QUALIFICATION HANDBOOK

Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (2463-02)

August 2017 Version 5.2

City & Guilds

Qualification at a glance

Subject area	**Marine Construction, Systems Engineering and Maintenance**
City & Guilds number	2463
Age group approved	All
Assessment	Online test Centre devised assignments
Support materials	Centre handbook Assessment pack
Registration and certification dates	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds number	Accreditation number
Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Boatbuilding)	280	320	2463-02	600/2304/1
Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Marine Engineering)	280	320	2463-02	600/2304/1
Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Painting and Finishing)	280	320	2463-02	600/2304/1
Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Marine Servicing and Maintenance)	280	320	2463-02	600/2304/1

Version and date	Change detail	Section
1.1 Oct 2011	Unit 210 title amended in ROC and unit	Structure, unit content
	Level 2 Certificate mandatory unit requirement corrected from 202 to 203	Structure (Page 5)
2.0 May 2012	Unit 204 & 211 UANs updated in ROC, changes to units 204 & 211	Structure (page 4-5) Unit 204 (page 24 – 27), Unit 211 (page 48 – 51)
3.0 Nov 2012	Additional pathway option added - Marine Servicing and Maintenance	Structure
3.1 Aug 2016	Information on grading added	Assessment
4.0 Nov 2016	Age restrictions amended	Age restrictions
5.0 March 2017	The sub section 'centre set assignment' of the Assessment section was amended	Assessment
5.1 August 2017	'Centre set and marked assessments' - Information on where to find materials added	Assessment
5.2 August 2017	Added TQT details Deleted QCF	**Qualification at a glance, Structure** **Throughout**

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Contents

1 Introduction

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

Area	Description
Who are the qualifications for?	They are for candidates who work or want to work in the marine engineering and boatbuilding sector
What do the qualifications cover?	They allow candidates to learn, develop and practise the skills required for employment and/or career progression in the Marine engineering or boatbuilding sector.
What opportunities for progression are there?	They allow candidates to progress into employment or to the following City & Guilds qualifications: • 2463 Level 3

Structure

To achieve the **Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Boatbuilding)**, learners must achieve **14** credits from the mandatory units and a minimum of **22** credits from the optional units available.

Unit accreditation number	City & Guilds unit	Unit title	Credit value
Mandatory			
R/503/2261	201	Introduction to the marine industry	7
Y/503/2262	202	Principles of boatbuilding technology	7
Optional			
F/503/3485	204	Yacht and boatbuilding assembly and sub-assembly	11
K/503/2265	205	Production of external boat components	11
M/503/2266	206	Interior installation and fitting out of boats	11
T/503/2267	207	Composite manufacture for marine construction	11

To achieve the **Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Marine Engineering)**, learners must achieve **14** credits from the mandatory units and a minimum of **22** credits from the optional units available.

Unit accreditation number	City & Guilds unit	Unit title	Credit value
Mandatory			
R/503/2261	201	Introduction to the marine industry	7
D/503/2263	203	Marine engineering processes and principles	7
Optional			
T/503/2267	207	Composite manufacture for marine construction	11
A/503/2268	208	Servicing and maintenance of marine engines	11
F/503/2269	209	Servicing and maintenance of marine propulsion systems	11
T/503/2270	210	Installing electrical wiring support systems	11
R/503/9842	211	Principles of marine electrical systems	11

To achieve the **Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Painting and Finishing)**, learners must achieve **32** credits from the mandatory units.

Unit accreditation number	City & Guilds unit	Unit title	Credit value
Mandatory			
R/503/2261	201	Introduction to the marine industry	7
Y/503/2262	202	Principles of boatbuilding technology	7
F/503/2272	212	Prepare surfaces and marine coatings	9
J/503/2273	213	Apply marine coatings	9

To achieve the **Level 2 Certificate in Marine Construction, Systems Engineering and Maintenance (Marine Servicing and Maintenance)**, learners must achieve **36** credits in total;

7 credits from the mandatory unit 201

Plus **7** credits from **either** unit 202 **or** 203

Plus a minimum of **22** credits from the remaining optional units 204 – 213

Unit accreditation number	City & Guilds unit	Unit title	Credit value
Mandatory			
R/503/2261	201	Introduction to the marine industry	7
Plus one of			
Y/503/2262	202	Principles of boatbuilding technology	7
D/503/2263	203	Marine engineering processes and principles	7
Optional			
F/503/3485	204	Yacht and boatbuilding assembly and sub-assembly	11
K/503/2265	205	Production of external boat components	11
M/503/2266	206	Interior installation and fitting out of boats	11
T/503/2267	207	Composite manufacture for marine construction	11
A/503/2268	208	Servicing and maintenance of marine engines	11
F/503/2269	209	Servicing and maintenance of marine propulsion systems	11
T/503/2270	210	Installing electrical wiring support systems	11
R/503/9842	211	Principles of marine electrical systems	11
F/503/2272	212	Prepare surfaces and marine coatings	9
J/503/2273	213	Apply marine coatings	9

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 Certificate in Marine Construction, Systems Engineering and Maintenance	280	320

2 Centre requirements

Approval

If your centre is approved to offer the Level 2 Certificate in Boat Building, Maintenance and Support (2451) you will be automatically approved for the Level 2 Marine construction, systems engineering and maintenance certificates (2463).

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

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

Resource requirements

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 areas 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.

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

Assessors and internal verifiers

Assessor/Verifier (A/V) units are valued as qualifications for centre staff, but they are not currently a requirement for the qualification[s].

Continuing professional development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

Candidate 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

This qualification is accredited for candidates aged 16 -18 years and 19+

3 Delivering the qualification

Initial assessment and induction

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

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

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

4 Assessment

This qualification is assessed by a combination of online multiple choice tests and centre and marked assignments covering practical skills and underpinning knowledge. The table below provides details on the assessment methods for each unit.

City & Guilds unit	Unit title	Assessment method
201	Introduction to the marine industry	e-assessment
202	Principles of boatbuilding technology	e-assessment
203	Marine engineering processes and principles	e-assessment
204	Yacht and boatbuilding assembly and sub-assembly	Centre set assignment
205	Production of external boat components	Centre set assignment
206	Interior installation and fitting out of boats	Centre set assignment
207	Composite manufacture for marine construction	Centre set assignment
208	Servicing and maintenance of marine engines	Centre set assignment
209	Servicing and maintenance of marine propulsion systems	Centre set assignment
210	Installing electrical wiring support systems	Centre set assignment
211	Principles of marine electrical systems	Centre set assignment
212	Prepare surfaces and marine coatings	Centre set assignment
213	Apply marine coatings	Centre set assignment

Centre set and marked assessments

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 this material is available to download from the City & Guilds website *at* ***http://www.cityandguilds.com/delivering-our-qualifications/centre-development/quality-assurance/quality-assurance-documents***.

Approval process for centre set assignments

Centre set assignments must be approved by the external verifier before use. For each assignment, the *assignment sign off sheet* (AD3) must be completed and be made available to the EV for inspection.

Grading

Centre set assignments are graded Pass, Merit or Distinction. Please see generic grading criteria on www.cityandguilds.com

Test specifications

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

Test 1: Unit 201
Duration: 1 hour 10 minutes

Unit	Outcome	Number of questions	%
201	1. Understand the range of services available within the marine industry	5	14
	2. Understand the terminology used to recognise boats and equipment	6	17
	3. Understand the health and safety rules and regulations applicable to the marine industry	12	35
	4. Understand employment roles and responsibilities	3	9
	5. Know how to contribute to self-development and create and maintain effective working relationships	5	14
	6. Know how to contribute to the effectiveness of boat production and support services	4	11
	Total	**35**	**100**

Test 2: Unit 202
Duration: 1 hour

Unit	Outcome	Number of questions	%
202	1. Know how to identify boat building materials and their properties	8	27
	2. Know how to interpret drawings, specifications and installation requirements	6	20
	3. Know how to use tools and equipment safely when boatbuilding	5	17
	4. Understand boatbuilding operations	11	36
	Total	**30**	**100**

Test 3: Unit 203
Duration: 1 hour

Unit	Outcome	Number of questions	%
203	1. Know how to identify marine engineering materials and their properties	10	33
	2. Know how to interpret and use marine engineering specifications and installation requirements	3	10
	3. Know how to use tools and equipment safely in a marine engineering environment	6	20
	4. Understand marine engineering processes	11	37
	Total	**30**	**100**

NB – All percentages have been rounded to whole numbers.

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. RPL is allowed and is also sector specific.

5 Units

Availability of units

Below is a list of the learning outcomes for all the units.

Structure of units

These units each have the following:

- City & Guilds reference number
- unit accreditation number (UAN)
- title
- level
- credit value
- unit aim
- relationship to NVQ
- endorsement by a sector or other appropriate body
- learning outcomes which are comprised of a number of assessment criteria

Unit 201 Introduction to the marine industry

UAN:	**R/503/2261**
Level:	2
Credit value:	7
GLH:	65
Relationship to NVQ:	This unit is linked to the following NVQ units; 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134 and 135.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This mandatory unit is concerned with safety awareness and communication skills needed to work effectively in the marine industry. It covers health and safety, interaction with other employees and an understanding of the terminology and structure of the industry.

