



Australian Government

MARL053 Demonstrate advanced knowledge of ship operations and maintenance

Release: 3

MARL053 Demonstrate advanced knowledge of ship operations and maintenance

Modification History

Release 3. This is the third release of this unit of competency in the MAR Maritime Training Package:

- Minor change to unit application.

Release 2. This is the second release of this unit of competency in the MAR Maritime Training Package:

- Minor grammatical correction to numbering in performance criteria.

Release 1. This is the first release of this unit of competency in the MAR Maritime Training Package.

Application

This unit involves the skills and knowledge required to ensure that vessels comply with regulatory and survey requirements, the principles of ship construction as well as implementing maintenance and repair procedures associated with satisfying maintenance of class.

It includes analysing regulatory framework impacting on commercial shipping operations; maintenance strategies relating to classification surveys; statutory survey requirements; and factors influencing vessel stability.

It also includes analysing repair and maintenance methods for hull work, pipe work and pumping systems, machinery, propellers and other items to satisfy maintenance of class position; International Maritime Dangerous Goods (IMDG) Code requirements; safe working practices in enclosed or confined spaces; dry docking procedures and responsibilities of engineering staff; and shipboard vibration.

This unit applies to people working in the maritime industry in the capacity of:

- Engineer Class 1 (STCW Chief Engineer Unlimited)
- Engineer Class 2 (STCW Second Engineer Unlimited).

Licensing/Regulatory Information

Legislative and regulatory requirements are applicable to this unit.

- This unit is one of the requirements to obtain Australian Maritime Safety Authority (AMSA) certification as an Engineer Class 1 (STCW Chief Engineer Unlimited) or Engineer Class 2 (STCW Second Engineer Unlimited) and to meet regulatory requirements this unit must be delivered consistent with Marine Orders and with the relevant sections of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).
- Those regulatory requirements include STCW International Maritime Organization (IMO) model course competencies and areas of knowledge, understanding and proficiency, together with the estimated total hours required for lectures and practical exercises. Teaching staff

should note that timings are suggestions only and should be adapted to suit individual groups of trainees depending on their experience, ability, equipment and staff available for training.

Training providers seeking to offer this unit of competency must gain AMSA approval before the unit is offered.

Seafarers seeking certification should check with AMSA.

Pre-requisite Unit

Not applicable.

Competency Field

L – Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1

Analyse regulatory framework impacting on commercial shipping operations and survey requirements

PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

1.1

Functions of IMO, its fields of influence, role of member states, adoption of recommendations through maritime legislation and exemptions are analysed

1.2

Role of International Labour Organization (ILO) Convention in relation to dockyard and shipboard practices is analysed

1.3

Key provisions of Australian maritime legislation are analysed

- 1.4** Role of AMSA in relation to maritime safety, protection of marine environment, and aviation and marine search and rescue (SAR) is explained
- 1.5** Role of Flag State Administrations; purpose of the Navigation Act, Marine Notices, Marine Orders, Port State Control and other methods of implementation and enforcement of international agreements and conventions are analysed
- 1.6** Role of insurance underwriters, protection and indemnity (P & I) clubs and procedures for lodging claims following machinery failure and/or damage are analysed
- 1.7** Role of classification societies, International Association of Classification Societies (IACS) and Memorandum of Agreement with Flag States is analysed
- 1.8** Role of ship owners and ship management companies regarding International Safety Management (ISM) Code and ship management responsibilities regarding operation and maintenance is analysed
- 1.9** Role of independent inspection agencies and adoption of inspection and maintenance guidelines for different ship types is analysed
- 1.10** STCW crew training requirements and implications for emergency response, administration, operation and

- maintenance are analysed
- 1.11** Key provisions of the Code of Safe Working Practice for Australian Seafarers are analysed
- 1.12** Areas of vessel covered by statutory surveys are identified
- 1.13** Statutory requirements for change of flag, owner and term expiry during layup are identified
- 1.14** Records and documentation required for statutory surveys, legislation and measures are identified to ensure protection of the marine environment and safety of life at sea are identified
- 1.15** Load line measurements and conditions of freeboard assignment are analysed
- 1.16** Key areas of maintenance and testing of load line items and actions for addressing identified maintenance requirements and defects are identified
- 1.17** Areas covered by safety construction surveys and associated faults, maintenance and repairs are identified
- 1.18** Procedures for planning safety equipment surveys and actions for addressing identified maintenance requirements and defects are analysed
- 1.19** Requirements for survey preparation under the International Convention for the Prevention of Pollution

			from Ships (MARPOL) are analysed
		1.20	Survey requirements for cargo ship safety construction, safety equipment and safety radio certificates; passenger ship safety certificates; chemical tanker and gas carrier certificates of fitness are analysed
		1.21	Application of Port State Control surveys, Flag State jurisdiction and IMO guidelines in relation to vessel detention and identification of substandard ships are analysed
		1.22	Substandard ship and factors causing ship detention are identified
2	Analyse maintenance for classification surveys and maintain class certification	2.1	Common areas covered by classification surveys are analysed, reasons for class withdrawal are clarified and condition of class are explained
		2.2	Survey methods are analysed
		2.3	Terms of periodical, annual, renewal, intermediate and occasional surveys are identified
		2.4	Common defects identified in classification surveys and appropriate remedial actions are analysed
		2.5	Methods for repair and maintenance are analysed
		2.6	Properties and repair techniques of ordinary and high tensile hull grades of steel are analysed

