

Level 2 Diploma in Marine Engineering (Foundation) (2473-12)

Version 1.1 (August 2017)

Qualification Handbook

Qualification at a glance

Subject area	Marine
City & Guilds number	2473
Age group approved	16-18, 18+, 19+
Entry requirements	None
Assessment types	Multiple Choice; Short Answer; Assignment
Approvals	Qualification approval
Support materials	Qualification handbook; Assessment pack; Centre-devised recording forms
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 2 Diploma in Marine Engineering (Foundation)	530	612	2473-12	603/2237/8

Version and date	Change detail	Section
1.1 August 2017	Ofqual accreditation number added	Qualification at a glance

Contents

Qualification at a glance	2
Contents	3
1 Introduction	4
Structure	5
GLH	6
2 Centre requirements	7
Approval	7
Resource requirements	7
Learner entry requirements	7
Age restrictions	7
3 Delivering the qualification	8
Initial assessment and induction	8
Support materials	8
4 Assessment	9
Summary of assessment methods	9
Assessment strategy	11
5 Grading	13
6 Units	14
Structure of the units	14
Unit 201 Introduction to the marine industry	15
Unit 203 Business improvement techniques	30
Unit 208 Marine engineering processes and principles	34
Unit 209 Servicing and maintenance of marine engines and ancillary systems	48
Unit 210 Servicing and maintenance of marine propulsion systems	60
Appendix 1 Sources of general information	68
Appendix 2 Useful contacts	70

1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	This qualification is aimed at learners aged 16 and above who would like to gain the basic knowledge and skills required during their initial training to become a Marine Engineer, either as part of their Apprenticeship or as full time students.
What does the qualification cover?	<p>Learners will be introduced to the scope and opportunities offered within the wider marine industry.</p> <p>They will develop the range of transferable skills over a cross section of production, manufacturing and service sectors which are valued by employers and therefore increase their employability skills. This qualification will cover Marine engineering processes and principles to support learners to:</p> <ul style="list-style-type: none">• Install, maintain, fault find and repair marine engines, ancillary systems and equipment.• Design and produce solutions to meet boat layouts, restrictions and engineering requirements.• Produce boat engineering systems from engineering and technical drawings to specifications.• Manufacture, assemble, strip, repair and re-build components. <p>Learners will cover marine engines, ancillary systems and marine propulsion systems as part of this qualification.</p> <p>All the above will enable learners to progress into further training to become a Marine Engineer.</p>
What opportunities for progression are there?	Upon completion of this qualification learners will have developed most of the basic skills and knowledge required during their foundation phase of the Apprenticeship and will enable them to progress into further training to become a Marine Engineer.
Who did we develop the qualification with?	This qualification has been developed in collaboration with the Marine Engineer trailblazer group which is led by organisations including: Berthon Boat Company Ltd, Sunseeker International, Princess Yachts, Pioneer Sailing Trust, Pendennis Shipyard, Fairline Boats, Broom Boats, RNLI, Green Marine, English Harbour Yachts, Windboats,

Area	Description
	Hamble Yacht Services, Golden Arrow, Goodchild Marine and British Marine.
Is it part of an apprenticeship framework or initiative?	<p>Yes, this qualification has been developed to be included within the foundation phase of the new Apprenticeship Standard for Marine Engineers, which will replace the Level 2 and Level 3 Marine, Construction, Systems Engineering and Maintenance (Marine Engineering) qualifications in current SASE Frameworks.</p> <p>The qualification can also be used for full time students who would like to gain the basic knowledge and skills that will enable them to progress into further training to become a Marine Engineer.</p>

Structure

To achieve the Level 2 Diploma in Marine Engineering (Foundation), learners must achieve mandatory units 201, 203, 208-210.

Centres should use the following certification units to claim for the achieved grade:

- 904 (Pass)
- 905 (Merit)
- 906 (Distinction)

Level 2 Diploma in Marine Engineering (Foundation)

City & Guilds unit number	Unit title	GLH
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Mandatory units

201	Introduction to the marine industry	100
203	Business improvement techniques	50
208	Marine engineering processes and principles	100
209	Servicing and maintenance of marine engines and ancillary systems	180
210	Servicing and maintenance of marine propulsion systems	100

GLH

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
Level 2 Diploma in Marine Engineering (Foundation)	530	612

2 Centre requirements

Approval

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the Centre Manual - Supporting Customer Excellence for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Resource requirements

Resources

This qualification should be delivered in the workshops and classrooms of a centre with full facilities for Marine Engineering activities, with access to the necessary equipment, machines, relevant tools and consumables for working safely with engineering materials appropriate to each unit.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

See also the qualification page on the City & Guilds website for the latest version of the assessment strategy on the role of supervisors and managers in the assessment process.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Learner entry requirements

City & Guilds does not set entry requirements for these qualifications. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Age restrictions

City & Guilds cannot accept any registrations for learners under 16 as these qualifications are not approved for learners under 16.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification[s], their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Assessment pack	www.cityandguilds.com
Centre-devised recording forms	

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, Learning Assistant, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. Recording forms are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Summary of assessment methods

Candidates must successfully complete:

- **one** multiple-choice test for units 201 and 208
- **one** externally set, internally marked short-answer question assessment for unit 203
- **one** assignment and **one** externally set, internally marked short-answer question assessment for units 209-210

Available assessments/assignments

City & Guilds has written the following assessments to use with this qualification:

- evolve multiple-choice tests to be delivered on-screen
- externally set, internally marked short-answer questions

City & Guilds has written guidance for centres to write their own assignments.

City & Guilds has developed a template which tutors/assessors can use to write their own assignments.

Assessment Types

Unit	Title	Assessment method	Where to obtain assessment materials
2473-201	Introduction to the marine industry	Multiple-choice online test 2473-201 The assessment covers all the outcomes in this unit	www.walled-garden.com
2473-203	Business improvement techniques	Short answer questions 2473-203 The assessment covers all the outcomes in this unit	www.walled-garden.com
2473-208	Marine engineering processes and principles	Multiple-choice online test 2473-208 The assessment covers all the outcomes in this unit	www.walled-garden.com
2473-209	Servicing and maintenance of marine engines and ancillary systems	Centre-devised practical assignment and Short-answer questions 2473-209 These assessments cover all the outcomes in this unit	www.walled-garden.com
2473-210	Servicing and maintenance of marine propulsion systems	Centre-devised practical assignment and Short-answer questions 2473-210 These assessments cover all the outcomes in this unit	www.walled-garden.com

Centre set and marked assignments

City & Guilds has provided separate guidance for writers of centre based assessments which should be read in conjunction with this document, entitled '**GM1 - Developing centre-devised assessments - guidance for centre based assessment writers**'.

A set of generic recording forms is also provided as follows:

- Assessment tasks (AD1)
- Assessment grading criteria (AD2)
- Assessment sign off form (AD3)
- Evidence recording form (GF1)

- Assessment unit front and mark sheet (GF2)
- Assessment task front sheet (GF3)
- Assessment unit mark sheet (GF4)
- Assessment feedback and action plan form (GF5)
- Qualification assessment tracking form (GF6)
- Group assessment tracking form (GF7)

A full explanation of the use of these forms can be found in the centre-devised assessment writing guidance. All of these materials are available to download from the qualification page of the City & Guilds website.

Time constraints

The following must be applied to the assessment of this qualification:

- candidates must finish their assessment within six months
- all assessments must be completed within the candidate's period of registration
- assignments should take no longer than 8 hours. If they do, centres should consider why this is, and make sure that they are not trying to gather too much evidence.

Approval process for centre set assignments

Centre set assignments **must** be approved by the external quality assurer before use. For each assignment, the **Assessment sign off form (AD3)** must be completed and be made available to the EQA for inspection.

