



Higher National Unit specification: general information

Unit title: Marine Navigation Systems

Unit code: H1FC 35

Superclass: ZF

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Unit purpose

The purpose of this Unit is to provide the candidate with an opportunity to investigate and gain an understanding of the underpinning principles of operation of radar and automatic radar plotting aids (ARPA), position fixing systems, speed and distance measurement, navigational echo-sounders, marine compasses and automatic steering systems. This Unit would be suited for candidates who want to qualify as an Electro-Technical Officer at sea or those with an interest in Marine electronic Navigational Aids and their use and maintenance. The candidate will develop an understanding of the functions of the systems and sub-systems that constitute each piece of marine navigation equipment and will be able to identify and explain the components in each of the systems.

Outcomes

- 1 Analyse marine radar and automatic radar plotting systems.
- 2 Analyse terrestrial and satellite position fixing and transponder systems.
- 3 Explain ship speed and distance measuring systems and echo sounding systems.
- 4 Assess automatic steering systems.
- 5 Explain marine compass and repeater systems.

Recommended prior knowledge and skills

It would be an advantage if candidates had a knowledge and understanding of electrical and electronic theory. This can be evidenced by possession of the following SQA Units: *DC and AC Principles* (FY9E 34), *Power Electronics* (FY9R 34), *Marine Engineering: Electrical and Electronic Devices* (F90W 34). Candidates should also have a minimum of a level 7 mathematics such as *Mathematics for Engineering 2* (DG4L 34) or equivalent.

General information (cont)

Credit points and level

2 Higher National Units credits at SCQF level 8: (16 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.*

Core Skills

There are opportunities to develop the Core Skill: *Working with Others* at SCQF level 6 and the Core Skills components: *Critical Thinking* at SCQF level 6; *Reviewing and Evaluating* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

Higher National Unit specification: statement of standards

Unit title: Marine Navigation Systems

Unit code: H1FC 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

Analyse marine radar and automatic radar plotting systems.

Knowledge and/or Skills

- ◆ Calculate and explain the factors affecting minimum range, range discrimination, bearing discrimination, scanner speed.
- ◆ Calculate and explain the correlation between scanner speed, Pulse Repetition Frequency (PRF), Horizontal Bandwidth (HBW).
- ◆ Modes of presentation.
- ◆ Radar/ARPA systems.
- ◆ Target acquisition and tracking.
- ◆ System Interfacing requirements.

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 1 should 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 answer correctly questions based on a sample of the knowledge and skills items listed in the Outcome. In any assessment of this Outcome, **three out of six** 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 out of six Knowledge and/or Skills items are required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

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:

- ◆ Calculate minimum range, range discrimination, bearing discrimination, scanner speed.
- ◆ Uses the correlation between scanner speed, HBW, PRF to calculate these values for a given system.
- ◆ Describes two different modes of radar display presentation.
- ◆ Analyse the operation of a marine Radar/ARPA system using a block diagram approach, explaining the function of each block.
- ◆ Explain target acquisition and tracking in ARPA.
- ◆ Discusses the interface requirements with other key navigational equipment.

Where calculations are performed the candidate must:

- ◆ Apply appropriate formulae
- ◆ Apply the principles of the calculation
- ◆ Show all working through a calculation
- ◆ Provide reasonable answers to the questions asked. The answer should derive from the application of the formula and correct application of the principles of the calculation.

The Evidence Requirements state that candidates must ensure answers are derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where the candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

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, although standard formulae may be given. Candidates will be permitted to use scientific calculators during the assessment.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

Outcome 2

Analyse terrestrial and satellite position fixing and transponder systems.

Knowledge and/or Skills

- ◆ Principles of a Global Position System (GPS).
- ◆ Operation of GPS.
- ◆ Operation of GPS receivers.
- ◆ Principles of operation of the eLoran system.
- ◆ Operation of the eLoran system.
- ◆ Principles of operation of Automatic Identification Systems (AIS).
- ◆ AIS data transmission.
- ◆ Interfacing of AIS and GPS.

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 2 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, **four out of eight** 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 four from eight 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 the principles of a GPS, trilateration, Pseudo random code, errors.
- ◆ Describe a GPS using block diagram and associated signals.
- ◆ Describe a GPS receiver using a block diagram, explaining the operation of each component part.
- ◆ Explain the principle of operation of the eLoran system.
- ◆ Describe the operation of an eLoran system using a block diagram, explaining the function of the component parts.
- ◆ Explain the operation of AIS when used in a vessel traffic system (VTS) and vessel traffic management information system (VTMIS).
- ◆ Describe AIS data transmissions explaining static and dynamic data.
- ◆ Describe the interfacing of GPS, AIS and other essential navigation aids.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

Where calculations are performed the candidate must:

- ◆ Apply appropriate formulae.
- ◆ Apply the principles of the calculation.
- ◆ Show all working through a calculation.
- ◆ Provide reasonable answers to the questions asked. The answer should derive from the application of the formula and correct application of the principles of the calculation.

