

Level 3 Diploma in Marine Electrical Engineering (Advanced) (2473-33)

v1-0 December 2020

Qualification Handbook

Qualification at a glance

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

Title and level	City & Guilds number	Accreditation number
Level 3 Diploma in Marine Electrical Engineering (Advanced)	2473-33	603/6930/9

Version and date	Change detail	Section
v1 December 2020	n/a	n/a

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1 Introduction

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

Area	Description
Who is the qualification for?	This qualification is aimed at learners aged 16 and above who have successfully completed a qualification at level 2 and would like to gain the advanced knowledge, skills and behaviours required during their training to become a marine electrician either as part of the development phase of their apprenticeship, or as a full time student.
What does the qualification cover?	Following the skills, knowledge and behaviours gained during the Level 2 Diploma in Marine Electrical Engineering (Foundation), learners will be trained at an advanced level in the following areas: <ul data-bbox="603 864 1401 1290" style="list-style-type: none">• Respond appropriately to customer needs (internal and external)• planning and setting up projects• work methods, including using specialist equipment and minimising hazards and risks• functions of electrical components, electricity supply systems and functions of electrical machines, motors, generators and control circuits.• installation of electronic and navigation systems, preparation of and installation of these systems and how to commission them.
What opportunities for progression are there?	Upon completion of this qualification, learners will be equipped with the knowledge, skills and behaviours required for progression towards becoming a qualified marine electrician. On successful completion of the whole apprenticeship standard, learners will have been awarded BMET and MEI by British Marine and recognised by the Institute of Marine Engineering, Science and Technology (IMarEST) at 'Engineering Technician' level. Opportunity for progression to higher level marine electrical qualifications.
Who did we develop the qualification with?	This qualification has been developed in collaboration with the marine electrician employer group which is led by Berthon Boat Company (chair), Raymarine (UK), Pendennis Shipyard, RNLI, Osprey Technical Consulting, Princess Yachts, Sunseeker International, Cockwells, Volt Master Systems, Bournemouth and Poole College and British Marine.
Is it part of an apprenticeship framework or initiative?	This qualification has been developed to be included within the development phase of the new Apprenticeship Standard for marine electrical engineers, which will replace the current Level 2 and Level 3

Structure

To achieve the **Level 3 Diploma in Marine Electrical Engineering (Advanced)** learners must achieve all mandatory units (203, 309-312)

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

913 Pass

914 Merit

915 Distinction

Please see the Grading section for the grading process.

City & Guilds unit number	Unit title	GLH
Mandatory		
203	Business improvement techniques	50
309	Safe and effective working in the marine industry (marine electrical)	70
310	Principles of marine construction, components and marine electrical engineering	70
311	Principles of integrated marine electronic systems	180
312	Principles of marine electrical systems	180

Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT is comprised of the following two elements:

- 1) The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and
- 2) An estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training

Title and level	GLH	TQT
Level 3 Diploma in Marine Electrical Engineering (Advanced)	550	718

2 Centre requirements

Approval

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

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

Resource requirements

Centre staffing

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

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

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

Internal quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications.

Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

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

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

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

Staff must:

- be familiar with the occupation and technical content covered within the qualification
- be familiar with the requirements of the Apprenticeship Standard requirements.

Learner entry requirements

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

Individual employers will set the criteria, but most candidates will have four GCSEs at grade C (or equivalent) or above on entry (including English, Maths & Science). Employers who recruit learners without English, Maths and Science at Grade C or above, must ensure that the learner achieves this requirement, or an equivalent Level 2, prior to completion of the Apprenticeship.

This qualification is a mandatory component of the on-programme of the Marine Electrician Apprenticeship Standard (STo8o8/AP1).

The Standard and Assessment plan has been designed by Employers. Centres should make themselves familiar with the Standard, Assessment Plan requirements, details of which can be found at:

<https://www.instituteforapprenticeships.org/apprenticeship-standards>

Age restrictions

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

3 Delivering the qualification

Initial assessment and induction

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

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

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

Support materials

The following resources are available for this qualification:

Description	How to access
Assessment pack	www.cityandguilds.com

Recording documents

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

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

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

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

4 Assessment

Summary of assessment methods

Candidates must successfully complete:

- multiple-choice tests for unit 309 and 310
- short-answer question assessment for unit 203
- centre-devised assignments with supporting short-answer questions for units 311 and 312

Available assessments/assignments:

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

- multiple-choice tests to be delivered online for 309 and 310
- externally set, internally marked short-answer questions for unit 203.
- guidance for centre-devised assignments including example assignments and short-answer questions for units 311 and 312.

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 these materials are available to download from the City & Guilds website.

Approval process for centre set assignments

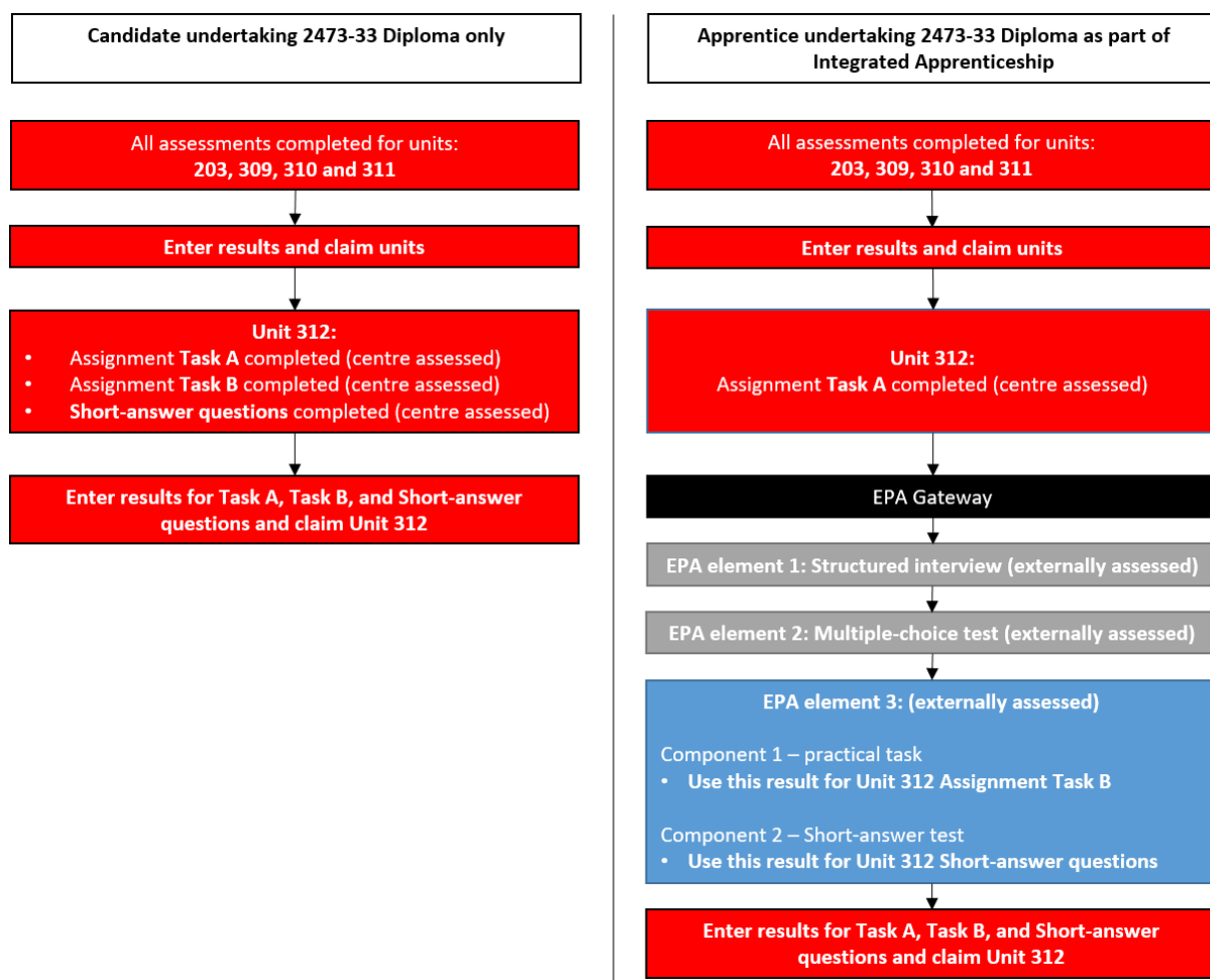
Centre set assignments must be approved by the external quality assurer before use. For each assignment, the Assessment sign off form (AD3) must be completed and be made available to the EQA for inspection.

Candidates undertaking the qualification as part of a Marine Electrician Integrated Apprenticeship (STo8o8)

All elements of assessment should be completed on-programme prior to the gateway, **except for the following**:

- Unit 312, Practical Assignment Task B
- Unit 312, Short-answer questions

For apprentices, these are covered by equivalent assessments as part of the End-Point Assessment (EPA). The assessments will be externally set and carried out **post-gateway** by the End-Point Assessment organisation (EPAO), as set out in the *End point assessment plan for Marine Electrician integrated apprenticeship standard AP/o1 STo8o8, Assessment method 3: 'Component 1: practical task' and 'Component 2: short-answer test'*.