Assessment strategy

Tables and content pertaining to the assessment strategy

Test Specifications

The way the knowledge is covered by each test is laid out in the table(s) below:

Assessment title: 201 Introduction to the marine industry

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

201	Duration: 75 minutes		
Learning Outcome		Number of marks	%
	01 : Understand the range of services available within the global marine industry	8	16
	02 : Understand the terminology used to recognise boats and equipment	6	12
	03 : Understand the environmental, Health and Safety rules and regulations applicable to the marine industry	17	34

201	Duration: 75 minutes		
	04 : Understand employment roles and responsibilities	4	8
	05 : Know how to contribute to self-development and create and maintain effective working relationships	7	14
	06 : Know how to contribute to the effectiveness of boat production and support services	8	16
	Total	50	100

Assessment title: 208 Marine engineering processes and principles

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

208	Duration: 60 minutes		
	Learning Outcome	Number of marks	%
	01 : Know how to identify marine engineering materials and their properties	14	35
	02 : Know how to interpret and use marine engineering specifications and installation requirements	4	10
	03 : Know how to use tools and equipment safely in a marine engineering environment	7	17.5
	04 : Understand marine engineering processes	15	37.5
	Total	40	100

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience, or qualifications which have already been achieved, to contribute to a new qualification.

For this qualification, RPL is allowed and is not sector specific.

5 Grading

Grading of individual assessments

Individual assessments will be graded Pass/Merit/Distinction.

For the units to be achieved, candidates must achieve a minimum of Pass in each assessment, as per the marking scheme provided for each assessment.

Pass reflects the minimum requirements that are expressed in the unit, with Merit and Distinction showing progression in the depth and breadth of the learner's knowledge, as well as in the type of cognitive operations learners demonstrate.

Grading of qualification

The Marine Engineer Employer Group has taken the decision to grade this qualification Pass/Merit/Distinction, through the aggregation of the individual assessments graded Pass/Merit/Distinction.

All assessments must be achieved at a minimum of Pass for the qualification to be awarded. All assessments graded Pass/Merit/Distinction contribute equally to the overall qualification grade.

For full details on how to grade the qualification, refer to the Assessment Pack available on the qualification page of www.cityandguilds.com.

Overall qualification grades must be entered using one of the following overall grading modules on the Walled Garden:

- 904 Pass
- 905 Merit
- 906 Distinction

6 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Learning outcomes, which are comprised of a number of assessment criteria

Centres must deliver the full breadth of the range. Specialist equipment or commodities may not be available to all centres, so centres should ensure that their delivery covers their use. This may be covered by a practical demonstration (e.g. video). For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task but are not required to use all the equipment or commodities in the range.

Unit 201

Introduction to the marine industry

Unit level:	Level 2
GLH:	100
Unit aim:	This mandatory unit is concerned with safety awareness and communication skills needed to work effectively in the marine industry. It covers health and safety, interaction with other employees and an understanding of the terminology and structure of the industry

Learning outcome

The learner will:

- 1 Understand the range of services available within the global marine industry

Assessment criteria

The learner can:

- 1.1 describe what boatyards, marinas and yacht basins are
- 1.2 list the facilities and services that are found in boatyards, marinas and yacht basins
- 1.3 describe the services of boatbuilding, refit and repair to the UK and global markets
- 1.4 describe the purpose of boatyards, marinas and yacht basins
- 1.5 describe methods for moving boats
- 1.6 identify personnel responsible for providing services
- 1.7 list ancillary marine services provided within the marine industry

Range

(AC1.2) **Facilities:**

- new build
- fit out
- maintenance
- repair and lay-up facilities
- painting and varnishing
- finishing (gel coat repair, polishing, burnishing, lacquering)
- moorings
 - swinging or fixed
 - marina pontoons
 - on piles
- accommodation facilities:
 - toilets

- showers
- laundry room (washing machines, spin driers)
- storage cabins or lock-ups
- mast and spar storage arrangements
- pump-out facilities
- fuelling facilities
- workshops
- storage facilities
- materials storage facilities
- machinery and equipment
- launching and recovery
- slipway services
- crane services
- dry dock
- locks

(AC1.2) **Services:**

- water points
- electrical hook-up
- waste and refuse disposal
- recycling
- material storage
- gas bottles
- fuel

(AC1.3) **Services of boatbuilding, refit and repair to the UK and global markets:**

- new build
- fit out
- repair
- sales and after sales
- warranty
- customer service and support
- parts

(AC1.4) **Purpose of boatyards, marinas and yacht basins:**

- building, repairing and fitting out of boats to include hull and deck construction in wood, metals and composites
- engine, propulsion and mechanical installation and maintenance
- electrical and electronic diagnostic maintenance and installations
- fit out or refit operations for joinery and upholstery
- electrics
- preparation, painting and finishing
- boat valeting
- berthing of boats
- boat lifting
- storage ashore
- shower and laundry services
- rigging
- sail making/ repair
- boat covers and awnings

(AC1.5) **Methods for moving boats:**

- afloat by:
 - engine power
 - sailing
 - towing
 - rowing
 - rafting
- ashore by:
 - mobile self-propelled hoists
 - mobile self-propelled boat movers
 - telehandler
 - coupled boat movers cradle
 - railed slipway
 - slippery ways
 - rollers
 - tractor and cradle on wheels
 - mobile crane
 - static crane
 - fork lift truck
 - dry stack
 - road transportation/ haulage

(AC1.6) **Personnel responsible for providing services:**

- shipwrights, boat-builders, joiners and sawyers:
 - boat-building boat repair, joinery and refit operations
- laminators:
 - FRP hull and deck mouldings
 - gel and FRP repairs
- composite technician:
 - FRP hull and deck mouldings
 - gel and FRP repairs
 - post curing
 - vacuum bagging techniques
 - materials selection
- marine engineers and fitters:
 - engine and generator installations
 - maintenance
 - winterising and commissioning
 - stern gear
 - propulsion systems
 - hydraulics
 - winches
 - machining
 - fabricating and welding
 - fitters
 - mechanical system fitting and maintenance
- welders:
 - metal fabrication activities and welding
- marine electricians and electronic engineers:
 - electronic and electrical installations
 - diagnostics and repair
- marine plumbers and gas installers:

- installation and maintenance of wash basins
- showers, toilet and waste water systems and LPG gas installations
- refrigeration engineer:
 - install and maintain AC and refrigeration units
- riggers:
 - splicing
 - rope work
 - install stays
 - dress and undress masts
 - step and unstep masts
 - manufacture and repair rigging
 - lifeline/safety lines
 - set/tune rig
- sail-makers:
 - make, repair and launder sails
- painters and varnishers:
 - preparation for boat painting
 - filling and fairing
 - boat spraying
 - painting and finishing operations
 - antifouling
 - interior and exterior varnishing
- finishers
 - gel coat repair
 - polishing operations
 - burnishing operations
 - lacquering
- upholsterers:
 - cabin décor
 - furnishings activities
 - external covers and awnings
- boat mover:
 - boat moving operations on water and ashore
 - lifting operations
 - pressure washing and blocking off
 - forklift and tractor operations
- naval architect:
 - plans all parts of boat
- marine surveyor:
 - inspects and examines boats and equipment on board to report on condition
 - can be for sale or insurance purposes
- marina manager:
 - manages the marina, operations and dock masters
- yacht broker:
 - sells new and second hand boats on behalf of the owner
 - finds potential buyers
 - manages the sale
- project manager:
 - leads and manages a project from start to finish
 - oversees the build or refit of a vessel
 - manages staff and subcontractors

- liaises with owner
- chandler:
 - supply of yacht fittings and fastenings, including: glues, ropes, charts, books, paint, chain, shackles, anchors, yacht clothing, boots and navigation equipment
- interior and exterior boat cleaning
- boat valets

(AC1.7) **Ancillary marine services:**

- harbour master
- skippers
- crew
- financial services
- insurance provision
- leisure operators
- boat haulage
- material and product supply chain
- water taxi
- charities

Learning outcome

The learner will:

- 2 Understand the terminology used to recognise boats and equipment

Assessment criteria

The learner can:

- 2.1 use basic terms to describe types of leisure and commercial craft
- 2.2 describe the terms used to identify boat locations and dimensions
- 2.3 identify common marine components and fittings
- 2.4 identify marine systems terminology

Range

(AC2.1) **Terms:**

- leisure craft:
 - yachts
 - motor cruisers
 - dinghies
 - river and canal boats
 - rigid inflatable boats (RIBS)
 - personal watercraft (PWC)
 - super yachts
- commercial craft:
 - tankers
 - tugs and workboats
 - lighters
 - passenger boats
 - pilot boats

- dredgers
- ferries
- lifeboats
- military vessels
- fishing vessels
- offshore support
- regulatory vessels (police, border force, etc)