- | | |
|-------------|---|
| 2.7 | Processes and materials used in underwater hull repairs are assessed |
| 2.8 | Methods of minimising and controlling internal and external hull corrosion, including bacterial corrosion of bilges and fuel tanks, are evaluated |
| 2.9 | Drainage arrangements and connections to other systems of spaces outside the engine room are explained |
| 2.10 | Ballast main connections to fore and after peak tanks are outlined and procedures for filling and emptying tanks are clarified |
| 2.11 | Examination and repair techniques for fixed pitch and controllable propellers are assessed |
| 2.12 | Dismantling, inspection, repair and re-assembly of thrusters and rudders are explained |
| 2.13 | Methods of performance testing shipboard pumping systems are evaluated |
| 2.14 | Causes of common faults and methods of assessment of shipboard pumping systems are identified |
| 2.15 | Condition monitoring of machinery is compared with planned maintenance systems |
| 2.16 | Causes of damage to and losses of bulk ships and tankers, and appropriate remedies are explained |

		2.17	Types and purpose of special and enhanced surveys are outlined
		2.18	Hull life extension surveys and enhanced survey requirements for tankers and bulk ships are outlined
		2.19	Different methods and applications of welding used in shipbuilding and repair are outlined
		2.20	How materials are joined so that the strength of components is not impaired is confirmed
		2.21	Different methods used to connect aluminium to steel are outlined
3	Analyse factors influencing vessel stability	3.1	Theories and factors affecting trim and stability as well as measures necessary to preserve trim and stability are explained
		3.2	IMO recommendations concerning ship stability are identified
		3.3	Risks associated with carrying thixotropic bulk cargo, deck cargo or grain and consequences of cargo movement or loss are outlined
		3.4	Damage and intact stability requirements for merchant ships, countermeasures for roll-on and roll-off (ro-ro) vessels and damage control assessment following collision or grounding is assessed
		3.5	Operational procedures to minimise and control flooding

			are prepared
		3.6	Stability requirements for routine and emergency dry docking, including stability assessment for the docking duration, are specified
		3.7	Factors causing ship squat and other influences on vessel manoeuvrability are assessed
		3.8	Stability documentation required for different ship types to satisfy International Convention for the Safety of Life at Sea (SOLAS) is identified
		3.9	Intact and damage stability criteria are explained
		3.10	Use of stabilisers is explained
		3.11	Bilge keels and fin type stabilisers are compared and contrasted
		3.12	How stabilisers are attached to the hull is explained
		3.13	Hull stiffening requirements for fin and bilge keel types is explained
4	Analyse IMDG Code requirements	4.1	Key principles of IMDG Code are analysed
		4.2	Action plans for managing emergency situations onboard a vessel involving dangerous goods are developed
		4.3	Criteria for evaluating effectiveness of action plans for managing emergency situations onboard a vessel involving dangerous goods are established

		4.4	Requirements of ordering and taking bunkers, as well as discharging to shore side reception facilities, are specified
5	Analyse safe working practices in enclosed spaces	5.1	Function, status and limitations of chemist certificate of compliance is explained
		5.2	Dangers of using cleaning solvents and painting in enclosed spaces using product safety data sheets (SDS)/material safety data sheets (MSDS) and work health and safety (WHS)/occupational health and safety (OHS) guidelines are assessed
6	Analyse dry docking procedures and responsibilities of engineering staff	6.1	Dockyard contract, docking specifications and survey requirements are used to plan preparation of vessel for docking, explaining variations required for emergency docking
		6.2	Dock work schedules, responsibilities for engineering personnel and procedures for dock entry, duration and re-floating are prepared
		6.3	Inspection and maintenance procedures for hull and machinery items in dock are explained
		6.4	In-water hull cleaning methods and preparation essential for in-water surveys are evaluated
		6.5	Types and application procedures of coatings used to protect ship hulls and tanks are

			identified
		6.6	Procedures for vessel layup to satisfy class, insurance, owner and statutory requirements are prepared
		6.7	Inspection and reactivation processes after prolonged layup are outlined
7	Analyse shipboard vibration	7.1	Appropriate terms are applied when describing vibration
		7.2	Influence of materials, construction, loading patterns and ship type on natural hull vibration patterns is assessed
		7.3	Significance of hull response to excitation by sea state, machinery and propulsion systems is explained
		7.4	Methods of prediction and in-service assessment of resonant vibration are evaluated
		7.5	Vibration-related structural and equipment damage and failure is identified
		7.6	Solutions to troublesome vibration are proposed
		7.7	Acceptable vibration limits using relevant standards are established
8	Analyse vessel bunkering requirements	8.1	Requirements for bunkering orders are analysed
		8.2	Procedures for taking bunkers are analysed