Once the apprentice has completed the End-Point Assessment, the results of the practical task and short-answer questions should be entered against **Unit 312 Task B** and **Unit 312 short answer-questions** for completion of the unit, and evidence retained for EQA.

Assessment Types

Unit	Title	Assessment method	Where to obtain assessment materials
2473-203	Business improvement techniques	Short-answer questions 2473-203	www.walled-garden.com
2473-309	Safe and effective working in the marine industry (marine electrical)	Multiple-choice online test 2473-309 The assessment covers all the outcomes in this unit	Evolve
2473-310	Principles of marine construction, components and marine electrical engineering	Multiple-choice online test 2473-310 This assessment covers all the outcomes in this unit	Evolve
2473-311	Principles of integrated marine electronic systems	Centre-devised practical assignment and Short-answer questions 2473-311 These assessments cover all the outcomes in this unit	www.cityandguilds.com
2473-312	Principles of marine electrical systems	<p>Candidates undertaking Diploma only: Centre-devised practical assignment (Tasks A and B) and Short-answer questions 2473-312</p> <hr/> <p>Candidates undertaking Diploma as part of an Integrated Apprenticeship: Centre-devised practical assignment (Task A) Externally set practical assignment (Task B) Externally set Short-answer questions</p>	<p>www.cityandguilds.com</p> <p>www.cityandguilds.com End-Point Assessment organisation</p>

Time constraints

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

- all assessments must be completed within the candidate's period of registration.

Assessment strategy

Test Specifications for the multiple choice tests

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

Assessment title: Safe and effective working in the marine industry (marine electrical)

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

Unit	Duration: 75 minutes		
309	Learning Outcome	Number of questions	%
	01: Understand the importance of compliance with statutory legislation, regulations and organisational requirements in the marine industry	17	34
	02: Understand safe working practices and procedures	14	28
	03: Know how to plan, organise and monitor work needed to carry out marine industry activities	14	28
	04: Understand safe and effective production systems used in the marine industry	5	10
Total		50	100

The grade boundaries for this test will be approximately:

Pass: 60%

Merit: 70%

Distinction: 80%

These boundaries may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

Assessment title: Principles of marine construction, components and marine electrical engineering

Assessment type: Multiple-choice online test

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

Permitted candidate resources: non-programmable calculator

Unit	Duration: 75 minutes		
310	Learning Outcome	Number of questions	%
	01: Understand materials used in marine construction and marine electrical engineering	14	28
	02: Understand the use of drawings and specifications used in marine electrical engineering	11	22
	03: Understand marine construction techniques	7	14
	04: Understand marine electrical engineering systems	8	16
	05: Understand the use of fittings and components used in marine construction	10	20
Total		50	100

The grade boundaries for this test will be approximately:

Pass: 60%

Merit: 70%

Distinction: 80%

These boundaries may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

5 Grading

Grading of individual assessments

Individual assessments will be graded Pass/Merit/Distinction unless otherwise stated in the Assessment Pack.

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

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

Grading of qualification

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

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

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

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

- 913 Pass
- 914 Merit
- 915 Distinction.

5 Units

Structure of the units

These units each have the following:

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

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

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

Learning outcome

The learner will:

- 1 Know what is meant by continuous improvement

Assessment criteria

The learner can:

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

Range

(AC1.2) **Benefits**

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

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

- value added
- non-value added
- waste

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

- transport
 - inventory
 - motion
 - waiting
 - over-production
 - over-processing
 - defects
 - skills/unrecognised people potential
-

Learning outcome

The learner will:

- 2 Understand what is meant by workplace organisation

Assessment criteria

The learner can:

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

Range

(AC2.3) **Effects**

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

Learning outcome

The learner will:

- 3 Know what is meant by visual management
-

Assessment criteria

The learner can:

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

Range

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

- accurate and relevant
- eye-catching
- simple
- greater ownership

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

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

Learning outcome

The learner will:

- 4 Understand problem solving techniques

Assessment criteria

The learner can:

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

Range

(AC4.3) Techniques

- tally charts
- flowcharts
- histogram/Pareto chart
- benchmarking
- process mapping
- correlation diagram
- run diagram
- Statistical Process Control
- control charts
- Gantt charts
- root cause paths
- value stream maps
- Ishikawa diagrams (cause and effect, fishbone)
- brainstorming
- mind mapping
- 5 Why analysis

Unit 309

Safe and effective working in the marine industry (marine electrical)

Unit level:	Level 3
GLH:	70
Unit aim:	<p>This unit is concerned with safety awareness and communication skills needed to work effectively in the marine industry.</p> <p>The unit covers health and safety, interaction with other employees and an understanding of the terminology and structure of the industry.</p>
Assessment type	Multiple choice online test

Learning outcome

The learner will:

- 1 Understand the importance of compliance with statutory legislation, regulations and organisational requirements in the marine industry

Assessment criteria

The learner can:

- 1.1 describe health and safety **legislation and regulations** applicable to the marine industry
- 1.2 describe the requirements of **environmental legislation and regulations** relevant to the marine industry
- 1.3 state **employers' responsibilities** to maintain a safe working environment
- 1.4 state **employees' responsibilities** to maintain a safe working environment
- 1.5 describe how the Management of Health and Safety Regulations should be **implemented and maintained**
- 1.6 describe how the environmental regulations should be **implemented and maintained**
- 1.7 explain the **roles, responsibilities and powers** of people in health, safety and environmental positions
- 1.8 describe where and how health and safety and environmental information and advice **can be accessed**
- 1.9 describe the **hazards and acts** that can lead to observations, near misses, accidents and fatalities
- 1.10 describe **methods of accident prevention** in the workplace

- 1.11 describe the requirements of the **Recreational Craft Directive (RCD)**
 - 1.12 describe the requirements of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013
 - 1.13 state the **organisational procedures** for reporting accidents and incidents
 - 1.14 explain how to carry out a risk assessment
 - 1.15 identify potential **health and environmental hazards**
 - 1.16 state the **regulations** and **qualifications** required for those operating craft in UK categorised waters and at sea
-

Range

(AC 1.1)

Safety legislation/regulations:

- Confined Spaces Regulations
- Control of Major Accident and Hazards Regulations
- Control of Noise at Work Regulations
- Control of Substances Hazardous to Health Regulations (COSHH)
- Control of Vibration at Work Regulations
- Electrical Equipment (Safety) regulations
- Electricity at Work Regulations
- Employers' Liability (Compulsory Insurance) Act
- Health and Safety (Display Screen Equipment) Regulations
- Health and Safety (First Aid) Regulations
- Health and Safety at Work Act 1974 (HSAWA)
- Health and Safety Information for Employees Regulations
- Lifting Operations and Lifting Equipment Regulations (LOLER)
- Management of Health and Safety at Work Regulations
- Manual Handling Operations Regulations (MHOR)
- Noise and Statutory Nuisance Act
- Personal Protective Equipment at Work Regulations
- Portable Appliance Testing Regulations. (PAT)
- Provision and Use of Work Equipment Regulations (PUWER)
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)
- Safe Working in Confined Spaces Regulations and Code of Practice
- Supply of Machinery (Safety) Regulations
- Work at Height Regulations
- Workplace (Health, Safety and Welfare) Regulations

(AC 1.2)

Environmental legislation/regulations:

- Biocidal Products and Chemicals (appointment of Authorities and enforcement) Regulations
 - Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment Regulations
 - Clean Air Act
 - Control of Major Accident Hazards Regulations (COMAH)
 - Control of Substances Hazardous to Health (COSHH)
 - Controlled Waste Regulations
-

- CRC Energy Efficiency Scheme Order
- Dangerous Substances and Explosive Atmospheres Regulations (DESAR)
- Environmental Permitting (England and Wales) Regulations
- Environmental Protection Act
- Hazardous Waste (England and Wales) (Amendment) Regulations
- Pollution Prevention and Control Act
- Preparations and Chemicals Regulations
- Recreational Craft Regulations
- Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) (REACH)
- Waste (England and Wales) Regulations
- Waste Batteries and Accumulators Regulations
- Waste Electric and Electronic Equipment Regulations (WEEE)

(AC 1.3)

Employers' responsibilities:

- protection of environment
 - efficient use of resources
 - energy saving processes
 - processes for reporting spills on land and in water
 - segregation of waste
 - waste hierarchy
 - waste separation
- reporting of accidents and near misses
- safe methods of handling, storing, and transporting goods and materials
- safe place of work:
 - communicated health and safety policy
 - display of health and safety information
 - good housekeeping
 - provision of fire safety equipment and training
 - training
- safe plant and equipment:
 - control of vibration tools
 - guards on machines
 - health surveillance
 - inspection record keeping
 - local exhaust ventilation (LEV) tests
 - method statements
 - periodical test for electrical installations
 - planned maintenance of plant and equipment
 - portable appliance testing
 - thorough examination of lifting equipment
- safe system of work:
 - adequate management and supervision
 - risk assessment
 - safety data sheets