Learning outcome
The learner will: 1. Understand the range of services available within the marine industry
Assessment criteria
The learner can: 1.1 describe what boatyards, marinas and yacht basins are 1.2 list the **facilities**, **services** and **products** that are found in boatyards, marinas and yacht basins 1.3 describe the **purposes of boatyards, marinas and yacht basins** 1.4 describe **methods** of moving boats 1.5 identify **personnel responsible for providing services** 1.6 list **ancillary marine services** provided within the marine industry.

Range
Facilities Accommodation facilities (toilets, showers, laundry room washing machines, spin driers), storage cabins or lock-ups, mast and spar storage arrangements, fitting out, maintenance/lay-up facilities, moorings (swinging or fixed moorings, marina berth moorings, on piles moorings, painting, finishing facilities, pump-out facilities **Services** Water points, electrical hook-up, waste and refuse disposal

Products

Yacht fittings and fastenings, glues, ropes, charts, books, paint, chain, shackles, anchors, yacht clothing, boots, navigation equipment

Purposes of boatyards, marinas and yacht basins

New building, fitting out, maintenance and repair facilities to include hull and deck construction, composite manufacture for hulls and decks, engine installation and maintenance, electrical and electronic installations, fitting out or refit operations for joinery, plumbing, electrics, painting and finishing

Methods

Afloat by: engine power, rowing, towing, sailing and rafting.

Ashore by: mobile hoists, cradle and railed slipway, slippery ways, rollers, tractor and cradle on wheels, mobile crane and fork lift truck

Personnel responsible for providing services

Shipwrights, boat-builders, joiners and sawyers: boat-building boat repair and refit operations

Laminators: for FRP hull and deck mouldings, gel and FRP repairs

Marine engineers and fitters: engines, winches, hydraulic installations and maintenance.

Welders: metal fabrication activities

Marine electricians and electronic engineers: electronic and electrical installations

Marine plumbers and gas installers: installation and maintenance of wash basins, showers, toilet and waste water systems and LPG gas installations

Riggers and sail-makers: new and repair and maintenance services for sailing yachts

Painters and finishers: boat painting and finishing operations

Upholsterers: cabin decor and furnishings activities

Buyers, storekeepers, dock-master, riggers and charge hands, foremen managers

Ancillary marine services

Brokerages, financial services, insurance provision, marine surveying services, leisure operators

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
Terms Leisure craft: yachts, motor cruisers, sailing boats, river and canal boats, ribs, jet skis

Commercial craft: tankers, tugs, lighters, cargo ships, container ships, cruise liners

Locations

Port and starboard, beam, quarter, aft forward, aloft, draught, freeboard, transom, bow, accommodation areas on boats, galley, saloon, bunks and sleeping areas, toilets (WC, heads, shower, navigation area, chart table and steering (helm) position.

Dimensions

Waterline length (wll) and length overall (loa)

Marine components and fittings

Cleats and bollards, fairleads windlass, anchor navigation lights; masts/spars and booms, sails, safety equipment (life rafts, life belts, pulpit, pushpit, stanchions, lifelines) running rigging (sheets, halyards, running backstays, standing rigging includes stays and shrouds) types of blocks

Marine systems terminology

Propulsion systems and drives (Z & V) (inboard, outboard), steering systems, instrument systems, navigation systems, power supplies (battery, generators powered by fuel engines, wind or water flow, solar panels and shore power hook up)

Learning outcome
The learner will: 3. Understand the Health & Safety rules and regulations applicable to the marine industry
Assessment criteria
The learner can: 3.1 identify the **Health and Safety 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
Health & Safety regulations Health and Safety at Work Act 1974 (HSAWA), Control of Substances Hazardous to Health (COSHH), Lifting and Handling (LOLER 1998), Provision and Use of Work Equipment Regulations 1998 (PUWER), P.A.T. Portable Appliance Testing Regulations **Personal Protective Equipment** Hats, goggles, boots, masks, gloves, safety harness, lifejacket, buoyancy aids

When PPE is used in the marine industry

Operating machinery, working at height, working on board, working on water, working with hazardous substances

Safety signs

Warning or cautionary signs, prohibition signs, mandatory signs , safety signs, COSHH signs

Evacuation procedures

Escape routes, assembly points.

Common causes of fire

Fuel, oxygen, source of ignition

Types of fire extinguisher

Water, foam, powder, CO2 gas, fire blankets

Potential hazards

Spillages and slippery surfaces, faulty electrical connections or damaged cables, faulty or incorrectly set up of tools and equipment, faulty or missing machine guards, faulty material handling or transportation, Risk of explosion, dust and fumes, moving loads, working at heights, untidy work habits

Good housekeeping procedures

Correct storage of tools, equipment and materials, maintaining access and egress to work stations, walkways, emergency exits and fire doors, safe removal of waste and methods of waste disposal (burning, landfill, recycling, chemical breakdown), the acceptable codes of behaviour and dress, 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
Aspects of a contract of employment Job description, hours of work, rates of pay, role and responsibilities, disciplinary and grievance procedure, organisational structure, terms of notice, Employment Rights act, holiday entitlement **Relevant legislation** Equal Pay Act, Sex Discrimination Act, Race Relations Act, Equal opportunities Act. **Sources of information** Trades Union, ACAS, Citizens Advice Bureau, Employer/ Contract of employment, the internet

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.

Range
Methods of communication Letters, memos, drawings and sketches, written and verbal work instructions, computers, the internet, videos, pictures, manufacturers' instructions or guidance literature **Effective working relationships** The importance of listening skills, paying attention to work instructions, making sure that they understand what has been said by asking questions when unsure, avoid abusive or offensive behaviour, personal hygiene, willing co-operation with workmates, good time keeping, obeying company rules and regulations, working safely, treat people (workmates and customers) with courtesy and respect, being reliable and trustworthy. **Difficulties** Uncouth behaviour, constant physical and verbal bullying, racial or sexual remarks, the need for balanced dialogue for settling disputes **Relevant persons** Experienced and reliable workmates, charge hands, foreman, managers, the lines of authority within the company.

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 state the **types of information** required for maintaining records 6.2 state **sources of information** for boat production and support services 6.3 state the **importance of accuracy** when completing records 6.4 state the **importance of maintaining records** for disposal of waste in an environmentally responsible way.

Range
Types of information A description of the work and its location, special requirements (tools) , time sheets giving the labour hours, sub-contracted work details, requisition sheets , the test and quality information **Sources of information** Internal – past records, new build specifications, scantlings lists, time sheets, requisition sheets, test records, drawings and specifications External – Designers' drawings and specifications, Regulation agencies, Recreational Craft Directive, Marine Safety Agency, material and equipment suppliers' information and installation sheets and instructions. **Importance of accuracy** Preventing wrong information being recorded, enabling a true account of costs and time to be established, providing a log of what was done when and by whom, providing information for future planning and potential customers. **Importance of maintaining records** Legal requirement, social responsibility, company policy

Unit 202 Principles of boatbuilding technology

UAN:	**Y/503/2262**
Level:	2
Credit value:	7
GLH:	65
Relationship to NVQ:	This unit is linked to the following NVQ units; 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134 and 135.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
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.

Learning outcome
The learner will: 1. Know how to identify boat building materials and their properties
Assessment criteria
The learner can: 1.1 identify the common **materials** used in boat building 1.2 list the **properties that identify materials** 1.3 identify the **properties of materials** 1.4 describe the difference between oxidation, electrolytic and galvanic corrosion 1.5 list typical **adhesives** used in marine applications 1.6 identify types of **protective coatings** used in marine applications.