The Evidence Requirements state that candidates must ensure answers are derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where the candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

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.

Outcome 3

Explain ship speed and distance measuring systems and echo sounding systems.

Knowledge and/or Skills

- ◆ Factors affecting the speed of sound in seawater.
- ◆ Losses affecting sound propagation through sea water.
- ◆ Absolute and relative speed.
- ◆ Construction and use of electrostrictive transducers for speed and distance measurement.
- ◆ Doppler shift measurement compensation for trim and pitch.
- ◆ Compensation methods for change in salinity and temperature of sea water.
- ◆ Ship speed measurement system, electromagnetic log.
- ◆ Marine echo sounding system.
- ◆ The principles of echo sounding systems.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

Evidence Requirements

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

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, **five out of nine** 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 five from nine 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:

- ◆ Calculate the speed of sound in sea water for different temperature and density.
- ◆ Explain the losses of spreading, attenuation and volume reverberation, describing their affect.
- ◆ Calculate absolute and relative speed.
- ◆ Describe and explain the use and operation of electrostrictive transducers for speed and distance measurement.
- ◆ Calculate vessel speed for a given trim and pitch.
- ◆ Calculate the angle of transmission required for change in density and temperature of sea water and compensate for fresh water.
- ◆ Describe ship's speed measurement system using electromagnetic log.
- ◆ Use a block diagram approach to explain the operation of a ship speed measurement system describing the function of the various component parts.
- ◆ Explain the principles of operation, use and installation of echo sounding systems, calculating the depth of water under the hull.

Where calculations are performed the candidate must:

- ◆ Apply appropriate formulae
- ◆ Apply the principles of the calculation
- ◆ Show all working through a calculation
- ◆ Provide reasonable answers to the questions asked. The answer should derive from the application of the formula and correct application of the principles of the calculation.

The Evidence Requirements state that candidates must ensure answers are derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where the candidates' final answer may be inaccurate.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

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, although basic formulae may be given. Candidates will be permitted to use scientific calculators during the assessment.

Outcome 4

Assess automatic steering systems.

Knowledge and/or Skills

- ◆ Regulations governing automatic steering systems.
- ◆ Non follow up (NFU) and follow up (FU) control of electro-hydraulic steering gear.
- ◆ The components of a marine autopilot system.
- ◆ Application of three term control and the effect of control settings on autopilot.
- ◆ Integration of autopilot with other navigation systems.

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, **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:

- ◆ Explain the regulations governing automatic steering systems
- ◆ Describe follow up and non-follow up control systems, calculating the deviation signal.
- ◆ Analyse the operation of a typical marine auto pilot by use of a block diagram approach describing the function of the components.
- ◆ Analyse the effect of changing two control actions.
- ◆ Describe the interfacing of gyro compass and magnetic compass to the automatic steering system.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

Where calculations are performed the candidate must:

- ◆ Apply appropriate formulae.
- ◆ Apply the principles of the calculation.
- ◆ Show all working through a calculation.
- ◆ Provide reasonable answers to the questions asked. The answer should derive from the application of the formula and correct application of the principles of the calculation.

The Evidence Requirements state that candidates must ensure answers are derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where the candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

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.

Outcome 5

Explain marine compass and repeater systems.

Knowledge and/or skills

- ◆ Principles of operation of a magnetic compass.
- ◆ Construction and location of a marine magnetic compass.
- ◆ Principle of a free gyroscope.
- ◆ Construction of a marine gyro compass.
- ◆ Operation of a marine gyro compass.
- ◆ Compass repeater systems.

Evidence Requirements

Evidence for the Knowledge and/or Skills items in Outcome 5 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, **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.

Higher National Unit specification: statement of standards (cont)

Unit title: Marine Navigation Systems

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:

- ◆ Describe the operation of a magnetic compass, including errors.
- ◆ Explain the construction and location of a marine magnetic compass.
- ◆ Explain the principle of converting a free gyroscope into a marine compass, referencing Gyroscopic Inertia, Gravity Control and its result.
- ◆ Using a block diagram approach to describe a marine gyro compass system, explaining the function of the components
- ◆ Explain the applications of compass repeater systems, reference to Gyro follow-up and its implementation, use of a transmission system.
- ◆ describe the use and applications of compass repeater systems

Where calculations are performed the candidate must:

- ◆ Apply appropriate formulae.
- ◆ Apply the principles of the calculation.
- ◆ Show all working through a calculation.
- ◆ Provide reasonable answers to the questions asked. The answer should derive from the application of the formula and correct application of the principles of the calculation.