(AC 1.4)

Employees' responsibilities:

- comply with organisational health, safety and environmental policies
- elevate health, safety and environmental concerns to appropriate persons
- ensure standards of personal hygiene
- follow organisational housekeeping standards
- follow safe systems of work
- protect self and others at all times
- safe use and storage of equipment, tools, machinery and materials
- wear the appropriate Personal Protective Equipment (PPE)
- wear the appropriate Respiratory Protective Equipment (RPE)
- working so that actions do not cause damage to the environment in terms of air, water, or ground pollution

(AC 1.5, AC 1.6)

How Management of Health and Safety Regulations and the Environmental Regulations should be implemented and maintained:

- assess risks and record results (risk assessments)
- encourage a strong safety culture
- establish and communicate safe working practices and procedures, encourage strong safety and environmental practices
- establish and maintain emergency response procedures
- establish and maintain the control of contractors and visitors
- establish and maintain the control of emissions
- establish and maintain the control of waste streams
- keep up to date with health, safety and environmental matters by all means available, Internet etc.
- maintain appropriate health and safety records
- nominate a Health and Safety Officer
- operate health screening
- provide regular Health, Safety and Environmental staff information, training and updating
- set up a safety committee with cross company membership
- specify and maintain a Health and Safety and Environmental policy in accordance with the respective legislation / regulations

(AC 1.7)

Roles, responsibilities and powers:

- appointed person for lifting operations
- company director
- company safety manager/officer/advisor
- company trained first aider
- competent crew
- environmental health officers
- fire wardens
- health and safety inspectors

- occupational health provider
- safety representative

(AC 1.8)

Access to Health & Safety and Environmental information:

- company health and safety and environmental officer(s)
- company health, safety and environmental management system
- company notice boards
- Health and safety executive
- internet - commercial safety organisations and companies selling safety equipment
- safety data sheets

(AC 1.9)

Hazards and acts leading to observations, near misses, accidents and fatalities:

- badly lit workplace
- distractions in the workplace
- drug-taking and drinking
- improper / careless behaviour in the workplace
- inadequate extraction/ventilation of workshops
- inappropriate use of tools, machinery and equipment
- lack of adequate supervision
- lack of collective protection
- lack of respect for company health, safety and environmental policies and processes
- lack of staff training in correct use of equipment, machinery, etc.
- misuse of lifting equipment
- not wearing or maintaining the appropriate PPE
- poor housekeeping
- poorly maintained and serviced equipment
- staff fatigue
- unguarded machinery

(AC 1.10)

Methods of accident prevention:

- adhere to risk assessments
- being respectful of machinery and equipment and the risks they pose
- electrical safe isolation procedures (AC and DC)
- eliminating hazards
- good planning
- guard the hazard
- identify hazards and control risks
- information and awareness of hazards and ways to minimise these
- planned and reactive machinery/tooling maintenance
- provision of personal protection
- quarantine procedures

- safety training and publicity
- shut down / lock out tag out

(AC 1.11)

Requirements of the Recreational Craft Directive (RCD):

- compliance to the essential requirements of the RCD
- RCD Annex II Components of watercraft
- RCD conformity assessment process
- relationship between the European Directive and UK Legislation
- relationship between the RCD and International Standards (e.g. ISO)
- uniform level of safety in the design and manufacture of recreational craft throughout the European Economic Area
- Design and construction standards
- Emissions (exhaust, noise)

(AC 1.13)

Organisational procedures:

- complete accident book
- complete accident form / incident report form
- report accident / incident to first aider or other relevant person

(AC 1.15)

Health and environmental hazards:

- air pressure systems (stored energy)
- chemicals
- confined spaces
- contaminants and irritants
- dust
- falls from working at heights
- faulty electrical connections or damaged cables
- faulty or missing machine guards or interlocks
- faulty, blunt or incorrectly set up of tools and equipment
- flammable materials
- fumes
- hot works
- incorrect or poorly maintained PPE
- insulation properties of electrical equipment and ingress protection (IP rating)
- material ejection causing injury damage
- materials handling and transportation
- moving machinery
- noise
- pressure
- scrap or waste material
- slippery or uneven surfaces
- spillages

- stored energy
- suspended loads
- unshielded processes
- untidy work habits
- vibration
- volatile and toxic materials
- water borne infections
- weather conditions
- working afloat

(AC 1.16)

Qualifications:

- Advanced powerboat
- Boatman's license
- British Marine electrical technician (BMET)
- Coastal skipper
- Day skipper
- Marine electronics installer (MEI)
- Powerboat level 2
- STCW
- VHF radio
- Yachtmaster (ocean and offshore)

Regulations:

- Intended pleasure vessel (IPV) code
- Small vessel code (e.g. requirements of marine guidance note [MGN] 280)

Learning outcome

The learner will:

- 2 Understand safe working practices and procedures

Assessment criteria

The learner can:

- 2.1 describe **Personal Protective Equipment (PPE)** and types of **Respiratory Protective Equipment (RPE)** and what they are used for different in tasks or operations
- 2.2 describe the **general and personal safety equipment** found on boats
- 2.3 describe the **safety rules, slings, knots and accessories** used for mechanical lifting
- 2.4 describe the current **Manual Handling Operations Regulations**
- 2.5 describe the **safe isolation procedures outlined in the Electricity at Work Act**
- 2.6 describe the **requirements** for insulation and protection of personnel, electrical wiring, equipment and required competence
- 2.7 understand the reasons for and the differences between **earthing, grounding and bonding**
- 2.8 explain what **Hand-Arm Vibration Syndrome (HAVS)** is, how the associated risks can be managed, and identify **vibrating tools** associated with HAVS
- 2.9 explain why it is necessary to have a **permit to work**

- 2.10 identify to **whom hazards should be reported**
2.11 state **situations** in which it is unsafe to work in isolation
-

Range

(AC 2.1)

Personal Protective Equipment (PPE):

- buoyancy aids / life jackets when working on or near water
- ear attenuators / defenders when working in a noisy machinery or environment
- gloves
- hard hats when lifting anything overhead
- high visible jackets when lifting or in transport situations
- overalls for working in dirty or unclean environment
- safety boots when moving heavy materials
- safety goggles or glasses when grinding, etc.
- wet weather gear when working in adverse weather conditions
- working at heights
 - bosun's chair
 - climbing harnesses
 - descenders
 - fall arrest equipment
 - harness and lanyards

RPE equipment and when it should be used:

- dust masks
 - cutting penetrations
 - working in dusty environments
- fit testing
- vapour masks
 - fuel tank penetrations
 - soldering
 - working with fumes and solvents

(AC 2.2)

General and personal safety equipment:

- bilge pump
- emergency locker
- emergency positioning indicating radio beacon (EPIRB)
- fire pump
- fire-fighting equipment
- first aid box
- flares
- flashlights
- fog horn
- life buoys
- life jacket

- life raft
- radar reflector
- safety harness
- safety of lives at sea (SOLAS) signal card
- salvage pump
- sea anchor
- throwing line
- very high frequency (VHF) radio

(AC 2.3)

Safety rules mechanical lifting:

- always lower the load gently into position
- appropriate PPE
- avoid pushing or pulling the load to adjust the balance
- avoid shock loading the lifting equipment
- avoid swinging and twisting
- check date of equipment tests
- do not leave a load hanging unattended
- do not transport loads over the heads of people or walk under a load
- do not work under suspended loads
- ensure all lifting tackle is tagged appropriately
- ensure lifting equipment thoroughly examined and in date
- estimate the centre of gravity, position the lifting hook above the centre of gravity of the load
- make sure the load does not move once the lifting equipment is removed
- never exceed the maximum safe working load (SWL) indicated
- quarantine procedures for lifting tackle
- use authorised and trained personnel (banksman training, appointed person training, etc.)

