

Level 2 Diploma in Boatbuilding (Foundation) (2473-02)

Version 1-1(January 2017)

Qualification Handbook

Qualification at a glance

Subject area	Marine
City & Guilds number	2473
Age group approved	16-19, 19+
Entry requirements	None
Assessment types	Multiple Choice; Short Answer; Assignment
Approvals	Qualification approval
Support materials	Qualification handbook; Assessment pack; Exemplar assignment; 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 Boatbuilding (Foundation)	460	502	2473-02	603/0348/7

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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 Boatbuilder, 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 boatbuilding and marine sector.</p> <p>They will develop the range of transferable skills over a cross section of production, manufacturing, service and construction sectors which are valued by employers and therefore increase their employability skills.</p> <p>Learners will also gain the skills to work competently with at least two different types of materials, including wood, composites and metals.</p> <p>All the above will enable learners to progress into further training to become a Boatbuilder.</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 Boatbuilder.
Who did we develop the qualification with?	This qualification has been developed in collaboration with the Boatbuilder trailblazer group which is led by organisations including: Berthon Boat Company Ltd, Sunseeker International, Princess Yachts, Pioneer Sailing Trust, Pendennis Shipyard, Fairline Loats, Broom Boats, Green Marine, English Harbour Yachts, Windboats, Cockwells and the British Marine Federation.
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 Boatbuilders, which will replace the current Level 2 and Level 3 Marine, Construction, Systems Engineering and Maintenance (Boatbuilding) 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 boat builder.</p>

Structure

To achieve the **Level 2 Diploma in Boatbuilding (Foundation)**, learners must achieve mandatory units 201, 202 and 203 and **two** optional units from units 204-207.

City & Guilds unit number	Unit title	GLH
Mandatory		
201	Introduction to the marine industry	100
202	Principles of boatbuilding technology	100
203	Business improvement techniques	50
Optional		
204	Yacht and boatbuilding assembly and sub-assembly	140
205	Production of external boat components	140
206	Interior installation and fitting out of boats	70
207	FRP manufacture for marine construction	160

Total Qualification Time

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 Boatbuilding (Foundation)	460	502

2 Centre requirements

Approval

To offer these qualifications, all 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 boatbuilding activities, with all the equipment, machines, relevant tools and consumables for working safely with boatbuilding 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 quality assurer, but cannot internally verify their own assessments.

Assessors and Internal Quality Assurers

Registered centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. Assessor/Verifier (A/V) units are valued as qualifications for centre, but they are not currently a requirement for the qualification.

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
- 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, 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	
Exemplar assignment	
Developing centre devised assessments – guidance for centre based assessment writers (GM1)	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 quality assurer, 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 **each** of the mandatory units 201 and 202
- **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 **each** chosen optional unit

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
- exemplar assignment and underpinning knowledge questions for unit 205

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.

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 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
2473-202	Principles of boatbuilding technology	Multiple-choice online test 2473-202 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.cityandguilds.com
2473-204	Yacht and boatbuilding assembly and sub-assembly	Centre-devised practical assignment and Short-answer questions 2473-204 These assessments cover all the outcomes in this unit	www.cityandguilds.com
2473-205	Production of external boat components	Centre-devised practical assignment and Short-answer questions 2473-205 These assessments cover all the outcomes in this unit	www.cityandguilds.com
2473-206	Interior installation and fitting out of boats	Centre-devised practical assignment and Short-answer questions 2473-206	www.cityandguilds.com

Unit	Title	Assessment method	Where to obtain assessment materials
		These assessments cover all the outcomes in this unit	
2473-207	FRP manufacture for marine construction	Centre-devised practical assignment and Short-answer questions 2473-207 These assessments cover all the outcomes in this unit	www.cityandguilds.com

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.

Assessment strategy

Test Specifications

The way the knowledge is covered by each test is laid out in the tables below:

Assessment title: 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		
Unit 201	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
	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: Principles of boatbuilding technology

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

202	Duration: 60 minutes		
Unit 202	Learning Outcome	Number of marks	%
	01: Know how to identify boat building materials, their reaction to the environment and their properties	14	31
	02: Know how to interpret drawings, specifications and installation requirements	6	13
	03: Know how to use tools and equipment safely when boatbuilding	7	16
	04: Understand boatbuilding operations	18	40
Total		45	100

Assessment title: Business improvement techniques

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

203	Duration: 120 minutes		
Unit 203	Learning Outcome	Number of marks	%
	01: Know what is meant by continuous improvement	29	29
	02: Understand what is meant by workplace organisation	14	14
	03: Know what is meant by visual management	15	15
	04: Understand problem solving techniques	42	42
Total		45	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 **not** allowed.

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 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 Boatbuilder Employer Group has taken the decision to grade this qualification Pass/Merit/Distinction, through the aggregation of the individual assessment 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:

- 901 Pass
- 902 Merit
- 903 Distinction

6 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Assessment type
- 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 (eg 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.
Assessment type	Multiple-choice online test

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 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
- finishing facilities
- 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

(AC1.2) **Services:**

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

(AC1.3) **Services of boatbuilding 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 and mechanical installation and maintenance
- electrical and electronic diagnostic maintenance and installations
- fit out or refit operations for joinery
- electrics
- preparation, painting and finishing
- boat valeting
- berthing of boats
- boat lifting
- storage ashore
- shower and laundry services

(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

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

- shipwrights, boatbuilders, joiners and sawyers:
 - boatbuilding boat repair 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
- 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
 - 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 finishers:
 - preparation for boat painting
 - filling and fairing
 - boat spraying
 - painting and finishing operations
- upholsterers:
 - cabin décor
 - furnishings activities
 - external covers and awnings
- boat mover:
 - boat moving operations on water and ashore
 - lifting
 - 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 and liaises with owner
- chandler:
 - supply of yacht fittings and fastenings, glues, ropes, charts, books, paint, chain, shackles, anchors, yacht clothing, boots and navigation equipment
- buyers
- storekeepers
- 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
-

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
 - lighters
 - passenger boats
 - pilot boats
 - dredgers
 - ferries
 - lifeboats
 - military boats
 - fishing vessels

(AC2.2) **Locations:**

- port
 - starboard
 - forward
 - aft
 - bow
 - stern
 - transom
 - quarter
 - aloft
 - below
-

- steering (helm) position
- upper steering position
- coach roof
- wheelhouse
- engine room
- tank space
- 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
- freeboard

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

- cleats
- bollards
- fairleads
- windlass
- anchor
- winch
- wheel
- tiller
- navigation equipment
- masts/spars 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
- anodes

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

- main engines
- propulsion systems
- couplings and drives:
 - Z
 - V
 - sail drive
 - outdrive
 - outboard
 - wet jet
- steering systems:
 - mechanical
 - 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
- 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 (HSWA)
- 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 at Work Regulations
- Supply of Machinery Regulations
- Manual Handling Operations Regulations
- Work at Height Regulations
- Safe Working in Confined Spaces Regulations and Code of Practice
- Supply of Machinery Regulations
- 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
- Registration, Evaluation, Authorisation & restriction of Chemicals (REACH) (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

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

- hard hats
- goggles
- boots
- gloves
- safety harness
- lifejacket
- buoyancy aids
- overalls
- ear attenuators and defenders
- wet weather gear
- respiratory protection equipment (RPE):
 - masks
 - air feed hoods

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

- operating machinery
- working at height
- working on board
- working on water
- working in noisy environments
- working with hazardous substances:
 - chemicals
 - paints

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

- warning or cautionary signs
- prohibition signs
- mandatory signs
- 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
- exothermic chemicals
- solvents and paints
- hot works without permitting

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

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

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

- 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
- vibration
- chemicals

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

- 5S technique of good housekeeping:
 - sort
 - set
 - standardise
 - shine
 - sustain
- correct storage of tools, equipment and materials
- maintaining access and egress to:
 - work stations
 - walkways
 - emergency exits
 - fire doors
- 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
- 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
- mobile technology
- short wave radios

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

- the importance of listening skills
- pay attention to work instructions
- ensure understanding by asking questions to confirm understanding
- avoid abusive or offensive behaviour
- personal hygiene
- willing co-operation with all levels of organisation
- good time keeping
- obey company rules and regulations
- work safely

