will be required to produce evidence that they are able to use Nautical Publication (NP) 323 (Selected Stars) to obtain the approximate altitude and true bearing of stars available for observation and select, giving reasons for their choice, those most suitable for either a three star **or** a four star fix.

Candidates should also produce evidence that they can use either information contained in the Nautical Almanac **or** a proprietary star identifier to identify objects suitable for observation.

A different sample should be used on each assessment occasion.

Assessment guidelines

Outcome 4 may be assessed by means of an open-book assessment under supervised conditions. For assessment purposes Outcome 4 may be combined with elements of Outcomes 1, 2 and 3.

Every opportunity should be taken to link the provision of evidence to the real life activities that are performed onboard ship.

Opportunities exist to allow candidates to demonstrate an holistic knowledge of the subject area by combining Outcomes in a single assessment, however care should be taken when devising assessments so that a mistake in one element will still allow the candidate to obtain a meaningful solution.

Administrative Information

Unit code: F0LS 35

Unit title: Celestial Navigation

Superclass category: RE

Original date of publication: August 2006

Version: 01

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: Celestial Navigation

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 60 hours.

Guidance on the content and context for this Unit

The content of this Unit forms part of the underpinning knowledge for the level 3 SVQ *Marine Vessel Operations* and reflects the content of International Maritime Organisation's *Standards of Training Certification and Watchkeeping (STCW).*

Guidance on the delivery and assessment of this Unit

This Unit is designed to introduce candidates to the main concepts of celestial navigation and the use of celestial navigation for checking the accuracy of the ship's compass and for fixing the ship's position, both as a check on the accuracy of the electronic navigation aids or as a primary means of navigation where the navigation aids have failed.

This Unit forms part of the underpinning knowledge requirements for a Certificate of Competence in the Merchant Navy as Officer of the Watch Unlimited (STCW '95 II/1), and reflects the content of the International Maritime Organisation's STCW '95 requirements for that role.

Candidates will be introduced to the main publications and sources of information used for celestial navigation such as the Nautical Almanac, Nories (or other) Nautical Tables, Short method tables, tools to assist in deciding which bodies to use for position fixing, and charts and plotting sheets used to determine the ship's position from the position lines obtained.

Outcome 1 Introduces the candidates to the sextant and chronometer and explains what they are, their role in celestial navigation, then shows the candidates how to read and use the Sextant and Chronometer, check their accuracy, correct or apply any errors found, and use the information they provide.

Outcome 2 seeks to show the candidates how to use the information from nautical equipment and publications to determine the error of the ship's compass, and apply that error. The candidate is introduced to the nautical almanac and the information that it contains, and how to use that information to complete calculations involving the true bearings of celestial bodies.

Outcome 3 develops the use of information from publications and celestial bodies and applies it to more complex calculations, involving spherical trigonometery and the theory of altitude correction from which the candidate will be able to produce a position line and identify a point through which it passes — it includes the use of a variety of celestial bodies including the Sun, Stars and planets.

Outcome 4 instructs the candidate on how to use the information calculated in Outcome 3 to identify the position of the ship, and how to determine which celestial bodies to use in order to get the most accurate and reliable position lines. It introduces the candidate to a number of different publications used to assist in the identification of which bodies to use, and their approximate location at the time of observation.

Higher National Unit specification: support notes (cont)

Unit title: Celestial Navigation

Opportunities for developing Core Skills

The Unit provides candidates with the opportunity to develop the Core Skills of:

Communication: Writing, Reading at SCQF level 5. Candidates will develop the use of both by having to read and extract information in the Nautical Almanac and Nautical tables and then present this information in a clear and concise format in a written assessment. The Core Skill of Communication: Oral at SCQF level 6 can be developed through the candidate having to demonstrate and explain the causes of errors in the marine sextant and their correction. Candidates will have to use the correct nautical terminology and their explanation will need to be clear and concise when carrying out the correction procedure.

Numeracy: Using Number and Using Graphical Information at SCQF level 6 may be developed by the candidate performing complex calculations with many interdependent steps and using spherical trigonometry plus using tabular information when carrying out interpolation. Candidates will have to be able to interpret information presented in graphical format from the Nautical Almanac as well has having to portray results obtained in calculations in graphical format.

Problem Solving: Critical Thinking at SCQF level 6 may be developed by the candidate having to determine the correct approach to solving a navigational problem from a minimum amount of information presented to them. They will have to consider the order in which operations need to be carried out in order to arrive at the correct solution and also how to portray the information in the format required.

Open learning

The preferred method of delivery is by attendance at college as the majority of candidates following this Unit will be on a training programme comprising alternating periods at college and at sea, the sea periods being utilised to put into practice the knowledge and skills acquired.

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs,* which is available on SQA's website: **www.sqa.org.uk**.

General information for candidates

Unit title: Celestial Navigation

In this Unit you will learn about the practice of using observations of celestial bodies to identify your position and check for compass errors; it includes using a sextant to measure the altitude of celestial bodies, and the chronometer to obtain the time of such observations. The Unit is an integral part of your study and training for employment as a Merchant Navy Deck officer, and you will have opportunities to put the content of this Unit into practice during your sea phases.

The Unit is split into four main areas, each of which is a separate Outcome.

- In the first Outcome, you will study the use of a Marine Sextant and Chronometer, and how to identify and apply relevant corrections to obtain Observed Altitude and Universal Coordinated Time (UTC.)
- In Outcome 2 you will be shown how to calculate the error of the compass from observations of celestial bodies.
- In Outcome 3 you will be shown how to calculate the direction of a position line, and a point through which it passes, from observations of celestial bodies.
- In Outcome 4 you will be shown how to determine the ship's position from the celestial observations in Outcomes 2 and 3.

To successfully complete this Unit, you will need to achieve a satisfactory level of performance in each assessment. Outcome 1 will be assessed by practical demonstration, supplemented with specific questions to ensure that all the subject areas are covered. Outcomes 2, 3 and 4 may be assessed together or separately, by supervised assessments using calculations, for which you will have access to a formula sheet and relevant nautical publications and charts.

Wherever possible the concepts that you encounter in this Unit will be related to the actual practice that you are likely to encounter on board the ship. This should reinforce the practical exercises you will already have carried out in your navigational workbook.