Accessories for lifting:

- beams
- cargo nets
- chain pull/block
- eyebolts
- forks
- halyards
- hooks
 - swivel & safety hooks
- rigging equipment
 - bosun chair
 - climbing ropes
 - descenders
- rings
- slings
 - chain & ropes of wire
 - natural and man-made fibres

- shackles
- special purpose equipment
- spreaders
- strops (colour coding)
- winches
- wire pull

How lifting equipment accessories are used:

- abide with requirements of the Lifting Operations and Lifting Equipment Regulations (LOLER)
- always observe the SWL and its date of test
- always undertake with lifting plan
- check equipment is tagged and in date
- importance of the angle at the top, forces in the legs proportional to the angle at the top
- never bend slings around sharp corners and edges and avoid over-bending
- never twist or kink the sling or chain
- never use a worn or damaged slings or chains
- use appropriate equipment for the task / work operation
- use protective covers on corners of loads with slings and chains
- visual inspection of equipment before use

Knots:

- bowline - preventing a load from tightening a loop
- clove hitch - joining ropes to a pole or bar, single or double loop - preventing a sling from slipping off a crane hook
- reef knot - joining ropes of equal thickness
- two half-hitches - connecting a rope to a sling

(AC 2.4)

Manual Handling Operations Regulations:

- carrying out a risk assessment on the types of manual handling in operation in a boatyard or marina
- correct posture and technique for manual lifting and carrying portable machinery, tools, equipment
- methods employed in transporting equipment to support boats in a yard or marina
- providing adequate or appropriate knowledge and training to the workforce about manual handling
- the provision and use of suitable clothing, footwear or other personal effects

(AC 2.5)

Isolation procedures outlined in the Electricity at Work Act

- disconnection and separation of electrical equipment
- emergency resuscitation and first aid
- lock out/tag out
- permit to work

- precautions to prevent injury
- selection of isolation switches
- suitable means for cutting off the supply (safe isolation procedure)
- suitable means for isolation of any electrical equipment
- working on or near live conductors

(AC 2.6)

Requirements

- basic protection/insulation/safe distance
- certificated competency
- ingress protection (IP) rating
- location of equipment
- overcurrent protection
- personnel protection
- safety labels

(AC 2.7)

Earthing, grounding and bonding

- alternating current (AC) earth
- cathodic protection (bonding)
- common ground
- direct current (DC) ground
- radio frequency (RF) ground
- single side band (SSB) radio ground

(AC 2.8)

Vibrating tools:

- core grinder
- drills
- grinder
- jig saw
- oscillating tools
- reciprocating saws
- sanders:
 - belt
 - DA
 - disc
 - orbital

HAVS:

- annual health screening
- Control of Vibration at Work Regulations
- reporting and documentation

- tool selection
- tool servicing
- tool vibration measured
- trigger times controlled
- vibration calculator used (exposure action value, exposure limit value)

(AC 2.9)

Permit to work:

- awareness of people who are on site and work being undertaken
- for reasons of industrial secrecy
- to control and manage contracts and work being undertaken
- to ensure controls are in place
- to ensure no unauthorised people have access to a potentially dangerous environment and to prevent theft or malicious damage - security
- to ensure safe practices are carried out

(AC 2.10)

Who hazards should be reported to:

- fire officers
- safety manager/officer/adviser
- supervisors
- works rescue team

(AC 2.11)

Situations:

- in close proximity to moving machinery (running engines, rotating shafts)
- in extreme temperatures
- when a fire risk exists, with toxic, highly flammable or explosive substances
- when working in adverse weather conditions
- when working in confined spaces
- when working out of normal working hours
- where there is a danger of falling overboard or into water
- working at heights (up the mast, on stage planks)
- working near high power transmitters
- working with live conductors

Learning outcome

The learner will:

- 3 Know how to plan, organise and monitor work needed to carry out marine industry activities

Assessment criteria

The learner can:

The learner can:

- 3.1 explain how to maximise the **efficiency and effectiveness** of the resources
 - 3.2 explain the types of **records** that need to be maintained
 - 3.3 explain the importance of maintaining accurate production records
 - 3.4 explain the **problems** that may occur if documentation is not maintained and completed accurately
 - 3.5 state the **key roles** in a marine industry environment
 - 3.6 state the **technical skills, tools and materials** needed to deliver the work outcome
 - 3.7 list the **information sources** that detail what is required to deliver work outcomes
 - 3.8 explain the **action to be taken** when required resources are unavailable
 - 3.9 describe the purpose of the **regulatory and compliance bodies** that cover marine industry activities
 - 3.10 state the **checks** used to ensure marine industry activities meet quality and design specifications
 - 3.11 explain the **considerations** when planning boat construction schedules
-

Range

(AC 3.1)

Efficiency and effectiveness:

- adhere to LEAN principles
- correct quality and quantity of tools
- effective time management
- effective use of working area and facilities
- employ the right staff with appropriate skills
- equipment and materials
- good planning:
 - finalise time and cost of work to be done
 - identify and source equipment, machinery tools and materials
 - make, produce and use jigs and templates as required
 - review and verify design and plans
 - set up tools and machinery correctly for tasks
- provide training to enable staff to undertake their role

(AC 3.2)

Records:

- batch numbers
 - calibration records
 - critical path analysis charts, or other progress charts
 - drawings and specifications
 - method statements
 - process forms
 - quality assurance certificate
 - recreational craft directive logs and files
 - requisitions sheets
-

- safety data sheets
- stock control records
- technical data sheets
- time sheets
- tool records
- trials and equipment test records
- work schedule sheets

(AC 3.4)

Problems:

- difficulty tracing work that has been undertaken
- parts availability may not be accurate
- the customer may be charged too much or too little
- the reputation of the company may be put at risk
- the true cost of the work may not be recovered
- work may be done incorrectly or not up to the standard required or expected
- work may need to be reworked
- work that should be done may be missed or not completed

(AC 3.5)

Key roles:

- administrative support and IT
- apprentices
- buyer
- cell manager/leaders
- charge-hand
- designer
- facilities manager
- finance manager
- foreman
- health safety and environmental manager (OHSAS18001, ISO14001)
- human resources manager
- manager
- marina manager
- mentors
- production manager
- quality manager (ISO9001)
- sales and after sales manager
- skilled workers
- store keeper
- team leader/supervisor
- training staff
- warranty manager

(AC 3.6)

Technical skills, tools and materials:

- highly skilled workforce
- materials and components
- specialist services
- specialist tools and equipment
- suppliers (internal and external)
- training
- up to date and effective working methods

(AC 3.7)

Information sources:

- external information
 - British Marine electrical and electronic association (BMEEA) code of practice
 - codes of practice
 - compliance regulations and standards
 - customer information
 - designer's drawings and specifications
 - health and safety regulations and information
 - manufacturers' technical data and information
 - National Electronics Marine Association (NMEA) standards
 - recreational craft directive (RCD)
 - safety data sheets
 - surveyor's reports
- internal information
 - application records
 - bill of materials
 - cable schedule
 - calibration records
 - general arrangement plans
 - job instruction sheets
 - line plans
 - methods statements
 - new build specifications
 - requisition sheets
 - risk assessments
 - test records
 - time sheets
 - tool records
 - working drawings

(AC 3.8)

Action to be taken:

- implement contingency plans
- notify relevant personnel
- re-schedule work

(AC 3.9)

Regulatory and compliance bodies:

- American Boat and Yacht Council (ABYC)
- American Bureau of Shipping (ABS)
- British Marine Electrical and Electronic Association (BMEEA)
- Bureaux Veritas
- Canal and River Trust
- Environment Agency (England) / Natural Resources Wales (Wales) / Scottish Environmental Protection Agency (Scotland)
- International Marine Electrical Association (IMEA)
- Lloyds
- Marine Coastguard Agency (MCA)
 - IPV (Intended Pleasure Vessel) code
 - Small Vessel code
- National Marine Electronics Association (NMEA)
- Royal Institute Naval Architects (RINA)
- Royal Yachting Association (RYA)
- Standards bodies (e.g. BS EN and ISO)
- Trading Standards (RCD compliance)

(AC 3.10)

Checks:

- measurement
- operations and functional testing
- visual inspections
 - commission and functionality tests
 - dock side tests
 - electrical testing
 - mechanical testing
 - pre-launch tests
 - safety equipment tests
 - sea trials

(AC 3.11)

Considerations:

- availability of materials
- construction and production methods required
- customer requirements
- design specification
- long term capacity
- payment schedules
- production costs
- relevant regulations
- resources – skill set requirements
- suppliers
- timeframes
- transport logistics

Learning outcome

The learner will:

- 4 Understand effective production systems used in the marine industry

Assessment criteria

The learner can:

- 4.1 explain the basic **components** of a typical marine production system
 - 4.2 describe factors that affect **productivity**
 - 4.3 describe the **effect of industrial changes** on productivity
 - 4.4 state factors that affect **marine industry trading**
 - 4.5 state the factors that affect **good customer relations**
-

Range

(AC 4.1)

Components of a typical production system:

- access to water
- available finance to cover costs
- commissioning documentation
- energy
- labour (person/hours)
- land and buildings
- machinery
- materials
- testing and diagnostic equipment
- work instruction procedures

(AC 4.2)

Factors that affect productivity:

- availability and cost of materials
 - cost and availability of labour
 - effectiveness of planning processes
 - factors effecting costs of production:
 - down time
 - machinery and equipment breakdown/failure
 - need for rework
 - waste e.g. over production, over processing, waiting, transport, defects, inventory, motion
 - human factors:
 - absenteeism
 - communication skills
-

- fatigue
- mental health e.g. stress, anxiety
- morale
- motivation
- personality
- presenteeism
- punctuality
- skill level/ability
- machine and equipment availability and effective use of capacity
- project time constraints
- supplier performance
- transport and logistics
- working environment

(AC 4.3)

Effect of industrial change:

- increased scale of competition
- introduction of new technology – increased training demands
- lack of competitiveness in terms of:
 - marketing
 - productivity
 - quality
- reduced demand
- regulation/legislation introduction and changes
- unintended consequences (e.g. of engineering change, staff changes etc)

(AC 4.4)

Factors that affect marine industry trading:

- agreed delivery dates and the implications of penalty clauses
- cash flow
- clean and well-maintained premises
- communication between business and customer
- company reputation / perception
- contract management
- ensuring good product service
- quality of work produced
- repairs and builds are fit for purpose
- robust warranties
- the cost is within the quoted price including any agreed extras
- the legal standing of the designer's specification
- the method of payment

(AC 4.5)

Factors that affect good customer relations:

- after sales service and rectification of faults
- customer engagement

- ensuring the product supplied is fit for purpose
- handover/training
- meeting customer expectations and specifications
- producing good quality work
- provision of documentation
- robust warranties
- the work is finished by the agreed delivery dates
- the work is of the required quality and reliability
- the cost is within the quoted price including any agreed extras

Unit 310

Principles of marine construction, components and marine electrical engineering

Unit level:	Level 3
GLH:	70
Aim:	This unit is concerned with the selection and use of materials, tools and equipment and their application in marine construction and marine electrical engineering.
Assessment type:	Multiple choice on-line test

Learning outcome

The learner will:

- 1 Understand materials used for marine construction and marine electrical engineering

Assessment criteria

The learner can:

- 1.1 describe **materials** and how they are used in marine construction
- 1.2 evaluate the **properties** of materials used in marine construction
- 1.3 describe common **defects** in materials
- 1.4 explain the **protection methods** for wood, metal and composites used in marine construction and how they are applied
- 1.5 describe the types of **reinforcement and stiffening materials** used in marine construction
- 1.6 explain the selection and use of **joining processes** for electrical conductors
- 1.7 evaluate comparative holding power of **adhesives**
- 1.8 distinguish between **primary and secondary bonds** when fixing Fibre Reinforced Plastic (FRP) structures
- 1.9 describe **applications** of sealing and bedding compounds used in marine construction

Range

(AC 1.1)

Materials:

- bedding and joints (e.g. polyurethane and silicon sealants)
- composites
 - fibre reinforced plastic (FRP)
 - glass reinforced plastic (GRP)

- plastics
- fluids
 - additives
 - coolants
 - oils
- metals
 - alloys (brass, bronze)
 - ferrous (steel)
 - non-ferrous (lead, aluminium, copper, zinc, magnesium)
- seals
- solvents and solvent free alternatives
- timbers
 - hard woods
 - manufactured boards
 - soft woods

(AC 1.2)

Properties of materials:

- bedding and joints
 - adhesion
 - aerobic / anaerobic
 - chemical resistance
 - curing state
 - flexibility
 - water resistance
- composite
- fluids
- metal
 - compressive/shear strength
 - conductivity
 - corrosion resistance
 - ductility/malleability
 - hardness
 - heat resistance
 - nobility
 - tensile strength
 - toughness/brittleness
- wood

(AC 1.3)

Defects in materials:

- metals
 - cavitation
 - corrosion
 - cracks
 - crevice corrosion

- de-zincification
- fatigue
- galvanic and electrolytic action
- oxidation
- welding imperfections
- plastics
- wood

(AC 1.4)

Protection methods and their application:

- composites
 - brushing, rolling and spraying (painting)
 - polishing
- metal
 - anodising
 - brushing and rolling (painting)
 - electro plating
 - insulation
 - galvanizing
 - powder coating
 - protective wrapping
 - sacrificial anodes
 - sherardising
 - spraying
- wood
 - brushing and rolling – (varnishing – UV protection, painting)
 - hot and cold tank dipping
 - pressure treatment
 - spraying
 - steeping

(AC 1.5)

Types of reinforcement and stiffening materials:

- aramid (kevlar)
- carbon fibre
- metal
- polyurethane foam
- pre-impregnated (pre-preg.) cloths
- PVC foam
- wood (end grain Balsa)

(AC 1.6)

Fastening and joining processes:

- crimping
- soft soldering

- connecting block
- friction connectors
- bus bar
- specialist bolts
- stud bars
- thread locking compounds
- heat shrink
- plugs and sockets

(AC 1.7)

Comparative holding power adhesives:

- casein
- contact adhesive
- cyanoacrylate
- epoxy resins
- mastics e.g. polysulphide
- polyester resin
- polyurethane
- PVA
- resins
- resorcinol
- urea formaldehyde

(AC 1.8)

Primary bonds and secondary bonds:

- primary bonds made between plies of resin and reinforcement laid and cured at the same time
- secondary bonds made between plies of resin and reinforcement laid after previous layers have cured

(AC 1.9)

Applications of sealing and bedding compounds:

- cleanliness
- environmental conditions
- isolation of dissimilar metal
- manufacturer's guidelines

Learning outcome

The learner will:

- 2 Understand the use of drawings and specifications used in marine electrical engineering

Assessment criteria

The learner can:

- 2.1 identify the **specification authorities and regulating bodies** for marine construction activities
- 2.2 explain how to use drawing scales
- 2.3 identify **boat terms** from drawings and specifications
- 2.4 explain how to extract information from lines plans, construction drawings and general arrangement plans
- 2.5 identify diagrams, **schematics** and **symbolology** used in performing marine electrical engineering activities
- 2.6 use **calculations** to determine common marine engineering areas, volumes and capacities from plans, drawings and specifications
- 2.7 understand and demonstrate **mathematical techniques, formulae, and calculations** that underpin marine electrical and electronic work

Range

(AC 2.1)

Specification authorities and regulating bodies:

- American Boat and Yacht Council (ABYC)
- American Bureau of Shipping (ABS)
- British Marine Electrical and Electronic Association (BMEEA)
- Bureaux Veritas
- Canal and River Trust
- Environment Agency (England) / Natural Resources Wales (Wales) / Scottish Environmental Protection Agency (Scotland)
- International Marine Electrical Association (IMEA)
- Lloyds
- Marine Coastguard Agency (MCA)
- National Marine Electronics Association (NMEA)
- Royal Institute Naval Architects (RINA)
- Royal Yachting Association (RYA)
- Standards bodies (e.g. BS EN and ISO)
- Trading Standards (RCD compliance)

(AC 2.3)

Boat terms:

- aft
- air conditioning units
- alternative energy (e.g. fuel cells, solar, wind)

- anchor
- bathing platform
- batteries and boxes
- bilge
- bollards
- bow
- bow rollers
- bow thruster
- breadth
- bridge
- bulkhead
- bulwarks
- cabins
- camber
- capping rail
- chain locker
- chargers/inverters
- coach roof
- coaming
- cockpit
- couplings
- davits
- deadweight
- deck glands
- deckhouse
- decks
- depth
- displacement
- distribution boxes
- draught
- engine room
- fairleads
- flare
- foils
- forward
- frame
- freeboard
- gas locker
- generators (Alternating Current and Direct Current)
- gypsy
- gyro
- hatches
- heads
- inboard
- isolators
- keel (drop, fin, watertight, bilge, long, triple)

- lazarette/tiller flat
- length
- longitudinals
- mast
- midships
- motors
- navigation equipment
- outboard
- port
- power take off
- propulsion
- pumps
- refrigeration
- reverse osmosis water maker (ROWM)
- rolling chocks
- rubbing strakes
- rudder (balanced, unbalanced, semi balanced)
- saloon
- scuppers
- skin fittings
- sole boards
- stabilisers
- starboard
- stern
- stern thruster
- superstructure
- switchboard
- tank space
- thwartships
- transom
- tumblehome
- vents
- waterline
- wheel house
- winch
- universal joints

(AC 2.5)

Schematics:

- electrical
 - A - B list
 - block diagram
 - cable schedule
 - circuit diagram
 - connections
 - hydraulics

- layout diagram
- wiring diagram

Symbology:

- electrical symbols
 - AC (single phase and three phase)
 - antennas
 - batteries
 - bonding
 - capacitors
 - DC
 - diodes
 - display symbols
 - fuses / miniature circuit breaker (MCB)
 - inverters / inverter chargers
 - isolators
 - lamps
 - L.E.D's
 - loudspeakers
 - machine (M = motor/G = generators)
 - power supplies
 - relays
 - resistors
 - switches / contactors
 - transformers
 - transistors
 - thermistors and buzzers
 - wire terminations
- hydraulics

(AC 2.6)

Calculations:

- density
- mass
- quantity
- simple machines (force, ratio and efficiency)
- Simpson's rule
- surface area, i.e. anode
- torque
- volumes (tanks, common solids, irregular volumes and areas)

(AC 2.7)

Mathematical techniques, formulae, and calculations:

- attenuation calculations
 - battery ventilation calculations
 - current cable resistance calculations
 - Kirchhoff's law (first and second)
 - Ohm's law
 - Peukert's capacity
 - power factor
 - volt drop calculations
-

Learning outcome

The learner will:

- 3 Understand marine construction techniques

Assessment criteria

The learner can:

- 3.1 explain the **types of propulsion**
 - 3.2 describe **marine construction techniques**
 - 3.3 explain the use of **tools and equipment** used in marine electrical engineering
 - 3.4 explain the **considerations for stresses and strains** when constructing a vessel
-

Range

(AC 3.1)

Types of propulsion:

- air driven (hover craft)
- hybrid engines
- inboard marine engines driving propellers with direct, Z or V drives, Jet, hydraulic and electric drives
- oars
- outboard marine engines
- paddles & paddle wheels
- sails

(AC 3.2)

Marine construction techniques:

- fabrics
 - fibre reinforced plastics FRP (wet lay up, spray, resin infused, carbon fibre, Kevlar)
 - metals (steel, aluminium)
 - modern wood/epoxy (strip plank, cold moulding, clinker ply, stitch and tape)
 - plug construction techniques
 - traditional techniques (carvel, clinker, double diagonal)
-

(AC 3.3)

Tools and equipment:

- ammeter and shunt
- battery tester
- continuity tester
- diagnostic laptops
- drop tester
- earth loop impedance testers
- insulation testers
- logic tester
- measuring tools (e.g. micrometer, Vernier calipers, temperature guns)
- multimeters
- multi-functional testers
- portable appliance tester {PAT}
- power tools (e.g. battery drill, air impact wrench)
- range of common tools (e.g. spanners, sockets, screwdrivers)
- RCD testers
- socket outlet tester

(AC 3.4)

Considerations for stresses and strains:

- heaving
- pitching
- rolling
- sagging / hogging
- surging
- yawing

Learning outcome

The learner will:

- 4 Understand marine electrical engineering systems

Assessment criteria

The learner can:

- 4.1 explain marine **communication systems**
4.2 explain the principles of **marine electrical engineering systems**

Range

(AC 4.1)

Communication systems:

- automatic identification system (AIS)
- Collision regulations (COLREGS [navigation lights])
- flags
- Inter ship tracking systems
- mobile phones
- radar
- radio
- rockets and flares
- satellite support systems
- sonar

(AC 4.2)

Marine electrical engineering systems:

- bilge
 - alarms
 - filters
 - float switches
 - pick ups
 - pipework
 - pumps
 - regulations
 - size
 - valves
- compressed air
 - compressors
 - cylinders
 - lock out
 - pipework
 - stored energy
- domestic systems
 - heating
 - refrigeration
 - ventilation and air-conditioning
 - waste – grey and black
 - water – fresh and reverse osmosis water maker (ROWM)
- electrical
 - AC /DC systems
 - batteries
 - battery charging
 - Controller area network (CAN) bus and other networks
 - distribution system
 - invertors
 - renewable energy (solar, wind, hydro)

- fire system
 - manual / automatic
 - medium
 - pipework
 - pumps
 - suppression
 - thermolines
- fuel
 - balance
 - filler breaking system
 - filters
 - pumps
 - storage
 - tanks and senders
 - valves
- heating
 - diesel fired heating
 - water heating
- hydraulic
 - pumps and valves
 - stabilisers
 - steering
 - stored energy
 - thrusters
 - trim tabs
 - winches and deck gear
- refrigeration
 - compressors
 - dryers
 - heat exchangers
 - pumps
- ventilation and air conditioning
 - central cold water system
 - reverse cycle system
 - stand-alone system
- waste
 - black
 - condensate drains
 - filters
 - grey
 - maceration
 - pump
 - storage
 - treatment
 - vacuum
- water
 - calorifier system
 - filters

- fresh and reverse osmosis water makers (ROWM)
 - fresh water system
 - pumps
 - standard pressurised system
 - tanks and senders
-

Learning outcome

The learner will:

- 5 Understand the use of fittings and components used in marine construction

Assessment criteria

The learner can:

- 5.1 explain the importance of **location** of fittings and components installed on boats and their intended **purpose**
 - 5.2 explain the functions of different **exterior fittings and components**
 - 5.3 explain the application and use of different types of **fastening devices**
 - 5.4 explain the requirements for **electrical separation** when installing electrical equipment
 - 5.5 explain the reason for the use of **bedding and sealing compounds** in way of fittings and dissimilar metals
-

Range

(AC 5.1)

Location and purpose:

- allow easy access and operation
- do not present a hazard in use
- function satisfactorily
- maintain structural integrity
- meet customer requirements
- meet operational requirements
- meet regulatory safety requirements

(AC 5.2)

Exterior fitting and components (function):

- deck fittings
 - anchor stowage
 - bollards
 - bow rollers
 - cleats
 - davits
 - fairleads
 - forestay and backstay fittings
 - grab rails
-

- guard rails
- life-buoy and life-raft stowage
- mainsheet and headsail tracks
- passerelle
- pulpit and pushpit
- sampson post and fairleads
- stanchions
- tabernacle
- winches
- windlasses
- hull fittings
 - 'A' and 'P' brackets
 - anodes
 - hawse pipes
 - pintles and gudgeons
 - rudder gland
 - rudder stops
 - rudder tubes
 - rudders
 - shafts and props
 - skeg fittings
 - skin fittings
 - stern tubes, stern glands and seals
 - transducers
- superstructure
 - aerials
 - doors
 - hatches and skylights
 - lockers
 - radar mast
 - seats
 - upper steering position (USP)
 - vents
 - windows

(AC 5.3)

Application and use of fastening devices:

- electrical terminations
- grades of materials
- tensile strength
- thread identification
- torque loading
- use of locking devices and fluids
- use of locking devices to prevent fastenings becoming loose or undone

(AC 5.4)

Electrical separation

- AC/DC
- High current carrying cables and data cables
- High current carrying cables and fuel lines
- High current carrying cables and gas lines
- High current carrying cables and coaxial cables
- High current carrying cables and bilges
- Antenna minimum safe distance
- Compass safe distance

(AC 5.5)

Bedding and sealing compounds:

- adhesion
- electrolytic action
- insulation
- waterproofing

Unit 311

Principles of integrated marine electronic systems

Unit Level:	Level 3
GLH:	180
Aim:	This unit covers the health and safety requirements relating to installation of electronic and navigation systems, preparation of and installation of these systems and how to commission them.
Assessment type	Centre-devised practical assignment and short-answer questions

Learning outcome

The learner will:

- 1 Understand the health and safety requirements relating to the installation of integrated electronic and navigation systems

Assessment criteria

The learner can:

- 1.1 explain the **precautions** to be taken when using tools and equipment, including mast mounted equipment including the use of access equipment
- 1.2 explain why there is a need for personal protective equipment (PPE)
- 1.3 describe the **safe practices and procedures** required when carrying out assembly and installation of **electrical and electronic systems**
- 1.4 describe the **observations and precautions** to be undertaken when marking out and cutting openings for the installation of instruments and equipment
- 1.5 explain the **methods** for safely locating and fitting equipment
- 1.6 describe the safe **practices and procedures** required when using sealants, adhesives, other compounds and chemicals

Range

(AC 1.1)

Precautions

- lifting operations and lifting equipment regulations (LOLER)
- provision and use of work equipment regulations (PUWER)
- working at height regulations

(AC 1.3)

Safe practices and procedures

- electricity at work act
- manufacturer's recommendations
- regulatory compliance (British Marine Electrical & Electronics Association (BMEEA), International Standards Organisation (ISO) [small craft electrical systems AC and DC], National Marine Electronics Association (NMEA), Recreational Craft Directive (RCD))
- safe isolation procedure

Electrical and electronic systems

- audio visual systems (AV)
- automatic identification system (AIS)
- autopilot system
- battery monitoring systems
- compasses heading sensors and rate sensors
- digital selective calling (DSC)
- emergency position indicating radio beacon (EPIRB)
- galvanic protection
- global positioning system (GPS)
- light distance and ranging (LIDAR)
- lightning protection
- mast head units
- multi-functional displays (MFD)
- networking
- programmable logic controller (PLC) systems
- radio distance and ranging (RADAR)
- radio frequency (RF)
- renewable and hybrid systems
- safety of lives at sea (SOLAS) systems
- satellite communications (Wi-Fi etc)
- single side band (SSB)
- sounders and transducers
- very high frequency (VHF) radio

(AC 1.4)

Observations and precautions

- other personnel (e.g. awareness of work being carried out by other trades)
- PPE
- safe isolation procedures

- visual checks (e.g. checking proximity of other equipment and services such as checking for cables, pipes etc.)