(AC2.2) **Locations:**

- port
- starboard
- forward
- aft
- bow
- stern
- on deck
- transom
- quarter
- aloft
- below
- steering (helm) position
- upper steering position
- coach roof
- wheel house
- cockpit
- engine room
- tank space
- bilge
- tiller flat
- lazarette
- forepeak
- chain locker
- accommodation areas on boats:
 - galley
 - saloon
 - cabins
 - heads
 - shower

(AC2.2) **Dimensions:**

- length waterline (lwl)
- length overall (loa)
- beam
- draught (air and water)
- freeboard

(AC2.3) **Marine components and fittings:**

- cleats
- bollards
- fairleads
- windlass

- anchor
- winch
- wheel
- tiller
- navigation equipment
- masts/spars, spreaders and booms
- sails
- furlers
- tracks
- safety equipment:
 - life rafts
 - life belts
 - lifelines
 - pulpit
 - pushpit
 - stanchions
 - guardwires
 - handrails
- running rigging:
 - sheets
 - halyards
 - running backstays
- standing rigging:
 - stays
 - shrouds
- types of blocks
- davits
- through hull penetrations
- skin fittings
- stern gear
- A brackets
- P brackets
- stern tube
- shaft log
- shaft
- propeller
- rudder
- rope cutters
- trim tabs
- anodes

(AC2.4) **Marine systems terminology:**

- main engines
- propulsion systems
- couplings and drives:
 - Z
 - V
 - sail drive
 - outdrive
 - outboard

- jet drive
 - steering systems:
 - mechanical
 - hydraulic
 - electro hydraulic
 - instrument systems
 - navigation systems
 - power supplies:
 - batteries
 - generators powered by engines
 - wind or water flow
 - solar panels
 - shore power hook up
 - bow thrusters
 - stern thrusters
 - heating
 - air conditioning
 - fresh water systems
 - black waste systems
 - grey waste systems
 - reverse osmosis water makers
 - refrigeration
-

Learning outcome

The learner will:

- 3 Understand the health, safety and environmental rules and regulations applicable to the marine industry

Assessment criteria

The learner can:

- 3.1 identify the health, safety and environmental regulations in the marine industry
- 3.2 identify the range of personal protective equipment (PPE)
- 3.3 identify when PPE is used in the marine industry
- 3.4 identify safety signs in use within the marine industry
- 3.5 describe the role of qualified first aiders and the re-qualification period
- 3.6 explain evacuation procedures in the event of an emergency
- 3.7 identify common causes of fire
- 3.8 describe preventative measures to reduce risk of fire
- 3.9 identify types of fire extinguishers
- 3.10 explain the purpose of a risk assessment
- 3.11 identify potential hazards in the work environment
- 3.12 identify good housekeeping procedures

Range

(AC3.1) **Health, safety and environmental regulations:**

- Health and Safety at Work Act 1974 (HASAWA)
- Control of Substances Hazardous to Health (COSHH)
- Lifting and Handling 1998 (LOLER)
- Provision and Use of Work Equipment Regulations 1998 (PUWER)
- Portable Appliance Testing Regulations (PAT)
- Personal Protective Equipment (PPE) at Work Regulations
- Supply of Machinery Regulations
- Electricity at Work Regulations 1989
- Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR) 2013
- Manual Handling Operations Regulations (MHOR)
- Work at Height Regulations (WAHR)
- Safe Working in Confined Spaces Regulations and Code of Practice
- Biocidal Products and Chemicals (appointment of Authorities and Enforcement Regulations 2013
- Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment Regulations 2009
- Control of Major Accident Hazards Regulations 2015
- CRC Energy Efficiency Scheme Order 2013
- Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)
- Environmental Permitting (England and Wales) Regulations 2010
- Environmental Protection Act 1990
- REACH (the Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC)
- Recreational Craft Regulations 2004
- The Hazardous Waste (England and Wales) (Amendment) Regulations 2016
- The Hazardous Waste (Miscellaneous Amendments) Regulations 2015
- Waste (England and Wales) Regulations 2011
- Waste Batteries and Accumulators Regulations 2009
- Waste Electronic, Electrical Equipment Regulations (WEEE)

(AC3.2) **Personal Protective Equipment:**

- hard hats
- goggles/glasses/visors
- burning goggles
- welding helmet/mask
- boots
- gloves/gauntlets
- safety harness
- lifejacket
- buoyancy aids
- overalls
- ear plugs, attenuators and defenders
- wet weather gear
- respiratory protection equipment (RPE):
 - masks
 - air fed hoods

(AC3.3) **When PPE is used in the marine industry:**

- operating plant and machinery
- working at height
- working on board
- working on water
- working in noisy environments
- hot works
- working with hazardous substances:
 - chemicals
 - paints
 - particulates
- fumes
- confined spaces
- explosive atmospheres, e.g. spraybooth
- lifting operations
- manual handling
- working on batteries
- working with electricity

(AC3.4) **Safety signs:**

- warning or cautionary signs
- prohibition signs
- mandatory signs
- general safety signs
- COSHH signs

(AC3.6) **Evacuation procedures:**

- fire alarm
- escape routes
- assembly points
- fire drills

(AC3.7) **Common causes of fire:**

- electrical faults
- fuels
- oils
- exotherming chemicals
- solvents and paints
- hot works without a permit

(AC3.9) **Types of fire extinguisher:**

- water
- foam
- powder
- CO2 gas
- fire blankets
- fire suppression system

(AC3.11) **Potential hazards:**

- slips, trips and falls
- spillages and slippery surfaces
- faulty electrical connections or damaged cables

- faulty, blunt or incorrectly set up of tools and equipment
- faulty or missing machine guards or interlocks
- faulty material handling or transportation
- risk of explosion
- dust and fumes
- moving loads
- suspended loads
- working at heights
- untidy work habits
- weather conditions
- air pressure systems
- confined spaces
- moving machinery
- working on water
- noise
- sharps
- vibration
- chemicals
- naked flames

(AC3.12) **Good housekeeping procedures:**

- 5S/6S technique of good housekeeping:
 - sort
 - set
 - standardise
 - shine
 - sustain
 - safety
- correct storage of tools, equipment and materials
- maintaining access and egress to:
 - work stations
 - walkways
 - emergency exits
 - fire doors
 - vessels
- safe removal of waste and methods of waste disposal:
 - burning
 - landfill
 - recycling
 - chemical breakdown
- the acceptable codes of behaviour and dress
- following instructions
- walking not running
- appropriate lighting and ventilation

Learning outcome

The learner will:

4 Understand employment roles and responsibilities

Assessment criteria

The learner can:

- 4.1 list the main aspects of a contract of employment
 - 4.2 identify relevant legislation about conditions of employment
 - 4.3 state sources of information on employment rights and responsibilities
-

Range

(AC4.1) Aspects of a contract of employment:

- job description
- hours of work
- rates of pay
- role and responsibilities
- disciplinary and grievance procedure
- organisational structure
- terms of notice
- Employment Rights Act
- holiday entitlement
- policies and procedures

(AC4.2) Relevant legislation:

- Equality Act 2010
- Employment Rights Act 1996
- Working Time Regulations

(AC4.3) Sources of information:

- trade unions
 - ACAS
 - Citizens Advice Bureau
 - employer/contract of employment
 - gov.uk websites
 - company policies and procedures
-

Learning outcome

The learner will:

- 5 Know how to contribute to self-development and create and maintain effective working relationships

Assessment criteria

The learner can:

- 5.1 identify the methods of communication used to manage information within the organisation
 - 5.2 explain how to maintain effective working relationships
 - 5.3 explain the difficulties that can occur in working relationships
 - 5.4 identify the relevant persons to contact when information is not clear or sufficient
-

- 5.5 state the importance of asking for help when required
- 5.6 identify appropriate listening, questioning, recording and presentation techniques
-

Range

(AC5.1) **Methods of communication:**

- memos
- drawings and sketches
- diagrams
- written and verbal work instructions
- videos
- pictures
- manufacturers' instructions or guidance literature
- noticeboards
- emails
- intranet
- job sheets
- technical datasheets
- safety datasheets
- risk assessments
- method statements
- training
- mobile technology
- short wave radios