Range
Materials Timbers (hard wood, soft woods, manufactured boards), Composites (glass reinforced (GRP), fibre reinforced (FRP), plastics), Metals (ferrous – steel, non ferrous – aluminium, copper, alloys - brass, bronzes) **Properties that identify materials** Colour, texture, density, magnetism **Properties of materials** Tensile strength, hardness, toughness/brittleness, ductility/malleability, corrosion resistance

Adhesives

PVA, Formaldehydes, Epoxy resins, Polyurethanes

Protective coatings

Varnishes, paints (including anti-fouling), preservatives, resins, plastic sheathing, metallic coatings such as galvanising and sheridising

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
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 **Types of drawings** First and third angle orthographic projections, oblique and isometric projections, general layout and assembly drawings, exploded and sectional views, lines plans & table of offsets, construction plans, general arrangements, detailed drawings **Sources** Instruction manuals, technical books, tables, charts, graphs, data sheets, electronic sources

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 **tools, fastening systems 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
Tools, fastening systems and equipment Tools – Measuring and marking out tools, Cutting tools, Drilling tools, Shaping tools, Assembling and fixing tools, Sharpening systems, coating application tools , surface preparation tools Fastening systems – mechanical, chemical Equipment – masking tape, dust sheets, coatings (traditional and modern) **Equipment for lifting and transporting** Trolleys, skates, jacks, trucks pallet, fork lift, wall and overhead cranes, slings and pull lifts, docking equipment, slipways, mobile boat lifts, sliding ways **General rules** Safe storage, cleaning after use, sharpening, honing **Safety requirements** Use of correct PPE, ensure use and correct settings for guides and guards, the use of low voltage system, mains or battery operated tools

Learning outcome
The learner will: 4. Understand boatbuilding operations
Assessment criteria
The learner can: 4.1 state the **units and derived units** used to perform simple calculations 4.2 identify the **factors** to be considered when measuring and marking out 4.3 list the factors affecting **accuracy of measurement** 4.4 identify the purpose of **work holding devices** 4.5 describe the methods of **material removal** 4.6 describe the factors which effect material removal 4.7 describe the purpose of assembly joining/fixing 4.8 describe the purpose of finishing 4.9 identify the **sequence of operations** when carrying out boatbuilding, outfitting and finishing activities.

Range
Units and derived units Length, area, volume, mass, weight **Factors** Length, flatness, parallelism, angle, profile, relative position, capacity **Accuracy of measurement** Condition of equipment, calibration, correct positioning, dimensions, tolerances), **Work holding devices** Vices, clamps, chucks **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) Drilling (through holes, counter-bored holes, countersunk holes)

Factors which effect material removal (cutting speed, material hardness, grain direction and structure/timber), the use lubricants and friction reducing substances such as candle wax or bees wax

Sequence of operations

Preparation

Work area free from obstructions, extract information from instructions, specifications, and drawings, select materials, tools and equipment, devise operations plan, if required liaise with other trades, permit to work or advise client

Prepare material surface

Cleaning, abrading, coating, de-greasing

Carry out operation/process

Temporary jigs and support equipment in place, set up equipment/ machinery, follow correct procedures, comply with Health and Safety requirements

Complete process and checking

Check for accuracy against specification, reinstate work area

Unit 203 Marine engineering processes and principles

UAN:	**D/503/2263**
Level:	2
Credit value:	7
GLH:	65
Relationship to NVQ:	This unit is linked to the following NVQ units; 113, 114, 115, 131, 132, 133 and 134.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This mandatory unit is concerned with the selection and use of materials, tools and equipment and their application in marine engineering operations.

Learning outcome
The learner will: 1. Know how to identify marine engineering materials and their properties
Assessment criteria
The learner can: 1.1 identify the common **materials** used in marine engineering 1.2 list the **properties that identify materials** 1.3 identify the **properties of materials** 1.4 describe the difference between oxidation, electrolytic and galvanic corrosion 1.5 list typical **fixings and fastenings** used in marine engineering applications 1.6 identify types of **protective coatings** used in marine engineering applications.

Range
Materials Metals (ferrous – steel, non ferrous - aluminium, copper, alloys - brass, bronzes), Timbers, Composites **Properties that identify materials** Colour, texture, density, magnetism **Properties of materials** Tensile strength, hardness, toughness/brittleness, ductility/malleability, corrosion resistance

Fixings and fastenings

Nuts, bolts, screws, washers

Protective coatings

Paints, resins, plastic sheathing, metallic coatings such as galvanising and sheridising

Learning outcome
The learner will: 2. Know how to interpret and use marine engineering specifications and installation requirements
Assessment criteria
The learner can: 2.1 identify drawing conventions to ISO8888/2000 2.2 identify **types of drawings** used in marine engineering installations 2.3 list the **sources** of marine engineering installation information.

Range
Types of drawings First and third angle orthographic projections, isometric projections, general layout and assembly drawings, exploded and sectional views, construction plans, general arrangements, detailed drawings **Sources** Instruction manuals, technical books, tables, charts, graphs, data sheets, electronic sources

Learning outcome
The learner will: 3. Know how to use tools and equipment safely in a marine engineering environment
Assessment criteria
The learner can: 3.1 identify typical **tools, fastening systems and equipmen**t used in marine engineering installations 3.2 identify the **equipment for lifting and transporting** loads 3.3 state the **general rules** for the maintenance of tools and equipment 3.4 describe the **safety requirements** for using power tools.

Range
Tools, fastening systems and equipment Tools – Measuring and marking out tools, Cutting tools, Drilling tools, Shaping tools, installation/maintenance tools, Sharpening systems Fastening systems – mechanical, chemical Equipment – masking tape, dust sheets **Equipment for lifting and transporting** Trolleys, skates, jacks, pallet trucks, fork lift, wall and overhead cranes, slings and pull lifts, docking equipment, slipways, mobile boat lifts, sliding ways

General rules Safe storage, cleaning after use, sharpening

Safety requirements Use of correct PPE, ensure use and correct settings for guides and guards, the use of low voltage system, mains or battery operated tools

Learning outcome
The learner will: 4. Understand marine engineering processes
Assessment criteria
The learner can: 4.1 state the **units and derived units** used to perform simple calculations 4.2 identify the **factors** to be considered when measuring and marking out 4.3 list the factors affecting **accuracy of measurement** 4.4 identify purpose of **work holding devices** 4.5 describe the methods of **material removal** 4.6 describe the factors which effect material removal 4.7 describe the purpose of assembly joining/fixing 4.8 describe the purpose of finishing 4.9 identify the **sequence of operations** when carrying out marine engineering activities.

Range
Units and derived units Length, area, volume, mass, weight **Factors** Length, flatness, parallelism, angle, profile, relative position, capacity **Accuracy of measurement** Condition of equipment, calibration, correct positioning, dimensions, tolerances), **Work holding devices** Vices, clamps, chucks **Material removal** Sawing, grinding, filing, drilling (through holes, counter-bored holes, countersunk holes), thread tapping Factors which effect material removal (cutting speed, material hardness), the use lubricants and cutting compounds **Sequence of operations** Preparation Work area free from obstructions, extract information from instructions, specifications, and drawings, select materials, tools and equipment, devise operations plan, if required liaise with other trades, permit to work or advise client Prepare material surface Cleaning, abrading, coating, de-greasing Carryout operation/process Temporary jigs and support equipment in place, set up equipment/machinery, follow correct procedures, comply with Health and Safety requirements Complete process and checking Check for accuracy against specification, reinstate work area.

Unit 204 Yacht and boatbuilding assembly and sub-assembly

UAN:	**F/503/3485**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 116, 117, 120 and 123.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
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.

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 carry out 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 and composite boards 1.5 state the **factors** influencing the choice of materials in boatbuilding assembly and sub assembly 1.6 select and use the **hand tools and equipment** used in boatbuilding assembly and sub assembly 1.7 identify and operate the **woodworking machinery** used in boatbuilding assembly and sub assembly 1.8 operate the **hand held power tools** used in boatbuilding assembly and sub assembly 1.9 select **typical fastenings and adhesives** 1.10 use **protective coatings** for assembly and sub assembly operations

Range
Sources of information Codes of practice, Lloyds and RCD rules & regulations, customer/client specifications, BSS Boat safety scheme, inland waterways, BS/EN standards applicable to the Marine Industry, Line plans, working drawings and designer's specifications, The current drawing standards ISO 8888/2000. **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 (e.g. nail head impressions), Describe the cutting and shaping methods used to produce moulds, templates and jigs **Materials** Timbers (oak, mahogany, teak, iroko, baltic red pine, white wood, douglas fir) Composite/manufactured board (GRP, thermoplastics, laminates, marine ply, MDF), Metals (bronzes, copper, brass, stainless steel, galvanised steel, aluminium alloys), zinc **Material defects** Woods, composite boards – natural defects (shakes, knots, types of rot) seasoning defects (hardening, twisting, warping), voids, water damage Metals – corrosion (galvanic and electrolytic stray current) metal fatigue, de-zincification FRP – under cured resin, gel coat contamination, incorrect mixing and application of materials, incorrect workshop conditions (humidity, temperatures) **Factors** – Suitability based on: cost, weight, durability, stability/longevity, availability; **Hand tools and equipment** Cutting tools, saws (cross cut, panel, coping, tenon and pad saws, hacksaws, diamond, tungsten tipped, pull saws, hole saws), bow saw Material removal tools (chisels, planes (block, smoothing, jack, try, bollow, moulding), spoke shaves, drawknives, files, rasps, adze) Assembly and joining tools (drills, screw drivers , spanners, socket sets) Hammers (claw, ball pein, cross pein, maul, lump) Measuring and marking out tools (tapes, rules, squares, gauges, scribes, templates, 'Shepherds crook', tick stick, spiles and spiling battons) Work-holding devices (gripes, vices, chucks, 'G' cramps, sash cramps, quick-release cramps, lever cramps) Special tools (jigs, formers, saddles) **Woodworking machinery** Saws (circular, band, cross cut), planer/thicknesser (over and under), mortisers, spindle moulders, bench sanders, routers **Hand held power tools** Electrical drills, sanders, saws (jig, 'Skil' chain etc.) grinders, routers, power planes **Typical fastenings and adhesives** Screws, bolts, nails and pins, adhesives **Protective coatings** Paint and varnishes, plastic coating, metallic coatings (galvanisers)

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 and jig components.