(AC 1.5)

Locations

- bulkhead mounted equipment
- surface mounted equipment
- through bulkhead penetrations
- through hull penetrations
- cockpit and bridge mounted equipment
- mast mounted equipment (transducers and sensors)
- above and below the waterline

Methods:

- sealants
- correct Ingress Protection (IP)
- corrosion inhibitors
- electrical separation
 - galvanic awareness
 - AC/DC safe separation
 - data/high-current cable separation

(AC 1.6)

Safe practices and procedures required when using chemicals

- application of control of substances hazardous to health (COSHH) principles
- correct use of PPE (e.g. respirator or mask, eye protection, gloves etc.)
- making others aware of potential risks
- refer to material safety data sheet (MSDS)
- ventilation

Learning outcome

The learner will:

- 2 Understand the installation requirements and function of integrated electronic and navigation systems

Assessment criteria

The learner can:

- 2.1 describe the function of different **electronic and navigation systems**
- 2.2 evaluate and use **technical information** to plan the installation of integrated electronic and navigation systems
- 2.3 explain the **reasons for the care and safe storage** of technical drawings and information

- 2.4 state the methods of producing work plans and explain the **information required in work plans**
- 2.5 state the **existing services** to be considered when installing integrated electronic and navigation systems
- 2.6 describe the importance of using glands to pass cables through watertight bulkheads
-

Range

(AC 2.1)

Electronic and navigation systems

- audio visual systems (AV)
- automatic identification system (AIS)
- autopilot system
- battery monitoring systems
- compasses heading sensors and rate sensors
- digital selective calling (DSC)
- galvanic protection
- global positioning system (GPS)
- light distance and ranging (LIDAR)
- lightning protection
- mast head units
- multi-functional displays (MFD)
- networking
- programmable logic controller (PLC) systems
- radio distance and ranging (RADAR)
- radio frequency (RF)
- renewable and hybrid systems
- safety of lives at sea (SOLAS) systems
- satellite communications (Wi-Fi etc)
- single side band (SSB)
- sounders and transducers
- very high frequency (VHF) radio

(AC 2.2)

Technical information:

- codes of practice
- installation drawings
- manufacturer's instructions
- regulations

(AC 2.3)

Reasons for safe storage of technical information

- assistance with future maintenance and location of equipment
- fuse/breaker identification and ratings
- insurance

- owner/crew operation
- requirement of recreational craft directive (RCD)
- surveyor requirements
- warranty

(AC 2.4)

Information required in work plans:

- What you are going to do
- How you are going to do it
- Order work is going to be done in
- Materials and tools required
- Estimate of time required
- Will you need assistance

(AC 2.5)

Existing services:

- AC and DC current carrying cables
- communications cables
- compass safe distance
- data cables
- fuel
- gas
- heat sources safe distance
- hydraulics
- pipes
- polystyrene safe distance
- water

Learning outcome

The learner will:

- 3 Be able to install the equipment, materials and components required for integrated electronic and navigation systems

Assessment criteria

The learner can:

- 3.1 state the **factors which affect positioning of electronic and navigation systems** to ensure compliance with the industry codes of practice
- 3.2 describe the installation of electronic equipment, Programmable Logic Controller (PLC), ethernet and networking systems in accordance with required specifications and industry standards

- 3.3 describe the **types of damage** that can occur during installation of electronic and navigation systems and the necessary precautions
 - 3.4 describe the **factors which affect routing** of cables within electronic, radio frequency (RF) and navigation system installations
 - 3.5 apply formulae and calculations for **volt-drop and attenuation for cable installations**
 - 3.6 **install electronic and navigation systems** in accordance with required specifications and industry standards
 - 3.7 describe the requirements for **earthing grounding and bonding** marine equipment in integrated electronic and systems
 - 3.8 restore work area, return tools, unused materials and equipment to a safe and reliable condition, to prescribed standards of cleanliness on completion of marine electrical and electronic work operations
-

Range

(AC 3.1)

Factors which affect the positioning:

- access and maintenance
- appropriate locations
- customer preference
- environmental factors
- equipment ventilation
- ISO (small craft electrical systems AC and DC) and BS
- NMEA code of practice (antenna safe separation)
- manufacturer's instructions
- Maritime and Coastguard Agency (MCA) small craft codes
- operational functionality
- protection of electrical circuits
- proximity to electro-magnetic interference (EMI)
- Recreational Craft Directive
- routing of data cables and supply cables
- Safety of Lives at Sea (SOLAS) regulations
- vessel stability

Electronic and navigation systems:

- Audio visual systems (AV)
- Automatic identification system (AIS)
- Autopilot system
- Battery monitoring systems
- Compasses heading sensors and rate sensors
- Digital selective calling (DSC)
- Galvanic protection
- Global positioning system (GPS)
- Light detection and ranging (LIDAR)
- Lightning protection
- Mast head units
- Multi-functional displays (MFD)

- Networking
- Programmable Logic Controller (PLC) systems
- Radio detection and ranging (RADAR)
- Radio frequency (RF)
- Renewable and hybrid systems
- Safety of Lives at Sea (SOLAS) systems
- Satellite communications (Wi-Fi etc)
- Single side band (SSB)
- Sounders and transducers
- Very High Frequency (VHF) radio

(AC 3.3)

Types of damage:

- burrs
- corrosion
- galvanic
- human error
 - wrong location
 - incorrect penetration size
 - measurement
 - inappropriate tooling
- projections
- sharp edges
- soft furnishing damage
- surface damage
- swarf/foreign bodies
 - chemicals (e.g. adhesives, solvents etc.)
 - gel coat chips
 - heat
 - scratches
- water damage

(AC 3.4)

Factors which affect routing:

- access and maintenance
- aesthetics
- heat sources
- cable support systems
- characteristics of cables in use
- compliance with manufacturer's specifications
- maximum allowable length i.e. NMEA backbone and droppers
- efficient routing of cable adhering to codes of practice
- cable length and size in relation to volt drop
- coaxial cable attenuation or impedance mismatches
- AC and DC separation

- data/high-current cable separation
- compass safe distance
- electro-magnetic interference (EMI)
- interference with moving parts
- location of equipment
- maintain integrity of watertight bulkheads
- segregation of cables by intended use
- stability

(AC 3.5)

volt-drop and attenuation for cable installations

- NMEA 2000 volt drop calculations
- BMEEA current carrying cable volt drop calculations
- NMEA coaxial cable attenuation calculations

(AC 3.6)

Install electronic and navigation systems:

- get on the right boat
- confirm installation locations considering
 - EMI
 - ventilation
 - compass safe distance
- confirm proper cable types and lengths based on location(s), avoiding cable junctions
- consider ease of serviceability and future expandability (service loop etc.)
- consider mounting requirements
 - through bolts
 - backing plates
 - weight
 - galvanic compatibility
- consider sealing methods for surface penetrations
 - glands
 - silicon sealant
 - polyurethane sealant
 - ingress protection (IP)
- protect the vessel
 - drop cloths
 - over-shoes
 - masking tape
- maintain a clean & orderly workspace during the entire installation

(AC3.7)

Earthing grounding and bonding

- AC safety earth / Circuit Protective Conductor (CPC)
- DC negative grounding
- Radio Frequency (RF) grounding
- Anode ground / cathodic protection
- Single Side Band (SSB) counterpoise

- Common grounding point
 - Equipotential bonding
 - Active / passive connected materials
-

Learning outcome

The learner will:

- 4 Be able to commission integrated electronic and navigation systems

Assessment criteria

The learner can:

- 4.1 commission and demonstrate the function, operation and programming of marine **electronic and navigation systems**
- 4.2 support electronic and navigation system tests, dockside trials and sea trials
- 4.3 complete **documentation** in accordance with organisational policy, procedures and any other **relevant information and guidance**
-

Range

(AC 4.1)

Electronic and navigation systems:

- Automatic identification system (AIS)
- Autopilot system
- Battery monitoring systems
- Compasses heading sensors and rate sensors
- Digital selective calling (DSC)
- Global positioning system (GPS)
- Mast head units
- Multi-functional displays (MFD)
- Networking
- Radio detection and ranging (RADAR)
- Radio frequency (RF)
- Safety of Lives at Sea (SOLAS) systems
- Satellite communications (Wi-Fi etc)
- Sounders and transducers
- Very High Frequency (VHF) radio

(AC 4.3)

Documentation, relevant information and guidance:

- Completion of company documentation (e.g. completing in process control [IPC] and ISO control documents)
 - Manufacturer's instructions
-

- Operational manuals
 - Updating owner's manual and technical file or boat file
 - Warranty documentation
 - Wiring diagrams and schematics
-

Learning outcome

The learner will:

- 5 Be able to perform routine installation, and carry out diagnostic tasks on electronic and navigation systems

Assessment criteria

The learner can:

- 5.1 describe the use of **diagnostic and test equipment**
 - 5.2 perform **routine servicing** in the specified sequence using appropriate techniques and procedures
 - 5.3 **check, test and diagnose** faults in marine electronic and navigation systems
 - 5.4 isolate, remove, repair or replace electronic and navigation equipment circuits and cables and recommission and test
 - 5.5 describe how to dispose of un-serviceable equipment and waste in accordance with Waste Electrical And Electronic Equipment Regulations (WEEE) and other appropriate regulations (e.g. Control Of Substances Hazardous To Health [COSHH]) and in line with company policy and procedures
 - 5.6 record work operations undertaken and complete documentation in accordance with organisational policy, procedures and any other relevant information and guidance
-

Range

(AC 5.1)

Diagnostic and test equipment:

- ammeter
 - battery tester
 - cable detector
 - clamp meter
 - continuity tester
 - diagnostic laptop
 - earth loop impedance tester
 - gauss/tesla meter
 - insulation resistance meter
 - leakage current clamp meter
 - multi-functional tester
-

- multi-meter
- oscilloscope
- phase rotation meter
- portable appliance tester (PAT)
- RCD tester
- socket tester
- specialist test equipment (e.g. NMEA 2000 blue meter)
- test lamps
- volt stick
- voltmeter

(AC 5.2)

Routine servicing:

- manufacturers manuals recommendations and guidance

(AC 5.3)

Checks, tests and diagnostics

- antennas (VHF and AIS)
- automatic identification system (AIS)
- autopilot
- battery and battery charger
- camera
- fluxgate compass correct heading/direction
- global positioning system (GPS)
- multi-functional display
- NMEA 2000 connection systems / back bone, droppers and connectors, termination resistors
- radar
- switch panel
- tri data sender (water depth, speed, and temperature)
- VHF
- wind mast head unit (wind speed and direction)

Unit level:	Level 3
GLH:	180
Unit aim:	This unit is concerned with principles of marine electrical systems. It covers the functions of electrical components, electricity supply systems and functions of electrical machines, motors, generators and control circuits.
Assessment type	Centre-devised practical assignment and short-answer questions.