- treat people (workmates and customers) with courtesy and respect
- be reliable and trustworthy
- adhere to current regulations and legislation
- maintain a positive attitude

(AC5.3) **Difficulties:**

- disrespectful behaviour
- direct and indirect discrimination
- victimisation
- harassment

(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 stating labour hours
- sub-contracted work detail
- requisition sheets
- test and quality information
- calibration certificates
- materials and quantities

- measurements:
 - weight
 - ratio
- 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
- external:
 - designers' drawings and specifications
 - regulation agencies
 - Recreational Craft Directive (RCD)
 - technical data and information
 - safety data sheets
 - health and safety regulations and information
 - compliance organisations and regulations

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

- prevent re-work and warranty claims
- prevent wrong 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 202

Principles of boatbuilding technology

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 boat building maintenance and support operations.
Assessment type	Multiple-choice online test

Learning outcome

The learner will:

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

Assessment criteria

The learner can:

- 1.1 identify the common materials used in boatbuilding
- 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 and hydrolysis
- 1.6 identify types of permanent, semi-permanent and temporary bonds
- 1.7 identify types of protective coatings used in marine applications
- 1.8 state the factors influencing the choice of materials in boatbuilding assembly and sub-assembly

Range

(AC1.1) **Materials:**

- timbers and veneers:
 - hard woods (oak, elm, teak, iroko, mahogany, sapele, balsa)
 - soft woods (douglas fir, pitch pine, European redwood, spruce)
 - manufactured boards (plywood, MDF, honeycomb boards, foam cores, chipboard, OSB, blockboard, marine plywood)
- composites:
 - glass reinforced plastic (GRP)
 - fibre reinforced plastic (FRP)

- plastics
- metals:
 - ferrous (steel)
 - non-ferrous (lead, aluminium, copper)
 - alloys (brass, bronze)
- filler and filler compounds:
 - colloidal silica
 - talc and calcium carbonate
 - glass microfibres
- resins:
 - polyester
 - vinylesters
 - epoxy
- cloth:
 - reinforcing fibres
 - fibre reinforcement
 - pre-impregnated
- bedding:
 - silicon
 - rubber
 - PTFE
 - polyurethane
- solvents:
 - acetone
 - thinners
- organic peroxides
 - catalyst

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

- metal:
 - weight
 - density
 - colour
 - magnetism
- wood:
 - colour
 - grain
 - texture
 - smell
 - weight
- composite:
 - colour
 - orientation
 - identifier strand
- cloth:
 - fibre orientation
 - weight
 - identifier strand
- filler and filler compounds:
 - texture
 - colour

- hardness
- weight

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

- metal:
 - tensile strength
 - hardness
 - toughness/brittleness
 - compressive/sheer strength
 - ductility/malleability
 - corrosion resistance
- wood:
 - tensile strength
 - hardness
 - toughness/brittleness
 - erosion resistance
 - elasticity
 - durability
 - moisture content
 - compressive/sheer strength
 - workability
- composite:
 - tensile strength
 - hardness
 - toughness/brittleness
 - ductility/malleability
 - compressive/sheer strength
 - elasticity
- pre-impregnated:
 - tensile strength
 - hardness
 - toughness/brittleness
 - ductility/malleability
 - compressive/sheer strength
 - elasticity
- resins/organic peroxides:
 - pot life
 - shelf life
 - temperature
 - humidity
 - mix ratio (weight, volume)
 - viscosity
- cloth:
 - weight
 - fibre length
 - fibre direction
 - weave
 - pattern
 - colour
- filler and filler compounds:
 - size
 - viscosity

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

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

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

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

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

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

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

- split pins
- R clips
- polyurethane
- hot glue
- circlips
- nails
- pins

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

- varnishes
- paints (including anti-fouling)
- preservatives
- resins
- plastic sheathing
- metallic coatings (eg galvanising and anodising)
- powder coating
- vinyl wrapping

(AC1.8) **Factors:**

- suitability based on:
 - location
 - cost
 - weight
 - durability
 - stability/longevity
 - availability
 - customer requirements

Learning outcome

The learner will:

- 2 Know how to interpret drawings, 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 the production of boats and fitting out
- 2.3 identify common scales used for drawing
- 2.4 list the sources of marine installation information

Range

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

- centre lines
- water line
- datum lines
- station lines

- forward perpendicular (FP)
- aft perpendicular (AP)
- visible outline
- dimension lines
- hidden detail

(AC2.2) **Types of drawings:**

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

(AC2.4) **Sources:**

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

Learning outcome

The learner will:

- 3 Know how to use tools and equipment safely when boatbuilding

Assessment criteria

The learner can:

- 3.1 identify typical hand tools, machine tools and equipment used in boatbuilding, outfitting and finishing activities
- 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

Range

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

- cutting tools:
 - saws (cross cut, panel, coping, tenon, pad, hacksaws, diamond, tungsten tipped, pull, hole)

- material removal tools:
 - chisels
 - planes (block, smoothing, jack, try, bollow, moulding, rebate, bullnose, granny's tooth)
 - spoke shaves
 - drawknives
 - files
 - rasps
 - adze
- assembly and joining tools:
 - drills
 - screw drivers
 - spanners
 - socket sets
 - torque wrench
 - impact drive
- hammers:
 - claw
 - ball pein
 - cross pein
 - maul
 - lump
 - soft blow
 - mallet
- measuring and marking out tools:
 - tapes
 - rules
 - squares
 - gauges (bevel, spar)
 - scribes
 - templates
 - 'Shepherds crook'
 - tick stick
 - joggle sticks
 - spiles and spiling battens
 - water level
 - levels
 - laser measures and levels
 - 3D scanner
 - plumb bob
 - spirit level
- drilling tools
- shaping tools
- sharpening systems
- coating application tools
- surface preparation tools
- special tools:
 - jigs
 - formers
 - saddles
- work-holding devices:
 - grips

- vices
- chucks
- 'G' cramps
- sash cramps
- quick-release cramps
- lever cramps
- adhesive tapes
- dust sheets
- protective coatings
- electrical leads
- lead lights
- airlines
- local exhaust ventilation (LEVs)

(AC3.2) **Equipment for lifting and transporting:**

- transporting:
 - boat hoist
 - boat mover
 - tug
 - tractor
 - trailer
 - trolleys
 - skates
 - jacks
 - pallet truck
 - fork lift
 - telehandler
 - cranes (wall, mobile, telescopic, static, overhead)
 - slings and pull lifts
 - docking equipment
 - slipways
 - winch
 - mobile boat lifts
 - sliding ways
 - launches
- lifting accessories:
 - chains
 - blocks
 - ropes
 - trops
 - shackles
 - slings

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

- safe storage
- cleaning after use
- sharpening
- honing
- before use checks
- shadow boards
- safe working loads

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

- use of correct PPE

- ensure use and correct settings for guides and guards
- use of low voltage system
- pneumatic, mains or battery operated tools
- LEVs
- health surveillance for those exposed to hazardous substances or working practices
- logging trigger times and measuring vibration of power tools
- exposure action and limit values (EAL/ELV) extraction requirements
- work at height and work on water procedures

Learning outcome

The learner will:

4 Understand boatbuilding operations

Assessment criteria

The learner can:

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

Range

(AC4.1) **Construction methods:**

- clinker
- carvel
- double diagonal
- cold moulding
- strip planking
- stitch and glue
- composite male and female moulding
- steel and aluminium

(AC4.2) **Units and derived units:**

- length
- area
- volume

- mass
- weight
- density
- relative density
- force
- imperial and metric

(AC4.4) **Factors:**

- length
- flatness
- parallelism
- angle
- profile
- relative position
- capacity
- levelling and declivity

(AC4.5) **Factors:**

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

(AC4.6) **Work-holding devices:**

- vices
- clamps
- chucks
- jigs

(AC4.7) **Material removal:**

- sawing:
 - cutting sheet materials
 - roughing down to size
 - cutting at angle
- planing:
 - finishing to size
 - working on end grain
 - producing grooves
 - rebates or profiles
- shaping/turning:
 - cutting out waste
 - paring
 - carving
 - routing
 - honing
 - grinding
 - sanding
 - chiselling
 - filing
 - scissoring of cloths