Range
Requirements of a safe working environment Environmental control, washing facilities, dust and fume extraction, temperature and humidity control, the handling and storage of hazardous materials (COSHH), well maintained walkways, effective access and egress, safe and correct disposal of waste material **Safe methods** Never exceed safe working load (SWL), avoid shock loading, never transport loads over people, avoid twisting of slings and ropes **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, chines, gunwhales/inwhales, mast clamp, mast step, breast hook, quarter knees, planking, beams, carlins, hanging knees, lodging knees, hatch and side coamings. companion ways, doghouse, cockpit Composite – male and female moulds, release agents, wax, PVA, laminates, resins and core materials **Sources of information** Lines plan and offsets, CAD applications **Importance of complying** Reduce errors, prevent reworking, prevent waste, ensure quality **The sequence of operations** Comply with health and safety requirements Work area free from obstructions Extract information from instructions, specifications, and drawings Devise operations plan Select assembly or sub assembly components, tools and fixings to use If required liaise with other trades

Ensure level lines, datum line and position is clearly marked

Carry out assembly or sub assembles operations

Check that assembly or sub assembly conforms to operational requirements

Terminology and techniques

Plumb, level, dimensional orientation, horning in

Learning outcome
The learner will: 3. Understand quality standards for assembly and sub assembly components
Assessment criteria
The learner can: 3.1 describe the **techniques** used to check alignment 3.2 identify **common faults** in construction materials 3.3 state the relevant **regulations and compliance bodies** that apply to checking the assembly and sub assembly operations 3.4 identify the **relevant persons to contact** in the event of a problem 3.5 use **checks** that ensure that all operations have been completed according to plan 3.6 **reinstate** the work area after work is finished

Range
Techniques 'Horning in', levelling and plumbing, dimensional orientation and visual inspection **Common faults** Wood and composite boards – natural defects such as shakes, knots, types of rot, seasoning defects such as case hardening, twisting and warping Metals – corrosion, types such as oxidation, galvanic or electrolytic stray current cavitation in propellers, metal fatigue de-zincification FRP structures – de-lamination, under-cure of resin, gel coat contamination, incorrect mixing, application of materials or incorrect workshop conditions such as high humidity or cold temperature **Regulations and compliance bodies** Lloyds, 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) **Relevant persons to contact** Charge-hand, team leader, foreman, manager, designer, quality controller **Checks** Location, dimensions, functionally operative, visual **Reinstate** Clearing away all waste and discarded material, returning all tools and equipment to the stores or tool boxes, dismantling or returning all jigs and templates to storage areas, cleaning and sharpening all tools ready for the next job, ensuring the area is safe and free from dangers (risk assessment)

Unit 205 Production of external boat components

UAN:	**K/503/2265**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 116, 117, 120 and 123.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
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.

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 describe the **principles of lofting**

1.3 state the importance and purpose of drawings, specifications, data and procedure sheets

1.4 identify the **materials** used in the production of moulds and templates

1.5 identify the **characteristics** of the materials used in the production of moulds and templates

1.6 produce shapes of moulds and templates and transfer them onto the mould/template material using a variety of **techniques**

1.7 use **hand tools** and **woodworking machinery** safely

1.8 explain the function and safe use of **powered tools**

1.9 identify the **causes of defects in materials** when marking, setting out and cutting materials for moulds and templates

1.10 state the importance of minimising waste when marking, setting

out and cutting materials for moulds and templates.

Range
Sources of information Codes of practice, Lloyd's and RCD rules and regulations, Customer/client specifications, BSS Boat safety scheme,(inland waterways), BS/EN standards applicable to the Marine Industry, Lines plans, working drawings and designer's specifications, Current drawing standards ISO 8888/2000 **Principles of lofting** Lofting grid made up of forward and after perpendiculars, station lines, water lines, buttock lines and diagonal lines; 'table of offsets' to produce a line plan containing, sheer plan or profile half breath plan and body plan. **Materials** Template paper and card, solid timber, manufactured boards, composites, metals **Characteristics** Stability, ease of use, cost effectiveness **Techniques** Direct measurement, tracing/transfer, nail-head impressions **Hand tools** Cutting tools, saws: cross cut, panel, rip, coping, tenon and pad saws, hacksaws, diamond, tungsten tipped, pull saws, hole saws, Material removal tools: chisels (firmer, mortice, 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 Measuring and marking out tools: tapes, rules, squares, gauges, dividers, scribes, bevel board, **Woodworking machinery** Saws, circular, band, cross cut, planers, over and under, sanders, routers, mortisers, spindle moulders **Powered tools** Hand held power tools both electric and pneumatic: drills, sanders, saws, grinders, planers Thermal equipment: blow torches, heat mats for vacuum moulding, soldering irons. High pressure power washers. **Causes of defects in materials** Incorrect selection, incorrect setting out, incorrect cutting/shaping, distortion (twisting and warping or heat distortion in the case of 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
External boat components Hatches, hatch garage, companionway, hatch boards, coamings, gratings, vent boxes, navigation light boxes, rudders, tillers, masts, spars, oars, grab rails/hand rails **Materials** Timbers, hardwoods and softwoods; Composites; Manufactured boards; Metals **Techniques** Direct measurement, tracing/transfer (use of dummy sticks), nail-head impressions, templates **Cutting technique** Hand saws (pad, keyhole), adjustable table on band or dimension saws, adjustable base plate on jig and power saws, portable routers, spindle moulders **Cutting defects** Saw tooth marks, burn marks, planer ripple marks, burn marks from blunt cutters on routers **Surface finish** Painting, varnishing, staining and polishing, antifouling **Protective methods** Plastic covering, bubble wrap, peelable coatings, cardboard, paper

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 fixing devices** required for assembly operations 3.5 select and use **tools and equipment** for assembly operations 3.6 use **lifting equipment** safely 3.7 identify the **problems** which can occur when assembling boat components.

Range
Safety regulations HSAWA, COSHH, Provision and Use of Work Equipment Regulations, Need for risk assessment, Correct disposal of waste, Use of PPE, Lifting and handling regulations **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 **Methods of setting up** Levelling, plumbing and 'horning in', bracing, spiling, declivity, wedging **Temporary fixing devices** Cramps, clamps, gripes, nails, hot glue gun **Tools and equipment** Levelling/alignment equipment, Hand tools, Portable power tools, basic welding equipment, brazing and soldering **Lifting equipment** Blocks and tackles, jacks, cranes, travel hoist, fork lift truck, gantry **Problems** Blunt tools faulty equipment, Level of skills and training of personnel, poor planning and quality control, components not to specification, adequate stock control

Unit 206 Interior installation and fitting out of boats

UAN:	**M/503/2266**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 114, 115, 118, 119, 122 and 132.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
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.

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 explain the importance of using **techniques** to identify the correct location and positions for joinery and fitting 1.4 use **hand tools** and **powered hand tools** safely 1.5 identify **fastenings** required 1.6 describe the **fittings** installed in each of the accommodation areas on boats 1.7 describe the **checks** to be carried out on joinery and fittings to ensure serviceability 1.8 describe the **working problems and potential hazards** that can affect fitting out activities.

Range
Sources of information Codes of practice, Lloyd's and RCD rules and regulations, Customer's/client's specifications, BSS Boat safety scheme (inland waterways), BS/EN standards applicable to the Marine Industry. **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, manufacturer's data sheets and specifications, customer's specifications. **Techniques** Measurement, levelling, plumbing, declivity, horning in, scribing, spiling, use of dummy sticks, construction and use of datum lines, checking the position of preinstalled components **Hand tools** Cutting tools, saws: cross cut, panel, rip, coping, tenon and pad saws, hacksaws, diamond, tungsten tipped, pull saws, hole saws, knives and scissors Shaping tools: chisels (firmer, mortice, bevel edged), planes (smoothing, jack, try, rebate, shoulder, bollow, moulding, block), spoke shaves, drawknives, files, rasps, 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', **Powered hand tools** Drills, sanders, saws, planes, routers, grinder **Fastenings** Screws, bolts, nails and pins, adhesives **Fittings** Galley: sinks and drainage fittings, cooker and shut-off, ice box/fridge, storage lockers, hinges and locker catches, fire blanket, crockery and cutlery stowage, water system and filters, tanks – fresh and waste. WC compartment (heads): toilet – black water holding tanks, shower, wash basin, skin fitting for WC and wash basin, water system – hot and cold, lighting and ventilation, shower pump and filter. Navigation area: seating, chart table, lighting and vents, navigation instruments and skin fittings (transducer), storage lockers and drawers, drawer hardware, catches. Saloon: seating – height/width conventions, table – height/width conventions, storage locker and drawers, drawer, hardware, catches, lighting and ventilation, heating systems. Sleeping accommodation: bunks, pilot berths, and lee boards or cloths, lighting and ventilation, hanging lockers and storage. **Checks to ensure serviceability** Visual, functional, operational checks. **Working problems and potential hazards** Working problems: sequence of activities, access for other trades Hazards: ventilation, fire, access, lighting, housekeeping