The Evidence Requirements state that candidates must ensure answers are derived 'from the application of the formulae and correct application of the principles of the calculation'. This allows for acknowledgement of the correct working and application of formulae, even where the candidates' final answer may be inaccurate.

The statement allows for the eventuality where a single error at one stage in an extended calculation sequence has a cumulative effect on the final answer, even though working/formulae are otherwise correctly applied. Acknowledgement of the correct working should be given in such cases.

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.

Higher National Unit specification: support notes

Unit title: Marine Navigation Systems

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 80 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow candidates to develop skills, knowledge and understanding of the principles of Marine Navigation Systems in the following areas:

- 1 Analyse marine radar and automatic radar plotting systems.
- 2 Analyse terrestrial and satellite position fixing and transponder systems.
- 3 Explain ship speed and distance measuring systems and echo sounding systems.
- 4 Assess automatic steering systems.
- 5 Explain marine compass and repeater systems.

In designing this Unit, the Unit writer has identified the range of topics expected to be covered by lecturers. The writer has also given recommendations as to how much time should be spent on each Outcome. This has been done to help lecturers decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning.

A list of topics is given below. Lecturers are advised to study this list so that they can get a clear indication of the standard of achievement expected of candidates in this Unit.

- 1 Analyse marine radar and automatic radar plotting systems. (20 hours)

System parameters: factors affecting maximum range, discrimination, hits per target (eg pulse length, pulse repetition frequency (PRF), horizontal beam width (HBW), vertical beam width (VBW), duty cycle, antenna speed); radar range equation.

Modes of presentation: information display modes used in marine radars, relative motion (eg Ship's Head Up, North Up, Course Up), true motion.

Radar/ARPA systems: principles of operation of radar and ARPA equipment systems and subsystems (eg transmitter, receiver, video retiming, video correlation, azimuth systems, raster scan, time base, range and bearing indicators, performance monitoring).

Target acquisition and tracking: principles of target acquisition and tracking, system interfacing requirements (eg interfacing of speed log, gyrocompass, global position system (GPS), synthetic video, operator controls, electronic chart display and information system (ECDIS)).

Higher National Unit specification: support notes (cont)

Unit title: Marine Navigation Systems

2 Analyse terrestrial and satellite position fixing and transponder systems. (20 hours)

Hyperbolic navigation systems: operating principles of the eLoran System: for example transmission signal format; eLoran system and its operation.

Satellite position fixing: operating principles of a global position system (GPS): eg overview of GPS satellite constellation, pseudo random noise (PRN) codes for satellite identification, system navigational almanac, spread spectrum modulation techniques, code and carrier frequency tracking such as, early-late, phase lock loop methods.

Automatic Identification Systems (AIS): principles of operation of AIS equipment: for example time division multiple access (TDMA), frequency shift keying (FSK), frequency allocation, regulations, potential errors); interfacing of AIS and GPS, operation of GPS receivers and AIS transponders.

3 Explain ship speed and distance measuring systems and echo sounding systems. (20 hours)

Propagation of sound in seawater: factors affecting the speed of sound in seawater: eg temperature, pressure and salinity; constant used for speed of sound in seawater for calibration purposes, transmission losses: eg spreading and absorption losses, 'volume reverberation' noise.

Ship speed and distance measurement: absolute and relative speed, principles of Doppler shift measurement, use of single and dual axis Janus arrays, operating principles of Doppler speed measurement systems, electrostrictive transducers: eg construction, relationships between size and frequency of operation, Maritime Coastguard Agency (MCA) guidelines on the location of transducers, safety precautions when working on installations such as MCA 'M' notices, cleaning of transducers); effects of change in sea water salinity and temperature on indicated reading and methods used to compensate, use of block diagram to explain principles of operation of marine electromagnetic logs.

Echo sounding systems: principles of echo sounding, eg relating speed and time to the measurement of depth, continuous wave (CW) and pulsed systems, choice of transmission frequency, pulse width, pulse repetition rate, peak pulse power); principles of operation of a typical marine echo sounding systems, transducers, eg magnetostrictive and electrostrictive, comparisons between the two types, reasons for choice, construction of transducers, relationships between size and frequency of operation, MCA guidelines for location of transducers, justification for use of two transducers, safety precautions to be considered when working on installations such as MCA guidelines, testing of transducers such as, insulation resistance testing, safety precautions, etc.

Higher National Unit specification: support notes (cont)

Unit title: Marine Navigation Systems

4 Assess automatic steering systems. (10 hours)

Regulations: rotational and translational movements and attitudes of vessel, regulations relating to main and auxiliary steering gear.