- drilling:
 - through holes
 - counter-bored holes
 - counter-sunk holes
 - boring bar
- sheet metal cutting:
 - oxy/acetylene
 - plasma cutter
 - water jet

(AC4.8) **Factors which effect material removal:**

- dryness of material
- location of material
- cutting speed
- material hardness
- grain direction and structure/timber
- use of lubricants
- cutting compounds and friction reducing substances such as candle wax or bees wax

(AC4.10) **Principles of lofting:**

- lofting grid made up of:
 - forward and after perpendiculars
 - station lines
 - water lines
 - buttock lines
 - diagonal lines
- table of offsets to produce a line plan containing:
 - sheer plan or profile half breath plan
 - body plan

(AC4.11) **Purpose of finishing:**

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

(AC4.12) **Sequence of operations:**

- planning and set up:
 - review and verify designs and plans
 - finalise time and cost of the work to be done
 - identify and source equipment, machinery, tools and materials
 - make, produce and use jigs and templates as required
 - set up tools and machinery
- manufacture and assemble/disassemble and repair components:
 - manufacture/repair components to required specification
 - move components using the appropriate safe methods
 - check components for robustness, fit and tolerances

- analyse problems with machinery, equipment, tools and material, proposing/implementing solutions where appropriate
- move, shape and manipulate components to achieve best fit
- select and use appropriate methods for holding materials and components in place during assembly, and for the connecting, fixing and assembly of materials and components
- safeguard materials and components during assembly
- select suitable methods for fault finding and analysis
- make repairs whilst safeguarding the integrity of components and the surrounding area
- identify, mark, store and organise dismantled parts for reassembly
- fit out:
 - install and fix components using the most appropriate method and materials
 - ensure the joins are made and treated
 - position and fit items
 - finalise fit out for deck hardware
- finish:
 - check joins 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 and sea trials:
 - assess fixtures and fittings for quality and stability
 - commission the boat
 - assemble required documentation
- reinstate work area

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.
Assessment type	Short-answer questions

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 (eg production)
- improved quality (eg reduced defects)
- improved safety (eg safe to use)
- improved working practices (eg reduced operator motion)
- improved delivery (eg reduced transportation time, reduced lead time)
- reduction of waste (eg over-processing, excess inventory)
- resource utilisation (eg reduced waiting time)
- improved customer satisfaction (eg 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 effect 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) **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 204

Yacht and boatbuilding assembly and sub-assembly

Unit level:	Level 2
GLH:	140
Unit aim:	This optional unit is concerned with yacht and boatbuilding assembly and sub-assembly. It covers the specifications, tools, equipment and materials required, carrying out assembly and sub-assembly and understanding quality standards.
Assessment type	Centre-devised practical assignment and short-answer questions

Learning outcome

The learner will:

- 1 Know the specifications, tools, equipment and materials required for boat assembly and sub-assembly operations

Assessment criteria

The learner can:

- 1.1 use sources of information relevant to boat assembly and sub-assembly operations
- 1.2 interpret specifications to produce assembly and sub-assembly operations
- 1.3 select the materials used in boat assembly and sub-assembly
- 1.4 identify material defects commonly found in timber, composite boards and metal
- 1.5 use hand tools and equipment in boatbuilding assembly and sub-assembly safely
- 1.6 identify and operate the woodworking machinery used in boatbuilding assembly and sub-assembly
- 1.7 operate the hand held power tools used in boatbuilding assembly and sub-assembly
- 1.8 identify appropriate types of permanent, semi-permanent and temporary bonds
- 1.9 use protective coatings for assembly and sub-assembly operations

Range

(AC1.1) **Sources of information:**

- codes of practice
- rules and regulations:
 - Lloyd's
 - RCD
- surveyor's report
- manufacturers' specifications

- technical datasheets
- safety data sheets
- scheme of work
- customer/client specifications
- Boat Safety Scheme (BSS) (Inland Waterways Association)
- Inland Waterways
- BS/EN standards applicable to the marine industry
- line plans
- working drawings
- designer's specifications
- current drawing standards ISO 8888/2000

(AC1.2) **Interpret specifications:**

- identify material required from the specification
- select the correct tools to use for specific applications
- identify and select the fittings and fixtures required for assemblies
- describe the techniques used to transfer mould and template data onto mould and template material (eg nail-head impressions)
- describe the cutting and shaping methods used to produce:
 - moulds
 - template
 - jigs

(AC1.3) **Materials:**

- timbers and veneers:
 - hard wood (oak, elm, teak, iroko, mahogany, sapele, balsa)
 - soft wood (douglas fir, pitch pine, European redwood, spruce)
 - manufactured boards (plywood, MDF, honeycomb boards, foam cores, chipboard, OSB, blockboard, marine plywood)
- composites:
 - glass reinforced plastic (GRP)
 - fibre reinforced plastic (FRP)
 - plastics
- metals:
 - ferrous (steel)
 - non-ferrous (lead, aluminium, copper)
 - alloys (brass, bronze)
- filler and filler compounds:
 - colloidal silica
 - talc and calcium carbonate
 - glass microfibres
- resins:
 - polyester
 - vinylesters
 - epoxy
- cloth:
 - reinforcing fibres
 - fibre reinforcement
 - pre-impregnated
- bedding:
 - silicon

- rubber
- PTFE
- polyurethane
- solvents:
 - acetone
 - thinners
- organic peroxides:
 - catalysts

(AC1.4) **Material defects:**

- wood, composite board:
 - natural defects (shakes, knots, types of rot)
 - seasoning defects (hardening, twisting, warping)
 - voids
 - water damage
 - woodworm
 - UV reaction
 - working reaction
 - colour changes
- metal:
 - corrosion (galvanic, electrolytic stray current)
 - metal fatigue
 - de-zincification
 - oxidation
 - crevice corrosions
 - welding imperfections and cracks
- FRP:
 - under cured resin
 - gel coat contamination
 - incorrect mixing and application of materials
 - incorrect workshop conditions (humidity, temperatures)
 - voids
 - pin holes
 - delamination
 - osmosis
 - gel streak
 - gel coat cracking
 - star crazing

(AC1.5) **Hand tools and equipment:**

- cutting tools:
 - saws (cross cut, panel, coping, tenon, pad, hacksaws, diamond, tungsten tipped, pull, hole)
- material removal tools:
 - chisels
 - planes (block, smoothing, jack, try, bollow, moulding, rebate, bullnose, granny's tooth)
 - spoke shaves
 - drawknives
 - files
 - rasps
 - adze

- assembly and joining tools:
 - drills
 - screw drivers
 - spanners
 - socket sets
 - torque wrench
 - impact driver
- hammers:
 - claw
 - ball pein
 - cross pein
 - maul
 - lump
- measuring and marking out tools:
 - tapes
 - rules
 - squares
 - callipers
 - gauges (bevel, spar)
 - scribes
 - templates
 - 'Shepherds crook'
 - tick stick
 - spieles and spieling battens
 - water level
 - levels
 - laser levels
 - 3D scanner
 - plumb bob
 - spirit level
- work-holding devices:
 - grips
 - vices
 - chucks
 - 'G' cramps
 - sash cramps
 - quick-release cramps
 - lever cramps
- special tools:
 - jigs
 - formers
 - saddles

(AC1.6) **Woodworking machinery:**

- saws:
 - circular
 - band
 - cross cut
 - rip/tenon
 - fret/coping
- planer/thicknesser (over and under)
- mortisers
- spindle moulders

- bench sanders
- routers
- linisher
- pillar drill
- CNC controlled routers
- panel saw
- press
- bobbin sander
- table saw
- extraction systems
- spoke shaves
- chisels/gouges
- braces

(AC1.7) **Hand held power tools:**

- electrical and battery operated drills
- sanders
- saws:
 - jig
 - 'Skil'
 - chain
- grinders
- routers
- power planes
- pneumatic sanders
- die grinders
- whizzers