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
Methods of identification Identification of codes and labels, bar coding, visual recognition, pattern, catalogue or code numbers, drawing specifications **Methods used to identify the approximate weight** Measurement and calculation, manufacturer's information **Methods used to transport and lift** Lifting equipment: trolleys, skates, jacks, pallet truck, fork lift, wall and overhead cranes. Slings and pull lifts. **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. **How to protect and prevent damage** Covering and packing, padding, temporary supports, temporary surface coating. **Preparation of 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. **Align and fit** Use of 'dummy sticks' for spiling and scribing, use of spile 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 select and use the tools and equipment 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
Methods to ensure positional accuracy Dimensional checks against specifications, drawings and datum lines; Level, plumb and horning in checks; Visual checks **Fixing methods** Mechanical fastenings: screws, bolts, nails, rivets Adhesives: two-part epoxy, 'Phenol' formaldehyde, PVAs, contact adhesive, urea formaldehyde, cascein glue, Polyurethane (PU) FRP bonding: glass bonding, polyester paste, epoxy putty, methacrylates Sealants: silicon (marine), polyurethane, polysulphides, oil based, acrylic, jointing tape **How to ensure the strength and security** Backing pads and plates, load spreading methods, torque loadings, material breaking points. **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. **Alignment and fixing quality checks** By geometric accuracy, fit of joints, functional operation of fittings (fit for purpose), leak test, alignment of screw/bolt heads, visual.

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

Range
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. **Methods** Covering with cloth or cardboard, wrapping with bubble wrap, coating, storing in secure location until required, correct labelling **How to reinstate the work area** Clean and clear waste from work area, return tools, equipment and services, ensure protection and labelling in place, floors and access panels are replaced. **Records and checks** Recording of hours, recording of materials used, inspection checklist and records, quality control records, owner's RCD installation manual

Unit 207 Composite manufacture for marine construction

UAN:	**T/503/2267**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 124 and 130.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This unit is about the requirements for successful production of components in composite materials related to marine construction. It includes wet lay ups, use of pre-preg 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 composite construction

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 composite manufacture** 1.2 describe the function and the physical properties of the materials used in composite manufacture 1.3 state where to find the **standards for testing composite 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 composites**.

Range
Sources of information relevant to composite manufacture Current regulations, Codes of practice, Lloyd's and RCD rules, Customer's specifications, BS/EN standards applicable, manufacturer's data sheets, the internet

Standards for testing composite material specimens

BS/EN, company practice, manufacturer's data sheets, Lloyds rules

Working drawings and specifications

First and third angle orthographic projections, oblique and isometric projections, general layout and assembly drawings, exploded and sectional views.

Requirements for safe working environments

Provision of Personal Protective Equipment (PPE), Local exhausts ventilation (LEV systems), fume cabinets, washing facilities, dust proof lighting, dedicated dust and fume extraction, temperature control and humidity recording, permitted short and long term exposure limits, safe access and egress

Potential hazards when working with composites

Curing agents (catalysts & accelerators), dust, broken fibres, solvents, resin vapours, exothermic reaction, weight of finished components

Learning outcome
The learner will: 2. Be able to plan mould and lay up operations
Assessment criteria
The learner can: 2.1 describe the **methods of mould manufacture** 2.2 describe the methods of stiffening and cradling moulds and hulls 2.3 describe the **need for stiffening and cradling** to support moulds and hulls 2.4 describe the basic features of **materials** used in mould and lay up operations 2.5 identify the reasons for different weave patterns used in cloth reinforcements 2.6 describe the resin 'cure initiating' or hardening systems used in composites 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 composite 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 2.15 identify basic **moulding and lay up techniques**.

Range
Methods of mould manufacture Mould design considerations:, daw off angles, the use of split moulds , stiffening flanges and supports, releasing methods (Jacking points, compressed air points), stable material for mould construction 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 **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 **Materials** Thermosetting plastics, GRP, FRP composite materials Fibres used in composites such as: Glass, carbon, aramid, hemp, woven roving's, woven cloths etc., combination mats, hybrid cloths, pre-impregnated cloth (pre-pregs) Resins Pastes and liquid resins such as vinyl-esters, epoxies and polyesters. Ancillary materials including: catalysts, accelerators, colour pigments, thixotropic agents, fire retardants, fillers, adhesive film, sheet and pre-shaped foam, CNC cut kits, both foam and reinforcements. **Mixing procedures** Resin to reinforcement ratio, % of pigment addition, thixotropic agents, fire retardants, fillers **Tools, machinery, equipment and materials** 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 **Methods used to check and monitor resin/glass ratio** Ash test, accurate recording of amounts used **Methods of construction** Contact moulding – wet lay ups, contact moulding – spray techniques, resin transfer moulding, use of pre-preg materials, sandwich construction, (use of foam, wood or honeycomb core) , spiral winding, vacuum bagging and resin infusion. **Prepare the moulds** Allow mould to acclimatise if brought in from outside in cold weather, thoroughly clean, make repairs if necessary, surface rubbed down & polished to desired quality, waxing and the application off, release agents **Reasons for using templates** Cutting out reinforcement plies, complex shapes, checking profile shapes. **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 **Prepare operation sheets** Put on barrier cream and PPE, prepare mould, determine quantities

required , mix and apply gel coats , whilst waiting to gel, cut out reinforcements, mix laminating resin, apply resin and reinforcement plies, consolidate with appropriate tools, allow to cure, release and trim.

Moulding and lay up techniques

Hand lay up, vacuum bagging, resin transfer moulding

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 composite materials** 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 **use portable electrical equipment safely**.

Range
Safe methods of transportation Casters on cradles, trolleys, trailers, fork lift trucks, manual handling, overhead cranes and pulley systems **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 1200). **Safety precautions when using composite materials** Mixing of resin and adhesives, machining composites, using of powered hand tools, disposing of waste **Weigh and mix resins** Cleanliness, weighing, mixing, pot life, shelf life **Laminating operations** Flat panels, curved panels **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.

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 GRP/FRP construction 4.2 describe the **methods used for checking accuracy and quality** components in GRP/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 composites 4.5 describe **repair techniques** available for defective GRP/FRP components.

Range
Methods used for checking accuracy and quality Dimensional – measurement, jigs, profile, shape -templates, formers, surface finish-visual inspection, surface defects -visual inspection, tap test, the use of thickness metres/gauges, hardness test using a 'Barcol' test meter **Common damage** Impact, osmosis, scratches and gouges, water ingress, delamination, disbond, degradation **Repair techniques** Gl coat repairs, repairs made from inside component, repairs made from outside component

Unit 208 Servicing and maintenance of marine engines

UAN:	**A/503/2268**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 113 and 131.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This optional unit is concerned with the servicing and maintenance of marine engines. It covers servicing and maintenance of engines, resources and information required and basic servicing.

Learning outcome
The learner will: 1. Know how to service and maintain marine engines safely
Assessment criteria
The learner can: 1.1 identify the types of **marine engines** 1.2 describe the **types of engine installation** 1.3 describe the **operating principles** of marine engines 1.4 identify the **components of a marine engine** 1.5 identify the **ancillary systems and components** of a marine engine 1.6 state the **purpose of routine servicing and maintenance** 1.7 identify **types of data** required for servicing and maintenance 1.8 state the **hazards** and **precautions** to be taken when working with marine engines.

Range
Marine engines Single cylinder, Multi cylinder (in-line, horizontal, vee) **Types of engine installation** Inboard, outboard, jet ski **Operating principles** Compression ignition; two stroke, four stroke Spark ignition; two stroke, four stroke

Components of a marine engine

Cylinder, cylinder block and crankcase, cylinder head, piston and piston rings, connecting rod and gudgeon pin, small and big bearings, crankshaft, main and thrust bearings; sump, inlet and exhaust valves or ports, valve operating mechanisms, flywheel, crankshaft damper

Ancillary systems and components

Fuel – tanks, piping, filters, pumps, injectors, cleaners.

Cooling (air cooled and water cooled) - pumps, thermostats, hoses, pressure caps, sea inlet.

Lubrication – pumps, filters

Ignition/compression – spark plugs, glow plugs

Exhaust (wet/dry) – muffler, swan neck, water lock

Purpose of routine servicing and maintenance

Improve efficiency, extend engine life, reduce the chance of failure

Types of data

Workshop manuals, manufacturer's data and information sheets, service schedules, parts lists, legal and technical data reference books.