(AC5.2) **Effective working relationships:**

- the importance of listening skills
- paying attention to work instructions
- making sure that they understand what has been said by asking questions when unsure
- avoiding abusive or offensive behaviour
- personal hygiene
- willing co-operation with all levels of organisation
- good time keeping
- obeying company rules and regulations
- working safely
- treating people (workmates and customers) with courtesy and respect
- being reliable and trustworthy
- adhering to current regulations and legislation
- maintaining a positive attitude

(AC5.3) **Difficulties:**

- disrespectful behaviour
- direct and indirect discrimination
- victimisation
- harassment
- poor time keeping

(AC5.4) **Relevant persons:**

- experienced and reliable colleagues

- charge hands
 - foreman
 - managers
 - team leaders
 - mentors
 - the company hierarchy
-

Learning outcome

The learner will:

- 6 Know how to contribute to the effectiveness of boat production and support services

Assessment criteria

The learner can:

- 6.1 identify the principles of costing, budgeting, pricing and hours
 - 6.2 state the types of information to be used and recorded during a job
 - 6.3 state sources of information for boat production and support services
 - 6.4 state the importance of accuracy when completing records
 - 6.5 state the importance of maintaining records for disposal of waste in an environmentally responsible way
-

Range

(AC6.2) **Types of information:**

- description of the work
 - location of work
 - temperature and humidity
 - special requirements (tools)
 - time sheets giving the labour hours
 - sub-contracted work detail
 - requisition sheets
 - test and quality information
 - calibration certificates
 - materials and quantities
 - material certification or identification
 - permit to work (e.g. hot works)
 - measurements
 - weight
 - ratio
 - temperature
 - humidity
 - timings
 - size
 - volume
 - batch numbers
 - safety requirements
-

(AC6.3) **Sources of information:**

- internal:
 - past records
 - new build specifications
 - scantlings lists
 - time sheets
 - requisition sheets
 - test records
 - drawings and specifications
 - tool records
 - calibration records
 - application records
 - risk assessments
 - methods statements
 - service records
 - boat files/manuals
- external:
 - designers' drawings and specifications
 - manufacturer's specifications
 - regulation agencies
 - Recreational Craft Directive (RCD)
 - technical data and information
 - safety data sheets
 - H&S regulations and information
 - compliance organisations and regulations

(AC6.4) **Importance of accuracy:**

- prevent re-work and warranty claims
- prevent incorrect information being recorded
- enable a true account of costs and time to be established
- provide a log of what was done when and by whom
- provide information for future planning, efficiency and potential customers

(AC6.5) **Importance of maintaining records:**

- legal requirement
- social responsibility
- company policy
- stock control
- warranty
- continuous improvement
- safety

Unit 203

Business improvement techniques

Unit level:	Level 2
GLH:	50
Unit aim:	This unit aims to provide the learner with the knowledge of lean business process and quality improvement in order to effectively monitor and make enhancements to production, manufacturing and maintenance processes.

Learning outcome

The learner will:

- 1 Know what is meant by continuous improvement

Assessment criteria

The learner can:

- 1.1 explain the meaning of continuous improvement
- 1.2 outline the benefits of applying continuous improvement techniques
- 1.3 define each stage of the Plan – Do – Check – Act (PDCA) improvement cycle
- 1.4 define the different categories of waste

Range

(AC1.2) **Benefits:**

- reduced cost (e.g. production)
- improved quality (e.g. reduced defects)
- improved safety (e.g. safe to use)
- improved working practices (e.g. reduced operator motion)
- improved delivery (e.g. reduced transportation time, reduced lead time)
- reduction of waste (e.g. over processing, excess inventory)
- resource utilisation (e.g. reduced waiting time)
- improved customer satisfaction (e.g. meeting customer requirements)

(AC1.4) **Categories of work:**

- value added
- non-value added
- waste

(AC1.4) **Categories of waste:**

- transport
- inventory
- motion

- waiting
 - over-production
 - over-processing
 - defects
 - skills/unrecognised people potential
-

Learning outcome

The learner will:

- 2 Understand what is meant by workplace organisation

Assessment criteria

The learner can:

- 2.1 explain the meaning of workplace organisation
 - 2.2 outline the benefits of having an organised working environment
 - 2.3 describe the effects an unorganised work environment may have
 - 2.4 explain the importance of Standard Operating Procedures (SOPs) within workplace organisation
-

Range

(AC2.3) **Effects:**

- poor quality
 - increased costs
 - reduced efficiency
 - poor delivery times
 - poor morale/teamwork
 - poor health and safety
-

Learning outcome

The learner will:

- 3 Know what is meant by visual management

Assessment criteria

The learner can:

- 3.1 explain the meaning of visual management
 - 3.2 describe the benefits of applying good visual management
 - 3.3 describe different types of visual management
-

Range

(AC3.2) **Good visual management:**

- accurate and relevant
-

- eye-catching
- simple
- greater ownership

(AC3.3) **Types of visual management:**

- shadow boards
- PDCA worksheets
- colour coding
- floor footprints
- storyboards
- gauges
- photographs/pictures
- labelling
- lights
- schedule boards
- Kanban (pull systems)
- graphs
- management boards
- other area specific types of visual management

Learning outcome

The learner will:

- 4 Understand problem solving techniques

Assessment criteria

The learner can:

- 4.1 explain what is meant by a problem within a work environment
- 4.2 describe the benefits of solving work related problems
- 4.3 outline different techniques used for identifying and analysing problems
- 4.4 explain the importance of applying the appropriate corrective action and eliminating the root cause of a problem

Range

(AC4.3) **Techniques:**

- tally charts
- flowcharts
- histogram/Pareto chart
- benchmarking
- process mapping
- correlation diagram
- run diagram
- Statistical Process Control
- control charts
- Gantt charts

- root cause paths
- value stream maps
- Ishikawa diagrams (cause and effect, fishbone)
- brainstorming
- mind mapping
- 5 Why analysis

Unit 208

Marine engineering processes and principles

Unit level:	Level 2
GLH:	100
Unit aim:	This mandatory unit is concerned with the selection and use of materials, tools and equipment and their application in marine engineering operations.

Learning outcome

The learner will:

- 1 Know how to identify marine engineering materials, their reaction to the environment and their properties

Assessment criteria

The learner can:

- 1.1 identify the common materials used in marine engineering
- 1.2 list the properties that identify materials
- 1.3 identify the properties of materials
- 1.4 identify storage requirements of materials
- 1.5 describe the difference between oxidation, electrolytic and galvanic corrosion, cavitation and hydrolysis
- 1.6 identify types of permanent, semi-permanent and temporary bonds used in marine engineering applications
- 1.7 identify types of protective coatings used in marine engineering applications
- 1.8 state the factors influencing the choice of materials in marine engineering applications

Range

(AC1.1) **Materials:**

- bearing materials
 - acetol
 - alloys
 - tufnol
 - white metal
 - nitrile rubber
- bedding and joints:
 - cork
 - gland packing (rope, PTFE)

- paper
- polyurethane
- PTFE
- rubber (nitrile, neoprene, EPDN)
- silicon
- cloth:
 - fibre reinforcement
 - pre-impregnated
 - reinforcing fibres
- composites:
 - fibre reinforced plastic (FRP)
 - glass reinforced plastic (GRP)
 - plastics
- filler and filler compounds:
 - colloidal silica
 - glass microfibres
 - talc and calcium carbonate
- fluids
 - additives
 - coolants
 - oils
- metals:
 - alloys (brass, bronze)
 - ferrous (steel)
 - non-ferrous (lead, aluminium, copper)
- organic peroxides
 - catalyst
- resins:
 - epoxy
 - polyester
 - vinylesters
- solvents:
 - acetone
 - thinners
- timbers:
 - hard woods
 - manufactured boards
 - soft woods

(AC1.2) **Properties that identify materials:**

- bearing materials
 - colour
 - hardness
 - weight
- cloth:
 - fibre orientation
 - identifier strand
 - weight
- composite:
 - colour

- identifier strand
- orientation
- filler and filler compounds:
 - colour
 - hardness
 - texture
 - weight
- fluids
 - colour
 - viscosity
 - odour
- metal:
 - colour
 - density
 - magnetism
 - weight
- wood:
 - colour
 - grain
 - smell
 - texture
 - weight