(AC1.8) **Permanent bonds:**

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

(AC1.8) **Semi-permanent bonds:**

- nails
- nuts
- bolts
- screws
- rivets

- fast mounts
- rivnuts

(AC1.8) **Temporary bonds:**

- split pins
- R clips
- polyurethane
- hot glue
- circlips
- nails
- pins
- tapes

(AC1.9) **Protective coatings:**

- paint
- varnishes
- metallic coatings:
 - galvanising
 - anodising
 - powder coating
- vinyl wrapping
- nylon dipping

Learning outcome

The learner will:

- 2 Know how to carry out yacht assembly and sub-assembly operations safely

Assessment criteria

The learner can:

- 2.1 list the requirements of a safe working environment
- 2.2 identify safe methods for the use of lifting and handling equipment
- 2.3 identify the principal parts used for making assembly and sub-assembly components for boat construction
- 2.4 use sources of information for mould and template manufacturing
- 2.5 explain the importance of complying with operation sheets and schedules
- 2.6 list the sequence of operations and processes needed to carry out assembly and sub-assembly operations
- 2.7 identify terminology and techniques used to set up moulds, templates, jig components and check alignment

Range

(AC2.1) **Requirements of a safe working environment:**

- risk assessment
- safe systems of work
- method statement

- safety data sheets
- noise regulations
- environmental control
- washing facilities
- dust and fume extraction
- well maintained walkways
- effective access and egress
- safe and correct disposal of waste material
- temperature and humidity control
- Work at Height Regulations (2005)
- Manual Handling Operations Regulations
- Control of Substances Hazardous to Health (COSHH)
- Lifting and Handling 1998 (LOLER)
- Provision and Use of Work Equipment Regulations 1998 (PUWER)

(AC2.2) **Safe methods:**

- never exceed safe working load (SWL)
- avoid shock loading
- never transport loads over people
- avoid twisting of slings and ropes
- follow LOLER regulations
- balance load
- appreciate centre of gravity

(AC2.3) **Principal parts:**

- wood:
 - moulds and templates
 - keel
 - hog
 - stern knee
 - horn timber
 - deadwood
 - transom
 - stem and apron
 - frames and timbers (grown, laminated, bent)
 - floors (grown, laminated, plate, angle)
 - stringers
 - chine
 - gunwales/inwales
 - mast clamp
 - mast step
 - breast hook
 - quarter knees
 - planking
 - beams
 - carlins
 - hanging knees
 - lodging knees
 - hatch and side coamings
 - companion ways
 - doghouse
 - cockpit
 - coach roof

- wheelhouse
- decks
- fly bridges
- radar chairs and hoops
- chain plates
- main brackets
- P-brackets
- A-brackets
- composite:
 - male and female moulds
 - laminates
 - resins
 - core materials
- metal:
 - bulkheads
 - engine beds
 - steel and aluminium keel beds
 - handrails
 - push pit
 - pull pit
 - masts
 - booms
 - A-brackets
 - P-brackets
 - shaft lock
 - shaft
 - rudders
 - rigging

(AC2.4) **Sources of information:**

- lines plan and offsets
- technical drawing
- designer's drawings and specs

(AC2.5) **Importance of complying:**

- reduce errors
- prevent re-working
- prevent waste
- ensure quality
- standardised working

(AC2.6) **Sequence of operations:**

- planning and set up:
 - review and verify designs and plans
 - finalise time and cost of the work to be done
 - identify and source equipment, machinery, tools and materials
 - make, produce and use jigs and templates as required
 - set up tools and machinery
- manufacture and assemble/disassemble and repair components:
 - manufacture/repair components to required specification
 - move components using the appropriate safe methods
 - check components for robustness, fit and tolerances
 - analyse problems with machinery, equipment, tools and material, proposing/implementing solutions where appropriate

- move, shape and manipulate components to achieve best fit
- select and use appropriate methods for holding materials and components in place during assembly, and for the connecting, fixing and assembly of materials and components
- safeguard materials and components during assembly
- select suitable methods for fault finding and analysis
- make repairs whilst safeguarding the integrity of components and the surrounding area
- identify, mark, store and organise dismantled parts for reassembly
- fit out:
 - install and fix components using the most appropriate method and materials
 - ensure the joins are made and treated
 - position and fit items
 - finalise fit out for deck hardware
- finish:
 - check joins 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 and sea trials:
 - assess fixtures and fittings for quality and stability
 - commission the boat
 - assemble required documentation
- reinstate work area

(AC2.7) **Terminology and techniques:**

- plumb
- level
- dimensional orientation
- horning in
- bracing
- use of templates and jigs
- visual inspection
- sub-assembly datums
- correct 'hand' of component is used
- using cramps and clamps
- drilling holes
- securing components using correct/appropriate fastenings

Learning outcome

The learner will:

- 3 Understand quality standards for assembly and sub-assembly components

Assessment criteria

The learner can:

- 3.1 state the relevant regulations and compliance bodies that apply to checking the assembly and sub-assembly operations
- 3.2 describe the reasons for inspections and tests used in assembly and sub-assembly operations
- 3.3 describe how to prepare for final finish inspection
- 3.4 identify the relevant persons to contact in the event of a problem
- 3.5 use checks that ensure that all components have been completed according to plan
- 3.6 explain why it is important to protect completed components and what methods are used
- 3.7 describe the records and checks required on completion
- 3.8 describe how to reinstate the work area following completion

Range

(AC3.1) Regulations and compliance bodies:

- Lloyd's
- Recreational Craft Directive (RCD)
- Boat Safety Scheme (Inland Waterways Authority)
- Marine Safety Agency
- Bureau Veritas
- BS EN and ISO standards
- American Bureau of Shipping (ABS)
- Maritime Coastguard Agency (MCA)
- American Boat and Yacht Council (ABYC)

(AC3.2) Reasons for inspection and tests:

- visual inspection:
 - surface defects
 - twist and alignment
 - fit of joints
 - fixing damage
- functional test:
 - correct operation
 - water-tight
 - no interference with other systems
- dimensional control:
 - measurement
 - geometric alignment
- coding requirements:
 - welding

(AC3.3) **Final finish inspection:**

- final polish
- wiping down
- vacuuming
- oiling
- gap filing
- smoothing and sanding
- painting
- soften or suitably finish edges
- check joints
- check fastenings, rattles and squeaks

(AC3.4) **Relevant persons to contact:**

- charge-hand
- team leader
- foreman
- manager
- designer
- quality controller

(AC3.5) **Checks:**

- dimensional accuracy is within specification
- installed structures are correctly aligned, level and secure
- shape of the frame/hull is to template
- all plank fastenings line up with frames/beams
- specified type and quantity of fastenings are used and are correctly spaced out
- scarfs and joints are fitted with no gap in the interface
- seams and butts are evenly caulked watertight with no internal splitting
- cosmetic appearance is to specification
- functionally operative
- commissioning
- basin trials
- sea trials

(AC3.6) **Methods to protect components:**

- covering with cloth or cardboard
- wrapping with bubble wrap
- coating
- storing in secure, dry location until required
- correct labelling
- restrict access

(AC3.7) **Records and checks:**

- recording of hours
- recording of materials used
- inspection checklist and records
- quality control records
- owner's RCD installation manual
- project plan
- batch numbers
- boat file

- quality panels

(AC3.8) **How to reinstate the work area:**

- 5s approach
- clear away all waste and discarded material
- return all tools and equipment to the stores or tool boxes/shadow board
- dismantle or return all jigs and templates to storage areas
- clean and sharpen all tools ready for the next job
- ensure the area is safe and free from dangers (risk assessment)
- ensure protection and labelling in place
- floors and access panels are replaced

Unit 205

Production of external boat components

Unit level:	Level 2
GLH:	140
Unit aim:	This optional unit is about the requirements for the successful use of components which make up the structure of boats. It includes: the interpretation of lofted lines, drawings and specifications; the terminology and techniques needed to obtain the shape of moulds and templates and the skills required to mark, cut out, assemble and finish the items which make up a boat.
Assessment type	Centre-devised practical assignment and short-answer questions

Learning outcome

The learner will:

- 1 Be able to produce moulds and templates for external boat components

Assessment criteria

The learner can:

- 1.1 use sources of information relevant to the production of moulds and templates for components of boats
- 1.2 state the importance and purpose of drawings, specifications, data and procedure sheets
- 1.3 identify the materials used in the production of moulds and templates
- 1.4 identify characteristics of the materials used in the production of moulds and templates
- 1.5 state the importance of mould preparation
- 1.6 produce shapes of moulds and templates and transfer them onto the mould/template material using a variety of techniques
- 1.7 identify techniques for mould release
- 1.8 use hand tools and woodworking machinery safely
- 1.9 explain the function and safe use of powered tools and equipment
- 1.10 identify the causes of defects in materials when marking, setting out and cutting materials for moulds and templates
- 1.11 state the importance of minimising waste when marking, setting out and cutting materials for moulds and templates

Range

(AC1.1) **Sources of information:**

- codes of practice

- rules and regulations
 - Lloyd's
 - RCD
- customer/client specifications
- surveyor's report
- manufacturers' specifications
- safety data sheets
- scheme of work
- Boat safety scheme (BSS) (Inland Waterways Association)
- BS/EN standards applicable to the Marine Industry
- lines plans
- working drawings and designer's specifications
- current drawing standards ISO 8888/2000
- construction plan and scantlings list
- sail and rigging plan

(AC1.3) **Materials:**

- template paper and card
- solid timber
- manufactured boards
- composites
- metals
- plastics

(AC1.4) **Characteristics:**

- stability
- ease of use
- cost effectiveness

(AC1.6) **Techniques:**

- direct measurement
- tracing/transfer
- nail-head impressions
- CNC
- lasers
- placement technology

(AC1.7) **Techniques for mould release:**

- compressed air
- power washer
- wax
- chemical
- Teflon
- mechanical (wedges and hammer)

(AC1.8) **Hand tools:**

- cutting tools:
 - saws (cross cut, rip, coping, tenon, pad, hacksaws, diamond, tungsten tipped, pull, hole)
 - sheers
- material removal tools:
 - chisels (firmer, mortise, bevel edged)

- planes (smoothing, jack, try, rebate, shoulder, bollow, moulding)
- spoke shaves
- drawknives
- files
- rasps
- adze
- assembly and joining tools:
 - drills
 - screwdrivers
 - spanners
 - socket sets
 - long boards
 - glue guns
- measuring and marking out tools:
 - tapes
 - rules
 - squares
 - gauges
 - dividers
 - scribes
 - bevel board
 - lasers
 - water level
 - spirit level

(AC1.8) **Woodworking machinery:**

- saws:
 - circular
 - band
 - cross cut
 - panel
- planer/thicknesser (over and under)
- sanders
- routers
- mortisers
- spindle moulders
- CNC routers
- lathe
- local exhaust ventilation (LEV)

(AC1.9) **Powered tools and equipment:**

- hand held power tools both electric and pneumatic:
 - drills
 - sanders
 - saws
 - grinders
 - planers
 - guillotine
 - sheers
- thermal equipment:
 - blow torches
 - heat mats for vacuum moulding
 - soldering irons

- welding (MIG, TIG, MMA)
- high pressure power washers
- compressors

(AC1.10) **Causes of defects in materials:**

- incorrect selection
- incorrect setting out
- incorrect cutting/shaping
- distortion (twisting and warping)
- heat distortion in metals
- incorrect labelling

Learning outcome

The learner will:

- 2 Be able to cut and finish materials to form external boat components

Assessment criteria

The learner can:

- 2.1 identify external boat components
- 2.2 identify materials used to make boat components
- 2.3 describe the techniques used to transfer shapes onto the component material
- 2.4 select the correct cutting technique for square, angular or moulded profiles
- 2.5 set up and operate cutting tools needed to profile the components
- 2.6 identify possible cutting defects in materials
- 2.7 follow surface finish procedures for boat components
- 2.8 list the protective methods to apply to finished boat components for storage and transport

Range

(AC2.1) **External boat components:**

- hatches
- garage
- companionway
- boards
- coamings
- gratings
- vent boxes
- navigation light boxes
- rudders
- tillers
- masts
- spars
- oars
- grab rails/hand rails
- toe rails

- rubbing strakes
- fender
- deck
- keel
- coachroof
- doghouse
- centreboards
- dagger boards
- keels

(AC2.2) **Materials:**

- timbers:
 - hardwoods
 - softwoods
- composites
- manufactured boards
- metals

(AC2.3) **Techniques:**

- direct measurement
- tracing/transfer (use of 'dummy sticks')
- nail-head impressions
- templates
- laser placement technique

(AC2.4) **Cutting technique:**

- hand saws:
 - pad
 - keyhole
 - reciprocating
 - oscillating
 - hacksaw
 - powered hacksaw
 - chop saw
- adjustable table on band or dimension saws
- adjustable base plate on jig and power saws
- portable routers
- spindle moulders
- disc cutter
- drills
- power planer
- lather
- grinders
- flame cutting
- plasma cutting
- hole saws

(AC2.6) **Cutting defects:**

- saw tooth marks
- planer ripple marks
- burn marks from blunt cutters on routers
- warping

- denting
- scratching
- scoring
- break out
- gel chips
- cracks
- damaged fibre
- burred edges
- heat damage
- surface blemishes
- dulling

(AC2.7) **Surface finish:**

- painting
- varnishing
- staining and polishing
- antifouling
- plastic coating
- gel coat
- vinyl wrap
- anodising
- powder coating
- galvanising
- burnishing
- zinc plating
- chrome plating
- nano surface technology

(AC2.8) **Protective methods:**

- plastic covering
- bubble wrap
- peelable coatings
- cardboard
- paper
- hardboard

Learning outcome

The learner will:

- 3 Be able to assemble external boat components

Assessment criteria

The learner can:

- 3.1 list the safety regulations applicable to producing external boat components
- 3.2 prepare the work area prior to commencing assembly operations
- 3.3 describe methods of setting up external boat components
- 3.4 describe temporary and permanent fixing devices required for assembly operations
- 3.5 select and use tools and equipment for assembly operations
- 3.6 use lifting and transporting equipment safely
- 3.7 identify the problems which can occur when assembling boat components

Range

(AC3.1) Safety regulations:

- Health and Safety at Work Act 1974 (HSWA)
- Control of Substances Hazardous to Health (COSHH)
- Provision and Use of Work Equipment Regulations (PUWER)
- need for risk assessment
- correct disposal of waste
- use of PPE
- lifting and handling regulations (LOLER, manual handling regulations)

(AC3.2) Prepare the work area:

- floor or bench space required
- availability of material, tools and equipment
- material handling facilities
- adequate lighting, ventilation/extraction dust and fume (LEV)
- floor and surface protection

(AC3.3) Methods of setting up:

- levelling
- plumbing and 'horning in
- bracing and shoring
- declivity
- wedging
- gauges
- reference points
- datums

(AC3.4) Temporary fixing devices:

- cramps
- clamps
- gripes
- nails

- hot glue gun
- press
- vice
- shores and braces
- jigs
- weights
- screws
- bottle screws
- jacks

(AC3.4) **Permanent fixing devices:**

- welding
- resins
- glue
- PVA
- formaldehydes
- epoxy resins
- polyurethanes
- polyester resin
- mastics
- Resorcinol glue
- contact adhesive
- chemical locks/locking adhesive
- fibre glassing

(AC3.5) **Tools and equipment:**

- levelling/alignment equipment
- hand tools
- portable power tools
- basic welding
- brazing and soldering equipment

(AC3.6) **Lifting and transporting equipment:**

- boat mover
- tug
- tractor
- trailer
- trolleys
- skates
- jacks
- pallet trucks
- fork lift
- cranes:
 - wall
 - mobile
 - telescopic
 - static
 - overhead
- slings and pull lifts
- docking equipment

- slipways
- mobile boat lifts
- sliding ways
- launches
- lifting accessories:
 - chains
 - ropes
 - strops
 - shackles
 - slings

(AC3.7) **Problems:**

- blunt tools
- faulty tools and equipment
- inexperience of personnel
- poor planning and quality control
- components not to specification
- inadequate stock control
- inadequate working practices
- quality control issues