Hazards

Danger from power transmission systems rotating, reciprocating machinery and parts, lubricants and fuels, electrical equipment and systems, fire risks

Precautions

Lubricants and fuels – skin protection and ventilation

Electrical equipment – isolate, low-voltage systems

Fire risks – take precautions with fuels

Personal Protective Equipment (PPE); goggles, gloves, safety equipment

Legislation; COSHH, HASAWA, PUWER, LOLER

Learning outcome

The learner will:

2. Understand the resources and information required for servicing operations

Assessment criteria

The learner can:

2.1 describe the **main elements of a maintenance programme**

2.2 interpret technical data to compile a maintenance programme

2.3 state the **resources** required for servicing and maintenance

2.4 state the **documentation and information** required for servicing and maintenance.

Range

Main elements of a maintenance programme

Preventive and scheduled maintenance: cleaning, lubrication, replenishment, adjustment, checking, overhaul, replacement; corrective/emergency maintenance

Resources

Tools, test equipment, yard facilities and equipment: hand tools, measuring equipment, power tools, lifting equipment, draining equipment

Spare parts, materials and consumables: filters, seals, gaskets, electrical

connections, lubricants

Documentation and information

Reference data and documentation: technical information, service manuals

Reporting systems: job sheets, recommendations to other personnel.

Learning outcome
The learner will: 3. Be able to carry out basic servicing and maintenance of marine engines
Assessment criteria
The learner can: 3.1 carry out **routine tests** on a marine engine and its ancillary systems 3.2 carry out **checks** whilst servicing and maintaining marine engines

Range
Routine tests Engines: checking and adjustment of valve clearance, examination for seals and gaskets for leak, examination of cylinder head for coolant leaks, examination of exhaust manifolds for leaks, examination of engine mounting. Cooling: pressure test for leaks, testing thermostat, checking drive belts for condition and tension, checking cylinder and cowling for damage and cleanliness, antifreeze. Fuel system: condition of tank, fuel lines and unions, checking pump, cleaning and replacing filters. Lubrication system: checking oil level, checking for contamination, cleaning and replacing filters. Ignition system: ignition timing, condition of contact breaker and points, condition of distributor, condition of spark plugs, condition of leads and connections. Inlet and exhaust systems: checking manifold for leaks, checking exhaust system for condition, checking induction system for damage. Starting system: condition of leads and connections, servicing of battery, master switches **Checks** Safety checks: electrical power, piping and connectors, oil and coolant levels; performance checks: engine running temperatures, pressure, leaks, vibration

Learning outcome
The learner will: 4. Be able to record results and make recommendations
Assessment criteria
The learner can: 4.1 compare the **results obtained from servicing and maintenance** with manufacturer's data 4.2 identify **methods to record results** obtained 4.3 record results of service and maintenance activity.

Range
Results obtained from servicing and maintenance Exhaust gas emissions testing S.I. and C.I. engines, compression testing (S.I. and C.I.), cooling system testing, engine system testing with an electronic engine analyser **Methods to record results** Diagnostic test equipment, company maintenance records

Unit 209 Servicing and maintenance of marine propulsion systems

UAN:	**F/503/2269**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 113 and 131.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This optional unit is concerned with the servicing and maintenance of marine propulsion systems. It covers servicing and maintaining marine propulsions systems, resources and information required and basic principles of propulsion systems.

Learning outcome
The learner will: 1. Know how to service and maintain marine propulsion systems safely
Assessment criteria
The learner can: 1.1 identify the **features of marine propulsion systems** 1.2 state the main **components of propulsion systems** 1.3 identify types of **propulsion drive system** 1.4 explain the **purpose of routine servicing and maintenance** 1.5 list the **types of data** required for servicing and maintenance 1.6 state the **hazards** and **precautions** to be taken when working with propulsion systems.

Range
Features of marine propulsion systems In board engines: assembly fixtures, transmission systems, electrical connections, control systems Out board engines: assembly and mounting, control systems, electrical connections **Components of propulsion systems** Gearbox and reduction gear (cooling and lubricating), drive systems, shafts, propellers, brackets, seals, bearings, rudders, steering gear **Propulsion drive system** Direct, electro/hydraulic, outdrive, Z drive, V drive

Propellers: Fixed, feathering, folding, variable

Purpose of routine servicing and maintenance

Improve efficiency, extend engine life, maintain reliability

Types of data

Workshop manuals, manufacturer's data and information sheets, service schedules, parts lists

Hazards

Danger from power transmission systems rotating, lubricants, electrical systems, fire risks

Precautions

Lubricants – skin protection and ventilation.

Electrical systems – isolate, low-voltage systems.

Fire risks – take precautions with lubricants.

Personal Protective Equipment (PPE); goggles, gloves, safety equipment.

Legislation; COSHH, HASAWA, PUWER, LOLER

Learning outcome
The learner will: 2. Understand the resources and information required for servicing operations
Assessment criteria
The learner can: 2.1 describe the **main elements of a maintenance programme** 2.2 interpret technical data to compile a maintenance programme 2.3 state the **resources** required for servicing and maintenance 2.4 state the **documentation and information** required for servicing and maintenance.

Range
Main elements of a maintenance programme Preventive and scheduled maintenance: cleaning, lubrication, replenishment, adjustment, checking, overhaul, replacement; corrective/emergency maintenance. **Resources** Tools, test equipment, yard facilities and equipment: hand tools; socket sets, screwdrivers, pliers, spanners, wrenches, measuring equipment; feeler gauges, pressure gauges, test meters, power tools, lifting equipment, draining equipment. Spare parts, materials and consumables: filters, seals, gaskets, electrical connections, lubricants. **Documentation and information** Reference data and documentation: technical information, service manuals Reporting systems: job sheets, recommendations to other personnel.

Learning outcome
The learner will: 3. Understand basic principles of propulsion systems and undertake servicing and maintenance procedures
Assessment criteria
The learner can: 3.1 identify the installation, components and principles of operation for a **marine propulsion system and its ancillary systems** 3.2 describe and undertake **routine servicing and maintenance checks** on a marine propulsion system

Range
Marine propulsion system and its ancillary systems Gearboxes (lubrication and cooling), transmission (couplings), bearings, seals, brackets, rudders, steering systems, engine mounts, propeller (locating, security) **Routine servicing and maintenance checks** Safety checks, performance checks, engine running temperatures, pressure, leaks, alignment, vibration

Learning outcome
The learner will: 4. Be able to record results of testing marine propulsion systems and make recommendations
Assessment criteria
The learner can: 4.1 compare the results obtained from **performance checks** with manufacturer's data 4.2 identify **methods to record results** obtained 4.3 record results of service and maintenance activity.

Range
Performance checks Visual inspection, vibration/sound analysis **Methods to record results** Diagnostic test equipment, company maintenance records

Unit 210 Installing electrical wiring support systems

UAN:	**T/503/2270**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 111, 112, 131, 134 and 135.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This optional unit is concerned with maintaining electrical marine engineering equipment and systems. It covers preparing for installation and identification of equipment, materials and components.

Learning outcome
The learner will: 1. Know how to prepare for the installation of electrical wiring support systems
Assessment criteria
The learner can: 1.1 describe **drawings and technical information** required and the procedures for their care and safe keeping 1.2 explain the importance of work plans 1.3 identify **information** that should be contained in work plans 1.4 identify the **existing services** to be considered when installing systems 1.5 explain the importance of using appropriate techniques to pass cables through watertight bulkheads.

Range
Drawings and technical information Installation drawings, guidance and regulations relating to the installation of conduit, trunking or traywork, layout drawings (symbology to BS 60617) **Information** Sequence of operations, materials and components required, tools and equipment needed, safety considerations, physical resources, timescales **Existing services** Gas, water, fuel, electricity, communications cables, data cables

Learning outcome
The learner will: 2. Know how to identify equipment materials and components for the installation of electrical wiring support systems
Assessment criteria
The learner can: 2.1 state the **factors** which affect the selection of appropriate conduit, ducting, trunking or traywork components for different marine applications and environments 2.2 state the **components and connectors** used in the installation of electrical wiring support systems 2.3 describe the **equipment and tools** used for installation operations 2.4 explain the importance and use of **inspection fittings** 2.5 state the ways in which wiring and components can become **damaged.**

Range
Factors Specification/environment, size/section of materials, effects of ambient temperatures, effect of proximity to existing electrical systems, compliance with current regulations/legislations **Components and connectors** Screwed fittings, glued fittings, straight connectors, bends, tees, inspection fittings, light, power and control outlet boxes **Equipment and tools** Saws, files, stocks and dies, hot air guns, vices, pipe bending techniques, levels, plumb bobs, screwdrivers, spanners, hammers, hole punches and cutters, battery and power tools (110v), access equipment **Inspection fittings** Elbows, tees, bends, boxes (round and square), junction boxes, instrument panels and connectors **Damaged** Containing internal foreign bodies, burrs, sharp edges, contamination, proximity to heat source

Learning outcome
The learner will: 3. Know how to install electrical wiring support systems
Assessment criteria
The learner can: 3.1 state the responsibilities under current **electrical regulations** 3.2 state the precautions to be taken when using cutting and bending tools and equipment 3.3 explain the need for **protective equipment** 3.4 describe the safe practices and procedures required when carrying out assembly and installation activities on electrical wiring support systems 3.5 mark out lengths to be cut making allowances for **considerations** 3.6 use methods of holding work pieces without damaging them 3.7 bend and fabricate electrical wiring **installation components** to produce **components** 3.8 bend plastic conduit by use of friction and hot air guns, springs and jigs 3.9 describe how to form screw threads on ends of conduit 3.10 use screw fittings, glued fittings, fabricated components, nuts and bolts 3.11 make visual checks for **defects** 3.12 explain the importance of making sure that all components and installations are free from **defects** 3.13 list types of **accessory boxes** that are compatible with support systems 3.14 mark out and check **alignment of components** 3.15 describe **methods of securing system components** to ensure correct position and spacing of supporting brackets and devices 3.16 use electrical bonding to ensure earth continuity of metallic support systems 3.17 identify **problems** relating to component selection and installation 3.18 explain the importance of following **good working practices** 3.19 carry out **visual checks** following completion of the support system.