Learning outcome

The learner will:

- 1 Understand the functions of electrical components

Assessment criteria

The learner can:

The learner can:

- 1.1 explain the **electrical standard index (SI) units** and their relationships to each other.
- 1.2 perform calculations to demonstrate the functions of **resistors** in a circuit.
- 1.3 describe the effect of **stray magnetic fields**, their effect on the operation of other equipment and mitigation techniques.
- 1.4 explain the functions of an **electromagnetic circuit**.
- 1.5 describe and use a range of electrical **test instruments** including problem solving techniques.
- 1.6 explain the function of **circuit components** and produce circuits to carry out various operations on board a vessel.

Range

(AC 1.1)

Electrical standard index (SI) units and their relationships to each other:

- capacitance and inductance
- charge – I.t
- current – charge per unit time
- energy – joule
- power - energy per unit time – V.I
- resistance – voltage per unit current
- voltage – energy per unit charge

(AC 1.2)

Resistors:

- carbon
- ceramic
- resistance colour code
- resistors in parallel
- resistors in series
- variable
- wire wound

(AC 1.3)

Effects of stray magnetic fields on equipment, and mitigation techniques:

- sources of electronic magnetic interruption (EMI)
 - alternators
 - chargers
 - current carrying cables
 - electronics
 - engine ignition systems
 - inverters
 - motors
 - propeller shafts
 - radar
 - radio transmissions
 - shore supplies
 - transformers

(AC 1.4)

Electromagnetic circuit:

- contactors
- hall effect sensors
- inductors
- motors
- relays
- transformers

(AC 1.5)

Test instruments:

- ammeter
- battery tester
- cable detector
- clamp meter
- continuity tester
- diagnostic laptop
- earth loop impedance tester
- gauss/tesla meter

- hydrometer
- insulation resistance meter
- leakage current clamp meter
- multi-functional tester
- multi-meter
- oscilloscope
- phase rotation meter
- portable appliance tester (PAT)
- RCD tester
- socket tester
- test lamps
- volt stick
- voltmeter

(AC 1.6)

Circuit components:

- alarms
- batteries / power supplies
- bus bars
- conductors
- connectors
- contactors
- diode
- ground fault circuit interrupter (GFCI) / residual current device (RCD)
- indicators
- isolators
- motors
- overcurrent protection (circuit breakers / fuses)
- relays
- residual current breaker overload (RCBO)
- switches
- terminations
- test equipment

Learning outcome

The learner will:

- 2 Understand electricity supply systems, protection and earthing

Assessment criteria

The learner can:

- 2.1 describe the range of **electricity supply systems** and their characteristics.

- 2.2 explain **transformers** and their characteristics
 - 2.3 explain the functions of internal and external **earthing systems**
 - 2.4 describe the functions of **grounding systems**
 - 2.5 describe the functions of **bonding systems**
 - 2.6 explain the function of **overcurrent protection systems**
-

Range

(AC 2.1)

Electricity supply systems:

- AC generators (110volt, 230volt and 400volt 3 phase) (50/60Hz) mechanical
- Batteries
 - Voltages: 2volt, 6volt, 12volt, 24volt, 48volt
 - Electrolytes
 - Specific gravity
 - Deep cycle, traction, cranking
 - Flooded cell, AGM, gel cell
 - Series and parallel connections
 - Amp/hour rating
- DC generators and alternators
- hybrid
- renewables (water, wind, photo voltaic [PV], hydrogen fuel cell)

(AC 2.2)

Transformers:

- chargers
- isolation
- polarising
- step-down
- step-up
- switch mode power supply

(AC 2.3)

Earthing protection systems:

- component failure
- conductor / component damage
- dangerous currents due to short circuits
- insulation breakdown
- overloads
- stray current leakage

(AC 2.4)

Grounding systems:

- AC/safety ground
-

- common ground
- DC ground
- lightning ground
- RF ground

(AC 2.5)

Bonding systems:

- anode selection
- cathodic protection
- EMI
- impressed voltage

(AC 2.6)

Overcurrent protection systems:

- digital breakers
- fuses (slow, medium and fast blow)
- miniature circuit breakers (MCB) (B, C and D)
- RCBO

Learning outcome

The learner will:

- 3 Understand the functions of electric motors and rotating devices

Assessment criteria

The learner can:

- 3.1 explain the characteristics of single phase AC motors used on board vessels
- 3.2 explain the characteristics of induction motors used on board vessels
- 3.3 explain the characteristics of three phase motors used on board vessels
- 3.4 explain the characteristics of DC brushed motors used on board vessels
- 3.5 explain the characteristics of DC brushless motors used on board vessels

Learning outcome

The learner will:

- 4 Prepare, design, produce and fit a wiring loom to a marine engine.

Assessment criteria

The learner can:

- 4.1 **Design and plan** the set up for the installation of a marine engine wiring loom
 - 4.2 Produce lists of **tools, materials and parts** for a marine engine wiring loom
 - 4.3 Produce appropriate risk assessments for work activities
 - 4.4 Safely carry out the installation of a marine engine **wiring loom**
 - 4.5 Commission and test a marine engine
 - 4.6 **Diagnose and rectify faults** on marine electrical systems
 - 4.7 Restore work area to a safe and tidy condition in accordance with organisational policy, requirements and procedures.
-

Range

(AC 4.1) Design and planning

- Approved work methods
- Marine electrical drawings
- Technical specifications
- Organisational policies and procedures
- Design calculations

(AC4.2) Tools, materials and parts

- Appropriate tools and test equipment
- Cables, connectors and terminations
- Batteries and alternators
- Overcurrent protection
- Bulbs and indicators
- Control devices (switches, relays, etc.)
- Mounting and holding devices

(AC4.4) Wiring loom

- Appropriate insulation and protection
- Appropriate safe positioning away from heat sources, moving parts and fuel
- Loom protection/covering (flexible conduit, heat shrink, tape)

(AC4.6) Diagnose and rectify faults

- Select appropriate testing methods
- Identify and locate faulty parts/equipment
- Power down
- Lock out, tag out
- Replace as necessary
- Power up, commission and test

Learning outcome

The learner will:

- 5 Prepare, plan and produce a working marine electrical switching and contacting circuit

Assessment criteria

The learner can:

- 5.1 **Design and plan** a marine electrical switching and contacting circuit
- 5.2 Produce lists of **tools, materials and parts** for a marine electrical switching and contacting circuit
- 5.3 Produce appropriate risk assessments for work activities
- 5.4 Safely carry out the installation of a marine electrical **switching and contacting circuit**
- 5.5 Commission and test a marine electrical switching and contacting circuit
- 5.6 **Diagnose and rectify faults** on marine electrical systems
- 5.7 Restore work area to a safe and tidy condition in accordance with organisational policy, requirements and procedures.

Range

(AC 5.1) Design and planning

- Approved work methods
- Marine electrical drawings
- Technical specifications
- Organisational policies and procedures
- Design calculations

(AC5.2) Tools, materials and parts

- Appropriate tools and test equipment
- Cables, connectors and terminations
- Power supplies and overcurrent protection
- Bulbs and indicators
- Control devices (switches, relays, contactors, latching devices etc.)
- Mounting and holding devices

(AC5.4) Switching and contacting circuit

- Appropriate normally open/normally closed (NO/NC) contacts
- Holding/latching/reversing
- Appropriate routing of cables
- Appropriate insulation of cables
- Overcurrent protection
- Appropriate cable sizing/colour/specification for current carrying capacity and volt drop

(AC5.6) Diagnose and rectify faults

- Select appropriate testing methods
- Identify and locate faulty parts/equipment
- Power down
- Lock out, tag out
- Replace as necessary
- Power up, commission and test

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.

City & Guilds Centre Manual 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:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

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

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

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

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

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

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

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Useful contacts

UK learners

General qualification information

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International learners

General qualification information

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Centres

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

E: centresupport@cityandguilds.com

Single subject qualifications

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

E: singlesubjects@cityandguilds.com

International awards

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

E: intops@cityandguilds.com

Walled Garden

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

E: walledgarden@cityandguilds.com

Employer

Employer solutions including, Employer Recognition: Endorsement, Accreditation and Quality Mark, Consultancy, Mapping and Specialist Training Delivery

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