Learning outcome

The learner will:

- 4 Know how to complete, inspect and protect external boat components

Assessment criteria

The learner can:

- 4.1 describe how to prepare for final finish inspection
- 4.2 describe the reasons for inspections and tests used in the assembling of boat components
- 4.3 explain why it is important to protect completed external boat components and what methods are used
- 4.4 describe the records and checks required on completion
- 4.5 describe how to reinstate the work area following completion

Range

(AC4.1) **Final finish inspection:**

- final polish
- wiping down
- vacuuming
- oiling
- gap filing
- smoothing and sanding
- painting
- soften or suitably finish edges
- check joins

- check fastenings, rattles and squeaks

(AC4.2) **Reasons for inspection and tests:**

- visual inspection:
 - surface defects
 - twist and alignment
 - fit of joints
 - fixing damage
- functional test:
 - correct operation
 - water-tight
 - no interference with other systems
- dimensional control:
 - measurement
 - geometric alignment
- coding requirements:
 - welding

(AC4.3) **Methods:**

- covering with cloth or cardboard
- wrapping with bubble wrap
- coating
- storing in secure, dry location until required
- correct labelling
- restrict access

(AC4.4) **Records and checks:**

- recording of hours
- recording of materials used
- inspection checklist and records
- quality control records
- owner's RCD installation manual
- project plan
- batch numbers
- boat file
- quality panels

(AC4.5) **How to reinstate the work area:**

- 5s approach
- clear away all waste and discarded material
- return all tools and equipment to the stores or tool boxes/shadow board
- dismantle or return all jigs and templates to storage areas
- clean and sharpen all tools ready for the next job
- ensure the area is safe and free from dangers (risk assessment)
- ensure protection and labelling in place
- floors and access panels are replaced

Unit 206

Interior installation and fitting out of boats

Unit level:	Level 2
GLH:	70
Unit aim:	This optional unit is about the installation of interior modules, joinery units, deck modules and consoles that contain fittings such as doors, apertures and drawers. It covers the preparation of the work area, the use of specifications and drawings, positioning and fitting modules of units, fixing and securing modules, joinery and marine fittings and the inspection of completed parts.
Assessment type	Centre-devised practical assignment and short-answer questions

Learning outcome

The learner will:

- 1 Be able to prepare for installation of interior modules, joinery and marine fittings

Assessment criteria

The learner can:

- 1.1 use sources of information relevant to fitting out of boats
- 1.2 state the importance and purpose of drawings, specifications, data and procedure sheets
- 1.3 use hand tools and powered hand tools safely
- 1.4 identify fastenings required
- 1.5 describe the fittings installed in the accommodation areas on boats
- 1.6 describe the checks to be carried out on joinery and fittings to ensure serviceability
- 1.7 describe the working problems and potential hazards that can affect fitting out activities

Range

(AC1.1) **Sources of information:**

- codes of practice
- rules and regulations:
 - Lloyd's
 - RCD
- customer/client specifications
- surveyor's report
- manufacturers' specifications
- safety data sheets

- scheme of work
- Boat Safety Scheme (BSS) (Inland Waterways Association)
- BS/EN standards applicable to the marine industry
- line plans
- working drawings and designer's specifications
- current drawing standards ISO 8888/2000

(AC1.2) **Drawings, specifications, data and procedure sheets:**

- designer's drawings and specifications
- instruction sheets
- patterns and templates
- construction plan and scantlings list
- sail and rigging plan
- engine and equipment installation plans
- manufacturers' data sheets and specifications
- customer's specifications

(AC1.3) **Hand tools:**

- cutting tools:
 - saws (cross cut, panel, rip, coping, tenon, pad, hacksaws, diamond, tungsten tipped, pull, hole)
 - knives
 - scissors
- shaping tools:
 - chisels (firmer, mortise, bevel edged)
 - planes (smoothing, jack, try, rebate, shoulder, bollow, moulding, block)
 - spoke shaves
 - drawknives
 - files
 - rasps
 - sheers
- fixing/joining tools:
 - drills
 - bits and augers
 - screwdrivers
 - spanners
 - socket sets
- measuring and marking out tools:
 - tapes
 - rules
 - squares
 - gauges
 - dividers
 - scribes
 - spiles or 'dummy sticks'
 - levels

(AC1.3) **Powered hand tools:**

- drills
- sanders
- saws:
 - reciprocating
 - oscillating

- jigsaws
- planes
- routers
- grinder
- sheers

(AC1.4) **Fastenings:**

- screws
- bolts
- nails
- pins
- adhesives
- hook and loop
- welding
- rivets
- rivnuts
- fibre glass
- pop rivets
- big heads

(AC1.5) **Fittings:**

- sinks and drainage fittings
- cooker and shut-off
- ice box/fridge
- storage lockers
- hinges and locker catches
- fire blanket
- crockery and cutlery stowage
- fiddle
- gimble
- water system and filters
- water tanks:
 - fresh
 - waste (grey and black)
- water systems:
 - fresh (hot and cold)
 - grey and black water
- bilge:
 - pump
 - filter
 - skin fitting
- shower, including:
 - tray
 - pump
 - filter
- toilet
- wash basin
- skin fitting for WC and wash basin
- lighting and ventilation
- seating

- chart table
- navigation instruments and skin fittings
- transducer
- storage lockers and drawers
- drawer hardware:
 - catches
 - furniture
- table
- heating/air conditioning systems
- wet bar
- bunks
- pilot berths
- lee boards or cloths
- hanging lockers and storage
- fire systems
- gas bottles
- gas locker
- gas alarm

(AC1.6) **Checks to ensure serviceability:**

- visual
- functional
- operational
- accessibility

(AC1.7) **Working problems and potential hazards:**

- working problems:
 - sequence of activities
 - access for other trades
 - limited access
 - availability of resources (physical, human)
- hazards:
 - lack of ventilation
 - fire
 - access and egress
 - inadequate lighting
 - poor housekeeping
 - dust
 - fumes
 - working at height
 - working on water
 - confined spaces
 - electricity
 - chemical hazards (COSHH)
 - manual handling
 - noise at work
 - lifting

Learning outcome

The learner will:

- 2 Be able to position and fit interior modules, joinery and marine fittings

Assessment criteria

The learner can:

- 2.1 describe methods of identification of the modules, joinery and fittings to be installed
- 2.2 describe methods used to identify the approximate weight of the modules, joinery and fittings for installation
- 2.3 describe methods to transport and lift modules, joinery and fittings to the work area
- 2.4 describe the criteria for choosing transporting and lifting methods for modules, joinery and fittings
- 2.5 describe how to protect and prevent damage to modules, joinery and fittings during transportation
- 2.6 describe how to prepare the work area for the installation of modules, joinery and fittings
- 2.7 align and fit modules, joinery and marine fittings

Range

(AC2.1) **Methods of identification:**

- identification of codes and labels
- part number
- bar coding
- visual recognition
- pattern
- catalogue or code numbers
- drawing specifications

(AC2.2) **Methods used to identify the approximate weight:**

- measurement and calculation
- approximation
- manufacturer's information
- labels

(AC2.3) **Methods used to transport and lift:**

- lifting equipment:
 - trolleys
 - skates
 - jacks
 - pallet truck
 - fork lift
 - wall and overhead cranes
 - slings and pull lifts
 - goods lifts
 - blocks and tackle
- transporting equipment:
 - trolleys

- skates
- pallet truck
- forklift
- manual handling

(AC2.4) **Criteria:**

- manual handling considerations:
 - weight
 - size safety considerations (sharp edges, awkward shape)
 - available personnel
 - access/transport route
- lifting equipment considerations:
 - authorisation
 - regulations
 - lifting and slinging methods
 - safe working loads

(AC2.5) **How to protect and prevent damage:**

- covering and packing
- padding
- temporary supports
- temporary surface coating

(AC2.6) **Prepare the work area:**

- the correct procedure for preparing the work area:
 - safe access
 - lighting and ventilation
 - area free from contamination and obstruction
 - level lines and position lines marked
 - temporary jigs and support equipment in place
 - inform other trades
- prepare surface by:
 - cleaning
 - abrading
 - coating
 - de-greasing