Range
Electrical regulations BMEA, RCD, classification societies, government legislation **Protective equipment** Overalls, safety shoes, eye protection, gloves, barrier creams **Considerations** Bending, screwing, use of adhesives, fabricating, joining operations **Installation components** Conduit, trunking, ducting, traywork **Components** Bends, offsets, bridge sets, tee junctions, double and saddle sets to a tolerance within + or - 5mm.

Defects

Ripples/deformation around bends, absence of burrs and sharp edges, overall dimensions, position of bends or sets, angle of bends, mis-alignment, loose connections, insufficient supports, projections, burrs, sharp edges, swarf, foreign bodies

Accessory boxes

Sockets, switches, light fittings, wire junction, inspection fittings, terminals, electrical/electronic hardware, thermoplastic and metallic boxes with knockouts, specialist boxes for switchgear equipment

Alignment of components

Plumb bobs, levels, visual check, positioning

Methods of securing system components

Use of saddles and supports, drilling and using appropriate fixing devices, joints, screws, adhesive, cable ties

Problems

Parts are damaged, shortages of fittings or fixing devices, the correct tools are not available, conduit, ducting, trunking or traywork, fittings do not fit together, the required specification cannot be achieved

Good working practices

Leave the work area free of unused consumables, clean down work area, put tools and equipment into safe storage, label and record finished work, ensure neat and tidy appearance, compliance with specification

Visual checks

Checked against specification

Checked for level, plumb, squareness and aesthetics

Check system cleaned-through and construction markings removed

Unit 211 Principles of marine electrical systems

UAN:	**R/503/9842**
Level:	2
Credit value:	11
GLH:	100
Relationship to NVQ:	This unit is linked to the following NVQ units; 111. 112, 131, 134 and 135.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering.
Aim:	This is an optional unit. It is concerned with the underlying principles that govern the electrical supply systems used on leisure and commercial small craft

Learning outcome
The learner will: 1. Understand the functions of electrical distribution systems
Assessment criteria
The learner can: 1.1 identify the **components** used in electrical systems on board yachts and motor cruisers 1.2 describe the operation of shore power systems 1.3 describe the purpose of components used in electrical systems 1.4 identify the **components of propulsion engine driven generating systems** 1.5 describe the **safe operation of wind driven generating systems** 1.6 describe the **safe operation of solar generating systems** 1.7 describe the **operation of separate engine driven generator units** 1.8 identify **on board electrical system components**

Range
Components Shore cables, deck plugs and sockets, consumer units, circuit breakers, consumer units, residual current devices, transformers, switched mode power supplies, inverters, internal 13Amp sockets, calorifiers **Components of propulsion engine driven generating systems** Engine driven alternators, supplementary high charge regulators, split charge relays, charge splitting diodes, isolators, changeover switches

Safe operation of wind driven generating systems

Placing wind generators for safety, avoiding noise and vibration, sizing wind generators for battery charging, regulating wind generators

Safe operation of solar generating systems

Portable solar generators, fixed solar generator systems, optimum positioning for maximum power, avoiding shadows and excessive wear, sizing solar panel installations for battery charging, regulating solar panels

Operation of separate engine driven generator units

Constant running plant, battery demand operated plant, location of generator systems, automatic operation systems, sound and vibration proofing, special exhaust requirements

On board electrical system components

Halogen lamp luminaries, fluorescent luminaries, high energy led luminaries, extraction fans and blowers, electrical winches, electrical toilets, bow thrusters, keel lifting mechanisms, water pumps, refrigeration and air conditioning

Learning outcome

The learner will:

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

Assessment criteria

The learner can:

2.1 describe the **marine electrical systems** as fitted on board yachts and motor cruisers

2.2 describe the relationships between battery capacity, current demand, and recharge arrangements for on board systems

2.3 identify the advantages and limitations of shore supplies

2.4 identify the safety implications of 110 and 230 volt systems on small craft

2.5 identify the safety implications of 50 and 60 Hz frequencies on small craft

2.6 identify the requirements for and use of galvanic isolators

2.7 draw simple diagrams to show the interconnection of engine and 'ships' supplies for typical small craft

2.8 draw simple diagrams to show the interconnection of low voltage and medium voltage supplies through inverters and transformers (including switched mode power supplies)

2.9 carry out calculations in accordance with RCD/ISO and BMEA requirements to determine current supplied to specific equipment

2.10 determine load currents in supply cables, and specify protective devices

2.11 determine voltage drops in circuits with particular reference to low voltage systems delivering significant currents

2.12 determine correct cable sizes to minimize voltage drop in use

2.13 determine switching and protection requirements for circuits

2.14 identify special requirements for circuits and sockets exposed on deck

2.15 identify special circuit parameters for **electrically powered equipment**

2.16 explain the need to protect 110 and 230 volt (vac) supplies

2.17 identify the requirements for earthing and residual current devices in 110 and 230 Volt (vac) systems
2.18 identify fusing/circuit breaker requirements for battery derived 'ship supplies'
2.19 identify the advantages and disadvantages of fusing engine starter circuits
2.20 state the importance of providing lightning protection

Range

Marine electrical systems

Low voltage and medium voltage on board supply systems (according to both IEC and ISO definitions)

Electrically powered equipment

Powered winches, keel lifting mechanisms, bow thrusters, trim tabs, boarding ladder/walkway, garage, swimming platform, davits, steering systems

Learning outcome

The learner will:

3. Understand the methods of storing electricity on board

Assessment criteria

The learner can:

3.1 describe the **battery storage requirements** on board yachts and motor cruisers
3.2 identify typical relationships between battery load, capacity and recharging requirements
3.3 identify **types and applications of battery** used on board
3.4 identify appropriate battery sizes and arrangements for typical applications
3.5 explain the importance of separating batteries of different construction
3.6 explain the importance of insulating battery terminals
3.7 state the **procedures for checking the condition of a battery**
3.8 outline the **procedures to maintain a battery in good condition**
3.9 describe the safety precautions required in relation to battery charging and battery spaces
3.10 describe the effects of plate sulphation and how it can be minimised

Range

Battery storage requirements

Stable and secure installation, well vented, ample capacity for task, watertight integrity

Types and applications of battery

Types – Lead-acid, gel cell, absorbed glass mat, NiCad, Alkaline, Li-ion

Applications –cranking/engine starting, powering on-board electrics/electronics, powering portable equipment

Procedures for checking the condition of a battery

Battery drop test, specific gravity test, hydrometer, multimeter, battery

voltage test equipment

Procedures to maintain a battery in good condition

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

Learning outcome
The learner will: 4. Understand the requirements for installing instrumentation
Assessment criteria
The learner can: 4.1 identify the supply, installation and interconnection requirements for **on board instrumentation** 4.2 identify the **requirements for installing transducers** 4.3 identify the requirements for interfacing instruments 4.4 identify **interface standards** 4.5 explain the importance of routing signal cables separately 4.6 explain the importance of shielding signal cables 4.7 identify the importance of incorporating standard length cables for radar and aerial cables 4.8 identify the importance of using compatible instruments in interconnected systems

Range
On board instrumentation Wind instruments, logs, compasses, echo sounders, GPS systems, chart plotters, radar sets, laptop computers, dedicated computers, on board entertainment systems, battery condition monitoring systems, vhf radio transceivers, MF radio transceivers, HF radio transceivers, 'Ham' radio installations. **Requirements for installing transducers** Log impellors, echo sounder transducers, wind instrument sensors, electronic compasses (giro and fluxgate), magnetic compasses, radar transponders, aerials, ground plates, ammeter shunts **Interface standards** NMEA, BMEA, classification societies' requirements, manufacturer's recommendations, HSC 2000 regulations

Unit 212 Prepare surfaces and marine coatings

UAN:	**F/503/2272**
Level:	2
Credit value:	9
GLH:	75
Relationship to NVQ:	This unit is linked to the following NVQ units; 125, 126, 129 and 130.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This optional unit is concerned with preparing surfaces and marine coatings. It covers preparations prior to coating, including methods of application and tools and equipment required.