Electrohydraulic steering gear: action of electrohydraulic steering gear, rudder stock and rudder, non follow up (NFU) and follow up (FU) control actions, use of block diagrams to explain action of rudder control loop.

Marine autopilot system: operating principles, feedback systems, multi-loop control, application of three term control, effect of operator control settings on course keeping accuracy, integration with other navigation systems.

5 Explain marine compass and repeater systems. (10 hours)

Magnetic Compass: principles of magnetic compass, construction of maritime magnetic compass, safe operating distances, lubber line, location of compass (eg deviation, variation, compass adjustment).

Gyro compass: principle of free gyro, conversion to north seeking, damping in tilt, damping in azimuth, control and follow up systems, gyro errors, block diagrams of follow up system and transmission system.

Compass repeater systems: transmitting magnetic compass, synchros, stepper motors, optical systems.

Guidance on the delivery of this Unit

This Unit should be delivered by a combination of whole 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 context. In order that candidates achieve a firm understanding it is expected that centres delivering this Unit will have examples of actual modern electronic navigational equipment available for candidates to use and investigate. The Unit has been designed to incorporate sufficient time to allow lecturers to use the navigational equipment within their teaching.

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.

Guidance on the assessment of this Unit

Details on the approaches to assessment are given under the Assessment Guidelines section. It is recommended that this section is read carefully before proceeding with assessment of candidates.

Higher National Unit specification: support notes (cont)

Unit title: Marine Navigation Systems

Assessment Guidelines

Outcome 1

The assessment of this Outcome should be combined together with that for Outcomes 2 and 3 to form a single assessment paper, details of which are given under Outcome 5 of this section.

Outcome 2

The assessment of this Outcome should be combined together with that for Outcomes 1 and 3 to form a single assessment paper, details of which are given under Outcome 5 of this section.

Outcome 3

The assessment of this Outcome should be combined together with that for Outcomes 1, 2 and 3 to form a single assessment paper, details of which are given under Outcome 5 of this section.

Outcome 4

The assessment of this Outcome should be combined together with that for Outcome 5 to form a single assessment paper, details of which are given under Outcome 5 of this section.

Outcome 5

The assessment of this Outcome should be combined together with that for Outcome 4 to form a single assessment paper. This single assessment paper should be taken at a single assessment event lasting not more than two hours and 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.

The assessment for all five Outcomes should be combined into two assessment papers. Assessment paper one should combine learning Outcomes 1, 2 and 3; assessment paper two should combine learning Outcomes 4 and 5, each event lasting no more than two hours. Assessment should be conducted under controlled, supervised conditions.

If a candidate requires to be re-assessed, a different selection of questions must be used from all sections. A significant proportion of the questions used in the re-assessment must be different from those used in the original test.

Higher National Unit specification: support notes (cont)

Unit title: Marine Navigation Systems

Online and Distance Learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that the assessments are conducted under controlled, supervised conditions.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skill *Working with Others* at SCQF level 6. Throughout this Unit it is expected that candidates will carry out several investigations into the navigation systems within the laboratory. This would be completed as small groups working together.

The formative laboratory work and the formal assessments will give the opportunity to develop the Core Skills components: Critical Thinking at SCQF level 6; Reviewing and Evaluating at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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 to Unit

Version	Description of change	Date

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General information for candidates

Unit title: Marine Navigation Systems

This Unit has been designed to allow you to develop knowledge, skills and understanding in Marine Navigation Systems principles and concepts.

This Unit will also allow you the opportunity to develop the necessary practical and operating skills for working with and maintaining the navigational aids found on board modern merchant marine vessels. This equipment includes: global positioning systems and automatic identification systems (GPS and AIS); radars and automatic radar plotting aids (ARPA); compasses and automatic steering 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 context. Thus, it is likely during the Unit you will be provided with the opportunity to relate theory to practice by doing practical experiments using the type of equipment found in the marine industry.

There are opportunities to develop the Core Skill *Working with Others* at SCQF level 6. Throughout this Unit it is expected that candidates will carry out several investigations into the navigation systems within the laboratory. This would be completed as small groups working together.

The formative laboratory work and the formal assessments will give the opportunity to develop the Core Skills components: Critical Thinking at SCQF level 6; Reviewing and Evaluating at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

The formal assessment for this Unit will consist of two assessment papers lasting no more than two hours. Assessment paper one will include Outcomes 1, 2 and 3, assessment paper two will include Outcomes 4 and 5. The assessments 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.

This Unit will consist of 5 Outcomes that you will study:

- 1 Analyse marine radar and automatic radar plotting systems.
- 2 Analyse terrestrial and satellite position fixing and transponder systems.
- 3 Explain ship speed and distance measuring systems and echo sounding systems.
- 4 Assess automatic steering systems.
- 5 Explain marine compass and repeater systems.