(AC1.3) **Properties of materials:**

- bearing materials
 - hardness
 - lubrication
 - wear resistance
- bedding and joints
 - adhesion
 - aerobic / anaerobic
 - chemical resistance
 - curing state
 - flexibility
 - water resistance
- cloth:
 - colour
 - fibre direction
 - fibre length
 - pattern
 - weave
 - weight
- composite:
 - compressive/ sheer strength
 - ductility/ malleability
 - elasticity
 - hardness
 - tensile strength
 - toughness/ brittleness
- filler and filler compounds:
 - size

- viscosity
- fluids
 - anti- corrosion
 - lubrication
 - solubility
 - temperature range
 - viscosity
- metal:
 - compressive/ sheer strength
 - corrosion resistance
 - ductility/ malleability
 - hardness
 - tensile strength
 - toughness/ brittleness
 - heat resistance
 - conductivity
- pre-impregnated:
 - compressive/ sheer strength
 - ductility/ malleability
 - elasticity
 - hardness
 - tensile strength
 - toughness/ brittleness
- resins/ organic peroxides:
 - humidity
 - mix ratio (weight, volume)
 - pot life
 - shelf life
 - temperature
 - viscosity
- wood:
 - compressive/ sheer strength
 - durability
 - elasticity
 - erosion resistance
 - hardness
 - moisture content
 - tensile strength
 - toughness/brittleness
 - workability

(AC1.4) **Storage requirements of materials:**

- composites:
 - clean
 - dry condition
 - flat
 - humidity control
 - separate from catalysts
- filler and filler compounds:
 - clean

- dry
- humidity control
- metals:
 - dry
 - purpose built rack
- organic peroxide:
 - COSHH cabinet separate from flammables
- pre-impregnated:
 - refrigerated
- resins/thinners:
 - COSHH cabinet
- timber:
 - air circulation
 - drying rack
 - flat
 - undercover

(AC1.6) **Permanent bonds:**

- chemical locks/ locking adhesive
- contact adhesive
- epoxy resins
- fibre glassing
- formaldehydes
- glue
- mastics
- methyl methacrylate adhesives
- polyurethanes
- polyester resin
- PVA
- resins
- resorcinol glue
- welding

(AC1.6) **Semi-permanent bonds:**

- bolts
- fast mounts
- nails
- nuts
- rivets
- rivnuts
- screws
- washers

(AC1.6) **Temporary bonds:**

- circlips
- hot glue
- nails
- pins

- polyurethane
- R clips
- split pins

(AC1.7) **Protective coatings:**

- lagging
- metallic coatings (galvanising, anodising, sheridising)
- paints
- plastic sheathing
- powder coating
- preservatives
- resins
- varnishes
- vinyl wrapping

(AC1.8) **Factors:**

- location
- cost
- weight
- durability
- stability/longevity
- availability
- customer requirements
- corrosion resistance
- strength
- conductivity
- lubrication
- heat resistance
- water resistance
- ductility
- performance requirements

Learning outcome

The learner will:

- 2 Know how to interpret and use marine engineering specifications and installation requirements

Assessment criteria

The learner can:

- 2.1 identify drawing conventions to ISO8888/2000 for lines, dimensions and setting out
- 2.2 identify types of drawings used in marine engineering installations
- 2.3 identify common scales used for drawing
- 2.4 list the sources of marine engineering installation information

Range

(AC2.1) Lines, dimensions and setting out:

- aft perpendicular (AP)
- centre lines
- datum lines
- dimension lines
- forward perpendicular (FP)
- hidden detail
- station lines
- water line

(AC2.2) Types of drawings:

- construction plans
- detailed drawings
- exploded and sectional views
- first and third angle orthographic projections
- general arrangements
- general layout and assembly drawings
- lines plans and table of offsets
- oblique and isometric projections
- circuit diagrams

(AC2.4) Sources:

- charts
- data sheets
- electronic sources
- graphs
- instruction manuals
- regulatory bodies
 - Lloyds
 - Recreational Craft Directive (RCD)
 - Maritime and Coastguard Agency
- tables
- technical books

Learning outcome

The learner will:

- 3 Know how to use tools and equipment safely in a marine engineering environment

Assessment criteria

The learner can:

- 3.1 identify typical tools, fastening techniques and equipment used in marine engineering installations

- 3.2 identify the equipment for lifting and transporting loads
 - 3.3 state the general rules for the maintenance of tools and equipment
 - 3.4 describe the safety requirements for using power tools and machines
-

Range

(AC3.1) **Hand tools, machine tools and equipment:**

- cutting tools:
 - guillotine
 - drills
 - lathe
 - mill
 - nibbler
 - pipe cutter
 - plasma cutter
 - oxygen/acetylene cutting tool
 - saws (cross cut, panel, hacksaw, diamond tungsten tipped, oscillating, hole saw, horizontal band saw, band saw, circular saw, jig saw, air powered saws, retractable knives)
- material removal tools:
 - abrasive wheel
 - chisels
 - emery cloth
 - files
 - grinder
 - planes
 - rasps
 - reamer
 - sander
 - scrapers
 - de-burrers
 - bearing scrapers
- assembly and joining / fastening tools/ techniques and equipment:
 - brazing
 - silver soldering
 - soft soldering
 - welding (TIG, MIG, MMA)
 - hexagon keys
 - impact wrench
 - security keys
 - screw drivers
 - socket sets
 - spanners
 - torque wrench/ screwdriver
- hammers:
 - ball pein
 - claw
 - cross pein
 - lump
 - mallet
 - maul
 - soft blow

- sledge
- measuring and marking out tools:
 - callipers
 - centre punch
 - dial test indicator (clock gauge)
 - gauges (bevel, feeler, spar, spring)
 - laser measures and levels
 - levels
 - micrometer (internal/external)
 - plumb bob
 - rules
 - scribes
 - spiels and spieling battens
 - spirit level
 - squares
 - tapes
 - templates
 - vernier
 - verdict
 - water level
- drilling tools
- shaping tools
- sharpening systems
- coating application tools
- surface preparation tools
- special tools:
 - formers
 - jigs
 - saddles
 - compression tester
 - engine manufacturers specialised tools.
- work-holding devices:
 - chucks
 - face plates
 - 'G' cramps
 - grips
 - lever cramps
 - quick-release cramps
 - sash cramps
 - vices
- adhesive tapes
- dust sheets
- protective coatings
- electrical leads
- lead lights
- air lines
- local exhaust ventilation (LEVs)

(AC3.2) Equipment for lifting and transporting:

- lifting accessories:
 - blocks

- chains
- ropes
- shackles
- slings
- strops
- hooks
- transporting:
 - boat hoist
 - boat mover
 - cranes (wall, mobile, telescopic, static, overhead)
 - docking equipment
 - engine lift
 - fork lift
 - jacks
 - launch
 - mobile boat lifts
 - mobile elevated work platform (MEWP)
 - pallet truck
 - skates
 - sliding ways
 - slings and pull lifts
 - slipways
 - telehandler
 - tractor
 - trailer
 - trolleys
 - tug
 - winch

(AC3.3) **General rules:**

- calibration
- cleaning as you go
- cleaning after use
- pre and after use checks
- safe storage
- safe working loads
- sharpening
- shadow boards
- routine maintenance

(AC3.4) **Safety requirements:**

- adherence to required legislation and regulation
- confined spaces entry
- emergency stops on machines
- ensure use and correct settings for guides and guards
- equipment / machinery guards
- exposure action and limit values (EAV/ ELV) for vibrating tools
- health surveillance for those exposed to hazardous substances or working practices
- hot works permit
- local exhaust ventilation (LEVs)

- metal work fluid testing
 - portable appliance testing (PAT)
 - pneumatic, mains or battery operated tools
 - training on tool/machinery use
 - use of correct PPE and RPE when using machinery / tools
 - use of low voltage system
 - working at height procedures
 - working on or near water procedures
-

Learning outcome

The learner will:

4 Understand marine engineering processes

Assessment criteria

The learner can:

- 4.1 state the units and derived units used to perform simple calculations
 - 4.2 convert between units and derived units
 - 4.3 identify the factors to be considered when measuring and marking out
 - 4.4 list the factors affecting accuracy of measurement
 - 4.5 identify the types of work holding devices
 - 4.6 describe the methods of material removal
 - 4.7 describe the factors which effect material removal
 - 4.8 describe the types of assembly joining/ fixing
 - 4.9 describe the types of finishing
 - 4.10 identify the sequence of operations which maximise efficiency when carrying out marine engineering activities
-

Range

(AC4.1) **Units and derived units:**

- area
 - density
 - energy
 - flow
 - force
 - imperial and metric
 - length
 - mass
 - relative density
 - temperature
 - volume
 - weight
 - pressure
-

(AC4.3) **Factors:**

- angle
- capacity
- datum
- flatness
- length
- levelling, declivity, and inclination
- parallelism
- profile
- relative position
- tolerance
- type of measuring equipment used

(AC4.4) **Factors affecting accuracy of measurement:**

- calibration
- condition of equipment
- correct positioning
- dimensions
- humidity
- temperature
- tolerances

(AC4.5) **Work holding devices:**

- clamps
- chucks
- jigs
- vices
- face plates

(AC4.6) **Material removal:**

- sawing:
 - cutting at angle
 - cutting sheet materials
 - roughing down to size
- planing: (finishing to size)
- shaping/turning:
 - chiselling
 - filing
 - grinding
 - honing
 - routing
 - sanding
- drilling:
 - boring
 - counter-boring
 - counter sinking
 - through holes

- sheet metal cutting:
 - guillotining
 - nibbling
 - oxy/acetylene cutting
 - plasma cutting
 - shearing
 - water jetting
- machining
 - milling
 - turning
- thread cutting (tapping and dieing)

(AC4.7) **Factors which effect material removal:**

- atmosphere
- cutting compounds and friction reducing substances
- cutting speed
- location of material
- properties of materials
- quality of tools
- material hardness

(AC4.9) **Types of finishing:**

- appearance
- customer requirements
- durability
- feel
- functionality
- protection
- safety
- to meet a quality standard
- vessel use/ end use requirement

(AC4.10) **Sequence of operations:**

- planning and set up:
 - review and verify designs and plans
 - select and source a variety of precision data charts and reference tables
 - finalise time and cost of the work to be done
 - identify, source equipment and store, machinery, tools and materials
 - select, make, and use jigs, templates and tooling, as required
 - set up tools and machinery
- install / maintain / refit marine engines and marine ancillary systems and components:
 - measure and mark out to carry out precision machining and hand fitting processes
 - use hand tools to cut, drill, shape and finish components to required specification and accepted tolerances
 - move marine engineering components using the appropriate safe methods and equipment
 - check marine engineering components for robustness, fit and tolerances
 - shape, fabricate, manipulate and precision alignment of marine engineering components and materials to accepted tolerances

- analyse problems with machinery, equipment, tools and material, proposing/ implementing solutions where appropriate
- move, shape and manipulate marine engineering components to achieve best fit
- select and use appropriate methods for holding materials and marine engineering components in place during assembly, and for the connecting, fixing and assembly of materials and components
- safeguard marine engineering materials and components during assembly/ maintenance/ overhaul
- select suitable methods for fault finding and analysis
- make repairs whilst safeguarding the integrity of marine engineering components and the surrounding area
- identify, mark, store and organise dismantled marine engineering parts for reassembly
- fit out:
 - install and fix marine engineering components using the most appropriate method and materials
 - ensure the joints are made and treated
 - position and fit marine engineering items
 - finalise fit out for marine engineering components
- finish:
 - check joints are sealed and fit for purpose
 - prepare surfaces, treat suitability and ensure all are free from defects and protected
 - soften or suitably finish edges
 - assess quality of work
- commissioning marine engineering systems, equipment and machinery:
 - assess fixtures and fittings for quality, stability and free from defects
 - commission the boat
 - assemble and complete required documentation.
- reinstate work area
 - 5S approach
 - clean and return all tools and equipment to the appropriate storage area
 - clear away any waste and discarded materials
 - ensure work area is safe and free from dangers (risk assessment)
 - clean and sharpen any tools used ready for the next job

Unit 209

Servicing and maintenance of marine engines and ancillary systems

Unit level:	Level 2
GLH:	180
Unit aim:	This mandatory unit is concerned with the servicing and maintenance of marine engines. It covers servicing and maintenance of engines, resources and information required and basic servicing.

Learning outcome

The learner will:

- 1 Know how to service and maintain marine engines safely

Assessment criteria

The learner can:

- 1.1 identify the types of marine engine configurations
- 1.2 describe the types of engine installation
- 1.3 describe the operating principles of marine engines
- 1.4 identify the components of a marine engine
- 1.5 identify the ancillary systems and components of a marine engine
- 1.6 state the purpose of routine servicing and maintenance
- 1.7 identify types of data required for servicing and maintenance
- 1.8 state the hazards and precautions to be taken when working with marine engines

Range

(AC1.1) **Types of marine engine:**

- single cylinder
- multi cylinder
- in-line
 - horizontal
 - vee

(AC1.2) **Types of engine installation:**

- inboard
- outboard

(AC1.3) **Operating principles:**

- compression ignition
 - two stroke
 - four stroke
- spark ignition
 - two stroke
 - four stroke

(AC1.4) **Components of a marine engine:**

- camshaft and valve operating mechanisms
- connecting rod and gudgeon pin
- crankshaft
- crankshaft damper
- cylinder
- cylinder block and crankcase
- cylinder head
- exhaust
- flywheel
- induction (naturally aspirated or turbo/super charged)
- inlet and exhaust valves or ports
- main and thrust bearings
- oil pump and relief valve
- piston and piston rings
- small end and big end bearings
- sump
- timing gear

(AC1.5) **Ancillary systems and components:**

- control and instrumentation
 - alarms (sensors/ senders)
 - engine control unit (ECU)
 - monitors/ gauges
 - throttle and gear
- cooling and heating (air cooled and water cooled)
 - block heating
 - calorifiers
 - coolers
 - heat exchangers
 - hoses
 - pumps
 - pressure caps
 - sea water inlet
 - strainers
 - thermostats
- engine electrical
 - alternators
 - starter motors
 - stop solenoid
- exhaust (wet/ dry)

- muffler
- swan neck
- water lock
- fuel
 - tanks
 - piping
 - filters
 - pumps
 - injectors
 - cleaners
- ignition/ compression systems
- lubrication
 - pumps
 - filters
- mounts and couplings

(AC1.6) **Purpose of routine servicing and maintenance:**

- extend engine life
- maintain efficiency
- maintain manufacturer's warranty
- recognise defects
- reduce the chance of failure
- replace lifed items

(AC1.7) **Types of data:**

- workshop manuals
- manufacturer's data and information sheets
- service schedules
- service history
- parts lists
- legal and technical data reference books

(AC1.8) **Hazards:**

- danger from moving parts
- lubricants and fuels
- electrical equipment and systems
- fire risks
- noise
- heat
- confined spaces
- stored energy
- not following correct procedures
- working on water
- lifting/ transporting
- explosion
- chemicals

(AC1.8) **Precautions:**

- confined spaces
 - awareness
 - monitoring space
 - ventilation
 - RPE
- danger from moving parts
 - awareness
 - floors
 - guards
 - lock outs
- general precautions
 - emergency procedures
 - risk assessments and operating principles
 - safety data sheets
 - company procedures
 - hazard spotting/ checklists
- heat
 - PPE/RPE
- lubricants and fuels
 - skin protection
 - ventilation
- electrical equipment
 - safe isolation procedure
 - low-voltage systems
 - COSHH
 - PPE
 - MHOR
 - well ventilated
- fire risks
 - take precautions with fuels
 - permit to work
- legislation
 - HASAWA
 - COSHH
 - Environmental Protection Act
 - LOLER
 - PUWER
 - MHOR
- lifting and transporting
 - manual handling
 - mechanical equipment
 - strops/ slings
- noise
 - awareness of hazard
 - PPE
- personal protective equipment (PPE)
 - ear defenders
 - goggles
 - gloves
 - overalls
 - safety equipment

- safety shoes
 - stored energy
 - awareness of hazards
 - PPE
 - working on water
 - awareness of hazard
 - company policy
 - PPE
-

Learning outcome

The learner will:

- 2 Understand the resources and information required for servicing operations

Assessment criteria

The learner can:

- 2.1 describe the main elements of a maintenance programme
 - 2.2 state the documentation and information required for servicing and maintenance
 - 2.3 interpret technical data to carry out a maintenance programme
 - 2.4 state the resources required for servicing and maintenance
-

Range

(AC2.1) Main elements of a maintenance programme:

- preventive and scheduled maintenance:
 - cleaning
 - lubrication
 - replenishment
 - adjustment
 - checking
 - overhaul
 - replacement of consumables
 - corrective/ emergency maintenance

(AC2.2) Documentation and information:

- reference data and documentation:
 - method statements
 - risk assessments
 - service manuals/ sheets
 - safety data sheets
 - standard operating procedures
 - technical information
 - installation drawing
 - vessel/ craft documentation
 - reporting systems:
 - job sheets
 - electronic reports
-

- recommendations to other personnel

(AC2.4) **Resources:**

- specialist tools
- test equipment
- yard facilities and equipment
 - hand tools
 - measuring equipment
 - PPE
 - power tools
 - lifting equipment
 - draining equipment
- spare parts
- materials and consumables, e.g.:
 - cleaning materials
 - connections
 - electrical
 - filters
 - gaskets
 - lubricants
 - seals

Learning outcome

The learner will:

- 3 Be able to carry out basic servicing and maintenance of marine engines safely.

Assessment criteria

The learner can:

- 3.1 identify and apply the safety and environmental regulations and safe working practices and procedures
- 3.2 carry out pre-work inspection and prepare the work area
- 3.3 carry out routine maintenance on a marine engine and its ancillary systems
- 3.4 carry out checks whilst servicing and maintaining marine engines

Range

(AC3.1) **Safety and environmental regulations:**

- As covered in earlier unit

(AC3.1) **Safe working practices and procedures:**

- As covered in earlier unit

(AC3.2) **Pre-work inspection and prepare the work area:**

- follow work procedures (safe isolation, risk assessments, method statements, permit to work)
- obtain appropriate PPE for task
- protect surfaces
- safe access/ egress routes
- select tools, equipment and materials

(AC3.3) **Routine maintenance:**

- engines:
 - checking and adjustment of valve clearance
 - examination of seals and gaskets
 - examination of cylinder head for coolant leaks
 - examination of exhaust manifolds
 - examination of engine mounting
- control and instrumentation
 - operational checks
 - security of fixings
 - visual checks
- cooling
 - pressure test for leaks
 - testing thermostat
 - checking drive belts for condition and tension
 - checking coolers and heat exchangers for damage/ cleanliness
 - checking coolant by specific gravity or refractometer
 - checking/replacing impellor/ gasket/ face plate
 - checking coolant system anodes
- engine control unit
 - diagnostic download of fault history
 - functional checks
- engine electrical
 - corrosion
 - operational checks
 - security of fixings
 - visual checks
- fuel system
 - condition of tank
 - fuel lines and unions
 - check lift pump operation
 - cleaning and replacing filters
 - service/ replace injectors
 - bleed mechanical fuel system
- lubrication system
 - checking/ replacing oil
 - checking for contamination (oil sampling)
 - cleaning and replacing filter
- ignition system
 - ignition timing
 - condition of contact breaker and points
 - condition of distributor
 - condition of spark plugs
 - condition of leads and connections

- inlet and exhaust systems
 - check manifold for leaks
 - check exhaust system for condition
 - check induction system for damage
 - check turbo/ super charge for wear
- starting system
 - condition of leads and connections
 - servicing of battery
 - master switches

(AC3.4) **Checks:**

- safety checks:
 - control system (rotating parts, sea cock)
 - electrical power
 - piping and connectors
 - oil and coolant levels
 - strainers
- post work inspection check
 - vessel cleanliness
 - environmental disposal
 - security of vessel
 - tools returned and signed off
 - ensure vessel is safe and free from danger and left in operational condition
- performance checks:
 - battery condition check
 - earth bonding tests
 - engine running temperatures
 - pressure /leak tests
 - leaks
 - vibration
 - charging system checks

Learning outcome

The learner will:

- 4 Be able to record results and make recommendations

Assessment criteria

The learner can:

- 4.1 identify methods to record results obtained
 4.2 compare the results obtained from servicing and maintenance with manufacturer's data
 4.3 record results of service and maintenance activity

Range

(AC4.1) **Methods to record results:**

- diagnostic test equipment
- company/ vessel maintenance records

(AC4.2) **Results obtained from servicing and maintenance:**

- exhaust gas emissions testing S.I. and C.I. engines
- compression testing (S.I. and C.I.)
- cooling system testing
- engine system testing with an electronic engine analyser
- valve clearances
- data obtained from engine/ manufacturer specification/ sea trials

Learning outcome

The learner will:

- 5 Understand the functions of electrical distribution systems

Assessment criteria

The learner can:

- 5.1 identify and describe the purpose of components used in electrical systems on board yachts and motor cruisers
- 5.2 describe the operation of shore power systems
- 5.3 identify the components of propulsion engine driven generating systems
- 5.4 describe the purpose of separate engine driven generator units

Range

(AC5.1) **Identify and describe the purpose of components:**

- cables
- deck plugs and sockets
- circuit breakers
- consumer units
- residual current devices
- transformers
- switched mode power supplies
- inverters
- internal 13Amp sockets
- luminaries
- extraction fans and blowers
- electrical winches
- bowthrusters
- stern thrusters
- pumps
- float switches
- trim tabs

- electrical switches

(AC5.3) **Components of propulsion engine driven generating systems:**

- engine driven alternators
- supplementary high charge regulators
- split charge relays
- charge splitting diodes
- isolators
- changeover switches

(AC5.4) **Purpose of separate engine driven generator units:**

- prime mover
- alternator
- armature
- automatic voltage regulator (AVR)
- safety devices

Learning outcome

The learner will:

- 6 Understand electrical supply systems (12 and 24vdc and 230vac), circuit protection and grounding/ earthing arrangements

Assessment criteria

The learner can:

- 6.1 describe the marine electrical systems and equipment as fitted on board yachts and motor cruisers
- 6.2 describe the relationships between battery capacity, current demand, and recharge arrangements for on board systems
- 6.3 identify the advantages and limitations of shore supplies
- 6.4 identify the safety implications of 110 and 230 volt systems on small craft
- 6.5 identify the requirements for and use of galvanic isolators
- 6.6 determine load currents in supply cables, and specify protective devices
- 6.7 determine voltage drops in circuits with particular reference to low voltage systems delivering significant currents
- 6.8 identify fusing/ circuit breaker requirements for battery derived 'ship supplies'
- 6.9 identify the advantages and disadvantages of fusing engine starter circuits

Range

(AC6.1) **Marine electrical systems:**

- extra low voltage and low voltage on board supply systems (according to both IEC and ISO definitions)
- radar and aerial cable length

- shielding/routing signal cables
- transducers

(AC6.1) **Electrically powered equipment:**

- powered winches
- bow thrusters/ stern thrusters
- pumps

Learning outcome

The learner will:

7 Understand the methods of storing electricity on board

Assessment criteria

The learner can:

- 7.1 describe the battery storage requirements on board yachts and motor cruisers
- 7.2 identify types and applications of batteries used on board
- 7.3 identify appropriate battery sizes and arrangements for typical applications
- 7.4 explain the importance of separating batteries of different construction
- 7.5 explain the importance of insulating battery terminals
- 7.6 state the procedures for checking the condition of batteries
- 7.7 identify the procedures to maintain batteries in good condition
- 7.8 describe the safety precautions required in relation to battery charging and battery spaces
- 7.9 describe the effects of plate sulphation and how it can be minimised

Range

(AC7.1) **Battery storage requirements:**

- stable and secure installation
- well vented
- ample capacity for task
- watertight integrity

(AC7.2) **Types and applications of batteries:**

- Types
 - lead-acid
 - gel cell
 - absorbed glass mat
 - NiCad, Alkaline
 - Li-ion
- Applications
 - cranking/ engine starting
 - powering on-board electrics/ electronics
 - powering portable equipment

(AC7.6) **Procedures for checking the condition of batteries:**

- battery drop test
- specific gravity test
- hydrometer
- multimeter
- battery voltage equipment

(AC7.7) **Procedures to maintain batteries in good condition:**

- regular charging
- maintaining internal battery levels
- regular use
- terminal connection integrity
- battery isolation when not in use

(AC7.8) **Precautions:**

- warning notices
- well ventilated work area
- PPE
- insulated tools
- monitor charging current
- safe disposal
- manual handling (MHOR)
- battery not left unmonitored

Unit 210

Servicing and maintenance of marine propulsion systems

Unit level:	Level 2
GLH:	100
Unit aim:	This mandatory unit is concerned with the servicing and maintenance of marine propulsion systems. It covers servicing and maintaining marine propulsions systems, resources and information required and basic principles of propulsion systems.