(AC2.7) **Align and fit:**

- use of 'dummy sticks' for spiling and scribing
- use of splice boards
- locate and temporarily fasten
- temporarily secure using:
 - cramps
 - wedges
 - battens

Learning outcome

The learner will:

- 3 Be able to fix and secure interior modules, joinery and marine fittings

Assessment criteria

The learner can:

- 3.1 describe the methods to ensure the positional accuracy of modules, joinery and marine fittings
- 3.2 use fixing methods on interior modules, joinery and marine fittings
- 3.3 describe how to ensure the strength and security of fixed modules, joinery and marine fittings
- 3.4 use hand tools and powered hand tools safely
- 3.5 describe the techniques used to avoid damage to the module, joinery and fittings during the fixing process
- 3.6 carry out alignment and fixing quality checks

Range

(AC3.1) **Methods to ensure positional accuracy:**

- dimensional checks against specifications
- levelling and measuring equipment
- drawings and datum lines
- level, plumb and horning in checks
- visual checks
- relationship to other components
- declivity

(AC3.2) **Fixing methods:**

- mechanical fastenings:
 - screws
 - bolts
 - nails
 - rivets
 - rivnuts
 - big heads
 - quick-release fastenings
 - locknuts
 - captive nuts
 - nylocks
 - welding
 - split pins
 - castle nuts
 - roll pins
 - R clips
 - lockwire
 - sheerpin
 - chemical thread lock
 - circlip

- e-clips
- adhesives:
 - two-part epoxy
 - phenol formaldehyde
 - PVAs
 - contact adhesive
 - urea formaldehyde
 - casein glue
 - polyurethane (PU)
- FRP bonding:
 - glass bonding
 - polyester paste
 - epoxy putty
 - methacrylates
- sealants:
 - silicon (marine)
 - polyurethane
 - polysulphides
 - oil based
 - acrylic
 - jointing tape
- hook and loop, dual lock

(AC3.3) **How to ensure the strength and security:**

- backing pads and plates
- load spreading methods
- torque loadings
- material breaking points:
 - cross braces
 - knees
 - webs

(AC3.4) **Use hand tools and powered hand tools safely:**

- fixing hand tools:
 - spanners
 - screwdrivers
 - sockets
 - ratchets
 - torque wrench
 - pop rivet gun
 - rivnut gun
 - bedding gun
 - hot glue gun
 - staple gun
 - hammers
- powered hand tools:
 - impact driver
 - nut runner
 - battery drill
 - pop rivet gun
 - staple gun
 - nail gun

(AC3.5) **Techniques used to avoid damage:**

- maintain clean and clear working access
- clean away excess of adhesive/sealant
- avoid over-tightening fastenings
- select and use correct tools
- protective coverings

(AC3.6) **Alignment and fixing quality checks:**

- dimensional and geometric accuracy
 - fit of joints
 - functional operation of fittings (fit for purpose)
 - leak test
 - alignment of screw/bolt heads
 - visual
 - length of thread
 - specification and drawings
-

Learning outcome

The learner will:

- 4 Know how to complete, inspect and protect modules, joinery and marine fittings

Assessment criteria

The learner can:

- 4.1 describe how to prepare for final finish inspection
- 4.2 describe the reasons for inspections and tests used in the installation and fitting out of boats
- 4.3 explain why it is important to protect completed modules, joinery and fittings and what methods are used
- 4.4 describe the records and checks required on completion of installation
- 4.5 describe how to reinstate the work area following completion
-

Range

(AC4.1) **Final finish inspection:**

- final polish
 - wiping down
 - vacuuming
 - oiling
 - gap filing
 - smoothing and sanding
 - painting
 - soften or suitably finish edges
 - check joins
 - check fastenings, rattles and squeaks
-

(AC4.2) **Reasons for inspection and tests:**

- visual inspection:
 - surface defects
 - twist and alignment
 - fit of joints
 - fixing damage
- functional test:
 - correct operation
 - water-tight
 - no interference with other systems
- dimensional control:
 - measurement
 - geometric alignment
- coding requirements:
 - welding

(AC4.3) **Methods:**

- covering with cloth or cardboard
- wrapping with bubble wrap
- coating
- storing in secure location until required
- correct labelling
- restrict access
- floors and access panels are replaced

(AC4.4) **Records and checks:**

- recording of hours
- recording of materials used
- inspection checklist and records
- quality control records
- owner's RCD installation manual
- project plan
- batch numbers
- boat file
- quality panels

(AC4.5) **How to reinstate the work area:**

- 5s approach
- clear away all waste and discarded material
- return all tools and equipment to the stores or tool boxes/shadow board
- dismantle or return all jigs and templates to storage areas
- clean and sharpen all tools ready for the next job
- ensure the area is safe and free from dangers (risk assessment)
- ensure protection and labelling in place
- floors and access panels are replaced

Unit 207

FRP manufacture for marine construction

Unit level:	Level 2
GLH:	160
Unit aim:	This optional unit is about the requirements for successful production of components in FRP related to marine construction. It includes wet lay ups, use of pre-impregnated materials, interpretation of drawings, specifications, planning moulding and lay ups. It also covers the operations required to produce components and safe working practices to complete FRP construction.
Assessment type	Centre-devised practical assignment and short-answer questions

Learning outcome

The learner will:

- 1 Be able to interpret drawings, instructions, regulations and relevant codes of practice

Assessment criteria

The learner can:

- 1.1 use sources of information relevant to FRP manufacture
- 1.2 describe the function and physical properties of the materials used in FRP manufacture
- 1.3 state where to find the standards for testing FRP material specimens
- 1.4 use working drawings and specifications to extract the information to compile material requirements
- 1.5 describe the requirements for a safe working environment
- 1.6 identify potential hazards when working with FRP

Range

(AC1.1) **Sources of information relevant to FRP manufacture:**

- codes of practice
- rules and regulations:
 - Lloyd's
 - RCD
- customer/client specifications
- surveyor's report
- manufacturers' specifications
- safety data sheets
- scheme of work

- Boat Safety Scheme (BSS) (Inland Waterways Association)
- BS/EN standards applicable to the marine industry
- lines plans
- working drawings and designer's specifications
- current drawing standards ISO 8888/2000

(AC1.2) **Function and physical properties of the materials used in FRP manufacture:**

material	function	physical properties
mould surface	create shape	strong and flexible
fabric	strength	changes state, dry woven material, glass, carbon, kevlar
resin	binds the fabric	2 part viscous liquid, short pot life once mixed, exothermic reaction, solidifies
hardeners: slow, fast tropical, standard, ultra slow	mixes with resin and cures	curing rates differ when mixed with resin
core materials: foam, plywood, blockboard, balsa, cork, honeycomb	strength, stiffness, increases loadbearing	density, thickness and porosity varies across materials
filleting compounds: colloidal silica, silica, glass bubbles, microfibres, microballons	create radius to maintain strength	mixed with resin to create a paste

(AC1.3) **Standards for testing FRP material specimens:**

- BS/EN
- company practice
- manufacturers' data sheets
- Lloyd's rules
- RCD
- American standard
- technical data sheets
- safety data sheets
- design specification

(AC1.4) **Working drawings and specifications:**

- first and third angle orthographic projections
- oblique and isometric projections
- general layout and assembly drawings
- exploded and sectional views
- manufacturers' drawings
- 3D and digital drafts

(AC1.5) **Requirements for safe working environments:**

- provision of PPE

- fume cabinets
- washing facilities
- dust proof lighting
- dedicated dust and fume extraction (LEV systems)
- temperature control and humidity recording
- permitted short and long term exposure limits
- safe access and egress
- risk assessment
- RPE
- COSHH
- safe systems of work
- LOLER
- noise at work
- PAT
- grinding bay
- cutting room
- material room
- mixing room
- down draft table

(AC1.6) **Potential hazards when working with FRP:**

- curing agents:
 - catalysts
 - accelerators
 - epoxy hardeners
- dust
- broken fibres
- solvents
- resin vapours
- exothermic reaction
- weight of finished components
- static cuts and burns
- health hazards

Learning outcome

The learner will:

- 2 Be able to plan and manufacture a mould and moulding

Assessment criteria

The learner can:

- 2.1 describe the methods of mould manufacture and maintenance and materials used
- 2.2 produce a simple plug to produce a mould
- 2.3 manufacture a basic mould
- 2.4 describe the need for stiffening and cradling to support moulds and hulls
- 2.5 identify different weave patterns used in cloth reinforcements
- 2.6 describe the resin 'cure initiating' or hardening systems used in FRP
- 2.7 describe the importance of correct mixing procedures for resins and additives
- 2.8 identify the tools, machinery, equipment and materials required for mould and lay up operations
- 2.9 describe the methods used to check and monitor the resin/glass ratio
- 2.10 describe the methods of construction used in FRP manufacture
- 2.11 prepare the moulds prior to lay-up operations
- 2.12 explain the reasons for using templates for material preparations
- 2.13 list the components used in the vacuum bagging process
- 2.14 prepare operation sheets for simple constructions

Range

(AC2.1) **Methods of mould manufacture:**

- mould design considerations:
 - draw off angles
 - use of split moulds
 - stiffening flanges and supports
 - releasing methods (jacking points, compressed air points)
 - stable material for mould construction
 - male or female moulds
 - splash mould
- mould or plug construction using:
 - an existing hull to make the mould
 - wood plug construction methods
 - other appropriate former methods
 - incorporation of inserts for fixing non skid surfaces
 - skin fitting pads and recesses
 - datum points for fixing internal fittings

(AC2.1) **Maintenance:**

- frequency of use
- production cycle
- storage
- environmental factors

- length of production

(AC2.1) **Materials:**

- thermosetting plastics
- GRP
- FRP
- composite materials
- fibres used in composites such as:
 - glass
 - carbon
 - aramid
 - hemp
 - woven cloths
 - combination mats
 - hybrid cloths
 - pre-impregnated cloth (pre-pregs)
 - bleed cloths
 - peel ply
- resins
- pastes and liquid resins, ie:
 - epoxies
 - polyesters
 - vinyl-esters
- ancillary materials including:
 - organic peroxides (catalysts)
 - accelerators
 - colour pigments
 - thixotropic agents
 - fire retardants
 - fillers
 - adhesive film
 - sheet and pre-shaped foam
 - CNC cut kits (foam and reinforcements)

(AC2.4) **Need for stiffening and cradling:**

- prevent distortion during and after manufacture
- withstand loads
- enable easy transportation
- enable tilting from side to side to gain access
- facilitate mould release

(AC2.5) **Weave pattern:**

- chop strand mat
- continuous woven
- woven roving
- bi-axial
- uni-directional
- twill
- tissue

(AC2.7) **Mixing procedures:**

- resin to reinforcement ratio
- percentage of pigment addition

- thixotropic agents
- fire retardants
- fillers
- weight

(AC2.8) **Tools, machinery, equipment and materials:**

- PPE
- RPE
- barrier creams
- release agents (wax or PVA)
- reinforcement fibre mat
- resin
- catalyst
- accelerator
- brushes
- various types of rollers consolidators
- cleaning solvents
- diamond tipped saws
- routers
- grinders
- vacuum pumps
- heat mats
- Stanley knife
- cutting shears
- mallet
- wedges

(AC2.9) **Methods used to check and monitor resin/glass ratio:**

- ash test
- test panel
- accurate recording of amounts used:
 - weight
 - percentage
 - volume
 - ratio
 - saturation levels

(AC2.10) **Methods of construction:**

- contact moulding, wet lay ups
- resin transfer moulding
- use of pre-impregnated materials
- sandwich construction (use of foam, wood or honeycomb core)
- spiral winding
- vacuum bagging
- resin infusion

(AC2.11) **Prepare the moulds:**

- allow mould to acclimatise if brought in from outside in cold weather
- thoroughly clean
- make repairs if necessary
- surface rubbed down and polished to desired quality

- waxing and the application of release agents

(AC2.12) **Reasons for using templates:**

- cutting out reinforcement plies
- complex shapes
- checking profile shapes
- error proofing
- cost efficiency
- economies
- efficiency
- material efficiency

(AC2.13) **Components used in the vacuum bagging process:**

- porous release film
- absorption/bleeder cloth
- non-porous release cloth
- air breather
- sealing tape
- vacuum pump
- vacuum pressure gauge
- heat mats
- catch pot
- pipe work
- therma couple

Learning outcome

The learner will:

- 3 Be able to carry out operations correctly and in a safe manner

Assessment criteria

The learner can:

- 3.1 describe safe methods of transportation of jigs, moulds and components around the work place
- 3.2 state the safety regulations and rules for safe use of lifting equipment
- 3.3 state the safety precautions to be observed when using FRP
- 3.4 prepare reinforcing materials prior to moulding
- 3.5 weigh and mix resins following stated specifications
- 3.6 carry out laminating operations
- 3.7 release FRP components from a mould and trim
- 3.8 use portable electrical equipment safely

Range

(AC3.1) **Safe methods of transportation:**

- casters on cradles
- trolleys

- trailers
- fork lift trucks
- manual handling
- overhead cranes
- pulley systems

(AC3.2) **Safety regulations and rules for safe use of lifting equipment:**

- never exceed the safe working load (SWL)
- avoid shock loading
- never transport loads over persons
- types of sling and their safe use
- avoid twisting
- never bend around sharp corners
- importance of the angle between two slings (maximum 120°)
- all equipment should undergo periodical thorough examinations to LOLER and be tagged

(AC3.3) **Safety precautions when using FRP materials:**

- mixing of resin, catalysts and hardeners
- machining composites
- using of powered hand tools
- disposing of waste as hazardous waste

(AC3.5) **Weigh and mix resins:**

- cleanliness
- weighing
- mixing
- pot life
- shelf life
- percentage
- volume
- ratio
- saturation levels

(AC3.6) **Laminating operations:**

- flat panels
- curved panels
- hand lay up
- vacuum bagging
- resin infusion
- pre-impregnated

(AC3.7) **Safe use of portable electrical equipment:**

- precautions against electric shock
- reduce the risk of electric shock by using low voltage supply
- regular testing of electrical equipment (PAT)
- identify safety regulations relating to electrically operated portable machine tools including guarding, vacuum pump and trimming tools

Learning outcome

The learner will:

- 4 Know how to check the finished product with the specification

Assessment criteria

The learner can:

- 4.1 identify common manufacturing defects associated with FRP construction
- 4.2 describe the methods used for checking accuracy and quality components in FRP construction
- 4.3 carry out visual inspection on a finished component
- 4.4 describe types of common damage that can occur to boat hulls and decks made of FRP
- 4.5 describe repair techniques available for defective FRP components
- 4.6 explain why it is important to protect completed modules, joinery and fittings and what methods are used
- 4.7 describe how to reinstate the work area following completion

Range

(AC4.1) Common manufacturing defects:

- voids
- poor resin mix
- poor consolidation
- under saturation
- over saturation
- air bubbles
- distortion
- disbands
- star crazing

(AC4.2) Methods used for checking accuracy and quality:

- dimensional:
 - measurement
 - jigs
 - profile
- shape:
 - templates
 - formers
- surface finish:
 - visual inspection
- surface defects:
 - visual inspection
 - tap test
 - use of thickness metres/gauges
 - hardness test using a 'Barcol' test meter
 - drawings and specification

(AC4.4) Common damage:

- impact
- osmosis
- scratches and gouges
- water ingress
- delamination
- disbond
- degradation
- cracks
- star crazing

(AC4.5) **Repair techniques:**

- gel coat repairs
- repairs made from inside component
- repairs made from outside component
- splash moulds

(AC4.6) **Methods:**

- covering with cloth or cardboard
- wrapping with bubble wrap
- coating
- storing in secure location until required
- correct labelling

(AC4.7) **How to reinstate the work area:**

- 5s approach
- clear away all waste and discarded material
- return all tools and equipment to the stores or tool boxes/shadow board
- dismantle or return all jigs and templates to storage areas
- clean and sharpen all tools ready for the next job
- ensure the area is safe and free from dangers (risk assessment)
- ensure protection and labelling in place
- floors and access panels are replaced

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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