Learning outcome
The learner will: 1. Be able to prepare surfaces prior to marine coating
Assessment criteria
The learner can: 1.1 identify **instructions and specifications** relating to preparing surfaces 1.2 visually check surface coatings for **faults and defects** 1.3 describe the **preparation activities** required when preparing surfaces 1.4 describe the **hazards** associated with the materials and equipment used in carrying out surface preparation activities 1.5 explain **how hazards can be minimised** 1.6 state the **reasons for carrying out surface preparation** 1.7 identify the **types of surfaces** that may require preparing 1.8 describe types of **tools**, **techniques and materials** used in surface preparation 1.9 describe the **quality control techniques and tests** used during preparation to check compliance with the specification 1.10 describe the reason for the **safe disposal** of waste materials 1.11 prepare surface ready for marine coating.

Range
Instructions and specifications Manufacturers/suppliers technical data sheets, material safety data sheets, job cards, customer contractual specification including technical and cosmetic criteria **Faults and defects** Flaking, peeling, erosion, scratches, scuffs, osmosis, stress cracks, star crazing, blistering, corrosion, chalking (gross loss of gloss), adhesion, solvent testing, cracking/crazing, cissing, pinholing, sweating, wrinkling, adhesion, coating cure **Preparation activities** Prepare surfaces by hand or power tools, clean surfaces using manufacturers hand and power tools and recommended cleaning agents **Hazards** Sparks, dust/debris, hearing damage, hand/arm vibration, working at heights, fumes, cutting tools such as grinders, allergic reactions **How hazards can be minimised** Conduct risk assessment, use of PPE, correct handling and storage, safety instruction & training **Reasons for carrying out surface preparation** Promote adhesion, smooth surface, contamination, corrosion or blistering **Types of surfaces** Painted, unpainted Metals: ferrous, non ferrous, composite/GRP, wood, ferro-cement **Tools, techniques and materials** Degreasing solvents, chemical paint remover, hand abrasives, brushes or vacuum cleaner, hand tools, power wire brush, power discs, grinders, vacuum blasters, flame cleansing, high pressure washers **Quality control techniques and tests** Substrate surface profile, temperature/humidity, visual examination, swabs, adhesion test **Safe disposal** Environmental impact, regulatory requirements, company procedures

Learning outcome
The learner will: 2. Be able to prepare marine coatings
Assessment criteria
The learner can: 2.1 select **tools and equipment** for surface coating activities 2.2 describe the **hazards** associated with the materials and equipment used in carrying out coating material preparation activities 2.3 explain how **hazards** can be **minimised** 2.4 describe the **characteristics of marine coating products** 2.5 describe the **methods of application** for marine coating products 2.6 describe the **storage requirements** for marine coating products and solvents 2.7 describe the **factors to obtain an estimate of the product volume** 2.8 describe the importance of preparing marine coatings as per manufacturers' specifications 2.9 describe the **quality control requirements and techniques** to be used when preparing marine coatings 2.10 identify the **importance of maintaining records** of paint and solvent consumption 2.11 prepare marine coatings ready for application.

Range
Tools and equipment Appropriate personal protective equipment (PPE) for the activity Hand tools: rubbing blocks, sponges, leathers, trimming knife, paint scraper, plastic, rubber and metal, applicators, pneumatic and electric power, tools, filling blades Ancillary equipment: masking tape, dust sheets, paint brushes, rollers **Hazards** Inhalation of fumes/dust, fire and explosion, contact with solvents and other chemicals **Minimising hazards** Conduct risk assessment, use of PPE, correct handling and storage, safety instruction & training **Characteristics of marine coating products** Water based epoxies, solvent based epoxies, conventional alkyd or silicone alky, acrylic urethane, polyester polyurethane **Methods of application** Hand painting, spraying **Storage requirements** Containment arrangements, environmental regulated conditions such as temp/humidity, explosion proof storage container, COSHH regulations **Factors to obtain an estimate of the product volume** Estimation of areas to be covered, theoretical and practical paint consumption, loss factors, application method e.g. pads, brush, roller, spray or other

Quality control requirements and techniques

Manufacturers' recommendations, company procedures, national/international standards, customer contractual acceptance criteria and specifications, local environmental rules and regulations

Importance of maintaining records

Government legislation, owners requirements, insurance approval requirements, quality assurance and control program, coating manufacturers requirements for product liability

Unit 213 Apply marine coatings

UAN:	**J/503/2273**
Level:	2
Credit value:	9
GLH:	75
Relationship to NVQ:	This unit is linked to the following NVQ units; 121, 127, 128 and 130.
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Engineering
Aim:	This optional unit covers the underlying knowledge and skills required for the successful application of a range of marine coatings. It includes the techniques and procedures for application of coatings manually and using spray methods and the checking of the finished coating to identify minor surface defects.

Learning outcome
The learner will: 1. Be able to apply marine coatings
Assessment criteria
The learner can: 1.1 describe **instructions and specifications** relevant to applying marine coatings 1.2 describe the **characteristics of marine coating products** 1.3 describe the **methods of application** for marine coating products 1.4 state the **time intervals** that are required between coats, and why these must be adhered to 1.5 describe **manual application equipment** used when applying marine coatings 1.6 describe **spray applied application equipment** used when applying marine coatings 1.7 describe **techniques** used to avoid defects when applying marine coating products to a variety of surfaces 1.8 define the term **stripe coating** and state **where it is used** 1.9 describe the **requirements for working afloat, on outer/hull bottoms, and at heights** 1.10 state the **procedures** to be followed when containing and clearing away spillages and disposing of materials safely 1.11 apply marine coatings to surfaces.

Range
Instructions and specifications Manufacturers'/suppliers' technical data sheets, manufacturers' Safety Data Sheets, job cards, customer requirements, technical application manual or paint appendix, coating insurance requirements **Characteristics of marine coating products** Solvent based epoxies, alkyds/silicone alkyds, water based acrylics, water based epoxies, solvent based acrylic urethanes, solvent based polyester polyurethanes, water based polyurethanes **Methods of application** Hand painting, spraying **Time intervals** Cure cycle, to avoid solvent entrapment, to ensure adhesion in between coatings, to maintain maximum coating performance **Manual application equipment** Brushes, rollers, paint pads **Spray applied application equipment** Conventional spray, airless spray, air-assisted spray, electro-static equipment **Techniques** Correct film thickness, correct banding/surface overlap, complete surface coverage, smooth surfaces free of defects, contamination free inclusions, coating cure cycle **Stripe coating** An extra coat of materials usually applied by brush to build up thickness along edges of beams, around nuts and bolts and in less accessible areas **Where stripe coating is used** Corners and outside corners, obscured corners and edges, edges, welds/structural joints, slot weld **Requirements for working afloat, on outer/hull bottoms, and at height** Scaffolding, shrink foil, covers, safety harness, helmets **Procedures** Company policies, environmental legislation, regulatory procedures as per HSE

Learning outcome
The learner will: 2. Be able to check and report minor surface defects
Assessment criteria
The learner can: 2.1 describe **types of faults** that can occur in surface application 2.2 describe the **causes of faults** in surface application 2.3 describe **visual inspection techniques** 2.4 state how to recognise **surface defects** 2.5 describe **quality assurance/control requirements** to be followed when applying marine coatings.

Range
Types of faults Pinholes, runs, sags, drips, solvent entrapment, coating cure cycle, surface contamination **Causes of faults** Poor mixing, incorrect surface application, poor application techniques, temperature and humidity control **Visual inspection techniques** Lighting, mirrors, magnifying glass **Surface defects** Contamination (dust), runs, sags, drips, inclusions, fish-eyes, pin-holing, sweating **Quality assurance/control requirements** Manufacturer's recommendations, company procedures, national/international standards, customer contractual acceptance criteria and specifications, local environmental rules and regulations

Appendix 1 Relationships to other qualifications

Links to other qualifications

Mapping is provided as guidance and suggests areas of commonality between the qualifications. It does not imply that candidates completing units in one qualification have automatically covered all of the content of another.

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

These qualifications have connections to the:

- 2463 Level 3 Marine Construction, Systems Engineering and Maintenance

Literacy, language, numeracy and ICT skills development

These qualifications can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see **www.cityandguilds.com/functionalskills**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**

Appendix 2 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 such 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.

City & Guilds

Believe you can

www.cityandguilds.com

Useful contacts

UK learners **General qualification information**	**T: +44 (0)844 543 0033** **E: learnersupport@cityandguilds.com**
International learners General qualification information	T: +44 (0)844 543 0033 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	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **centresupport@cityandguilds.com**
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International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 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	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **walledgarden@cityandguilds.com**
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As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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