Learning outcome

The learner will:

- 1 Know how to service and maintain marine propulsion systems safely

Assessment criteria

The learner can:

- 1.1 identify the types of marine propulsion systems
- 1.2 state the main components of propulsion systems
- 1.3 identify types of propulsion drive system
- 1.4 explain the purpose of routine servicing and maintenance
- 1.5 state the range of documentation and information required for the servicing and maintenance of marine propulsion systems
- 1.6 state the hazards and precautions to be taken when working with propulsion systems

Range

(AC1.1) **Types of marine propulsion systems:**

- in board engines:
 - assembly fixtures
 - transmission systems
 - electrical connections
 - control systems
- out board engines:
 - assembly and mounting
 - control systems
 - electrical connections

(AC1.2) **Components of propulsion systems and ancillary systems:**

- gearbox and reduction gear (cooling and lubricating)
- drive systems
- shafts
- propellers
- brackets
- seals (stern seals, rudder seals)
- shaft cooling
- anti-syphon breaks
- shaft bonding
- bearings
- couplings
- UJ/ CV drives
- gland packing
- rudders
- steering gear
- cutlass bearings
- rope cutters
- anodes
- plumber blocks
- stern glands
- shafts
- keys
- shaft brakes

(AC1.3) **Types of propulsion drive system:**

- direct
- electro/ hydraulic
- outdrive
- Z drive
- V drive
- parallel output
- down angle
- sail drive
- stern drive
- jet drive
- pod drive
- propellers:
 - fixed
 - feathering
 - folding
 - variable
 - surface piercing

(AC1.4) **Purpose of routine servicing and maintenance:**

- extend engine life

- maintain efficiency
- maintain manufacturer's warranty
- recognise defects
- reduce the chance of failure
- replace lified items

(AC1.5) **Range of documentation and information:**

- workshop manuals
- manufacturer's data and information sheets
- service schedules/sheets
- parts lists
- safety data sheets
- standard operating procedures
- risk assessments
- vessel documentation
- legal and technical data reference books
- service history
- technical information
- service manuals
- reporting systems
 - job sheets
 - recommendations to other personnel

(AC1.6) **Hazards:**

- danger from power transmission systems rotating
- lubricants
- electrical systems
- fire risks
- noise
- heat
- confined spaces
- stored energy
- not following correct procedures
- working on water
- explosion
- chemicals
- lifting/ transporting

(AC1.6) **Precautions:**

- general precautions
 - emergency procedures
 - risk assessments and operating principles
 - safety data sheets
- moving parts
 - awareness
 - floors
 - guards
 - lock outs

- lubricants
 - skin protection
 - ventilation
- electrical systems
 - safe isolation procedure
 - COSHH
 - Manual handling (MHOR)
 - low-voltage systems
 - PPE
 - well ventilated
- fire risks
 - take precautions with lubricants
 - permit to work
- legislation
 - HASAWA
 - COSHH
 - Environmental Protection Act
 - LOLER
 - PUWER
 - MHOR
- noise
 - awareness of hazard
 - PPE
- heat
 - PPE/RPE
- confined spaces
 - awareness
 - monitoring space
 - ventilation
 - RPE
- stored energy
 - awareness of hazard
 - PPE
- not following procedures
- working on water
 - awareness of hazard
 - company policy
 - PPE
- explosion
- chemicals
- lifting/ transporting
 - manual handling
 - mechanical equipment
 - strops/ slings
- personal protective equipment (PPE)
 - ear defenders
 - goggles
 - gloves
 - overalls

- safety equipment
- safety shoes

Learning outcome

The learner will:

- 2 Understand the resources required for servicing operations

Assessment criteria

The learner can:

- 2.1 describe the main elements of a maintenance programme
2.2 interpret technical data to carry out a maintenance programme
2.3 state the resources required for servicing and maintenance

Range

(AC2.1) **Main elements of a maintenance programme:**

- preventive and scheduled maintenance:
 - cleaning
 - lubrication
 - replenishment
 - adjustment
 - checking
 - overhaul
 - replacement and consumables
 - corrective/ emergency maintenance

(AC2.3) **Resources:**

- test equipment
- yard facilities and equipment:
 - hand tools
 - measuring equipment
 - calibrated tools
 - specialist manufacturer tools
 - power tools
 - lifting equipment
 - draining equipment
- spare parts, materials and consumables:
 - filters
 - seals
 - gaskets
 - electrical connections
 - lubricants

Learning outcome

The learner will:

- 3 Be able to undertake servicing and maintenance procedures safely

Assessment criteria

The learner can:

- 3.1 identify and apply the safety and environmental regulations and safe working practices and procedures
- 3.2 carry out pre-work inspection and prepare the work area
- 3.3 carry out routine servicing and maintenance on marine propulsion systems ancillary systems
- 3.4 carry out checks whilst servicing and maintaining marine propulsion systems

Range

(AC3.1) **Safety and environmental regulations:**

- As covered in earlier unit

(AC3.1) **Safe working practices and procedures:**

- As covered in earlier unit

(AC3.2) **Pre-work inspection and prepare work area:**

- follow work procedures (safe isolation, risk assessments, method statements, permit to work)
- obtain appropriate PPE for task
- protect surfaces
- safe access/ egress routes
- select tools, equipment and materials

(AC3.3) **Routine servicing:**

- visual checks (internal/ external)
 - leaks
 - signs of wear
 - corrosion
 - alignment
 - damage
 - bonding
 - general condition
- performance checks
 - vibration
 - leaks
 - smell
 - sound
 - pressure/ temperature
 - operation

- measurement
- oil sample
- filtration

(AC3.3) **Maintenance:**

- re-packing gland (shaft/ rudder)
- setting seals
- alignment
- drive train
 - prop shaft to stern tube
 - prop shaft (P and A)
 - shaft straightness
 - wear
- cutlass bearing
 - check/ replace
- rope cutters
 - checks
 - anodes
 - setting
- prop/ coupling lapping
- inspection of keys and keyways
- check gearbox levels
- check anodes
- check gearbox cooling
- replenish/ bleed hydraulic system
- replenish greaser

(AC3.4) **Checks:**

- vessel cleanliness
- environmental disposal of any waste
- security of vessel
- tools returned/ signed off
- ensure vessel in safe condition and left in operational condition

Learning outcome

The learner will:

- 4 Be able to record results and make recommendations

Assessment criteria

The learner can:

- 4.1 identify methods to record results obtained
- 4.2 record results of the service/ maintenance activity
- 4.3 compare the results obtained from performance checks with manufacturer's data

Range

(AC4.2) **Results:**

- visual inspection
- vibration/ sound analysis
- oil analysis
- alignment
- straightness
- wear
- mount heights
- employer specific results

Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the Centres and Training Providers homepage on www.cityandguilds.com.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues.

Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information on such things as:

- **Walled Garden:** how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification.

Specifically, the document includes sections on:

- The centre and qualification approval process and forms

- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Appendix 2 Useful contacts

UK learners

General qualification information

E: learnersupport@cityandguilds.com

International learners

General qualification information

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results

F: +44 (0)20 7294 2413

E: centresupport@cityandguilds.com

Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

F: +44 (0)20 7294 2413

F: +44 (0)20 7294 2404 (BB forms)

E: singlesubjects@cityandguilds.com

International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

F: +44 (0)20 7294 2413

E: walledgarden@cityandguilds.com

Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

T: +44 (0)121 503 8993

E: business@cityandguilds.com

Publications

Logbooks, Centre documents, Forms, Free literature

F: +44 (0)20 7294 2413

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