		8.3	Bunkering guidelines for spills and fire are analysed
		8.4	Methods and requirements for sampling fuels are analysed
		8.5	Procedures for assessing the quality and quantity of fuels are explained
		8.6	Communication requirements and procedures during bunkering operations are analysed
		8.7	Methods for monitoring levels and facilitating changeover of tanks are analysed
9	Outline maintenance, repair and safe working practices associated with lifting and lifesaving equipment	9.1	Safe working practices applicable to cranes, chain blocks, items of loose gear and other lifting equipment are identified
		9.2	Safety and protective devices used in conjunction with lifting gear are identified
		9.3	Means of testing and adjusting lifting gear are confirmed
		9.4	Legislative and regulatory requirements for inspection, storage and maintenance of lifting gear are outlined
		9.5	Purposes and procedures involved in annual and quadrennial surveys of cargo gear are clarified
		9.6	Procedures for safe working load (SWL) and proof load tests, including lifeboat

			launching gear, are clarified
		9.7	Safe working practices applicable to rigging and lifting heavy items during maintenance and repair are identified
		9.8	Installation, operation and maintenance of lifesaving appliances and launching equipment are outlined
		9.9	Safety and protective devices associated with lifesaving appliances and launching equipment are confirmed
10	Outline operation of an inert gas system for a tanker	10.1	Construction, operation and maintenance of individual components of inert gas system (IGS) are explained
		10.2	Mandatory controls, alarms and cut-outs are identified
11	Outline components of vessels, frame and deck	11.1	Correct terms to describe size and shape of vessels are used
		11.2	Correct terms to describe structural components of vessels are used
		11.3	Correct terms to describe size or cargo carrying capacity of vessels are used
		11.4	Online and other sources of information on size, shape and structural components of vessels are accessed
		11.5	Longitudinal, transverse and combined framing are compared and contrasted in

			relation to ship strength
		11.6	Position, purpose and construction of a deep frame are explained
		11.7	Transition methods from one frame type to another are outlined
		11.8	How the strength of frames is maintained when connecting to deck beams and other strength members is explained
		11.9	How stress raisers are reduced around hatchways, door openings, forecastle, bridge structure, watertight doors and gastight doors is explained
		11.10	Bilge keels structure with particular reference to fitment to hull is outlined and purpose for this type of fitting is explained
		11.11	Classification requirements and restrictions of sheer strake, keel strake and garboard strake are examined
		11.12	Requirements for use of suction and discharge valves and fittings in the shell above and below the waterline are outlined
		11.13	Strength members required for deck machinery are outlined
12	Explain static and dynamic forces and moments exerted on hull of a vessel	12.1	Correct terms to describe effects of forces exerted on hull are used

		12.2	Various forces acting on the vessel are analysed
		12.3	Stresses on various components of the hull are compared as a result of these forces
		12.4	Differentiation is made between panting and pounding forces
		12.5	How forepeak sections are strengthened to resist panting and pounding forces is explained
		12.6	Anchor and cable arrangements in forepeak tank are explained
		12.7	Strength members in afterpeak sections are outlined
		12.8	Different rudder support arrangements are clarified
13	Explain how vessel structure is designed to resist distortion	13.1	Scantlings are defined
		13.2	Classification society rules for determining scantling sizes are identified
		13.3	Main strength members of vessel hull are identified
		13.4	Importance of maintaining integrity of principal strength members is explained
14	Explain bottom structure, forepeak and afterpeak of vessels	14.1	Differentiation is made between different types of keel construction

		14.2	Advantages and disadvantage of duct keel in relation to ship strength are explained
		14.3	How safe access to the duct keel is obtained, is outlined
		14.4	Longitudinally framed double bottom construction is distinguished from a transversely framed double bottom construction
		14.5	Differentiation is made between bracket floors and plate floors
		14.6	Structural requirements for supporting different types of main engines are outlined
		14.7	Classification society rules for construction of forepeak and afterpeak sections are explained
15	Explain construction of watertight bulkheads	15.1	Purpose of bulkheads is stated
		15.2	Minimum number of bulkheads and their locations are determined
		15.3	Bulkhead is sketched showing construction and attachment to hull
		15.4	Purpose, construction and location of collision bulkheads is outlined
		15.5	Test procedures for bulkheads are clarified
		15.6	How strength is maintained in openings is explained

		15.7	Requirements for penetration of collision bulkhead are stated
		15.8	Situations in which non-watertight bulkheads are fitted are identified
16	Outline vessel ventilation systems	16.1	Different types of ventilation systems are clarified
		16.2	Why ventilator cowls are required is explained

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Unit Mapping Information

This unit replaces and is not equivalent to MARL036 Demonstrate advanced knowledge of ship operation and maintenance.

This unit replaces and is not equivalent to MARL023 Demonstrate basic knowledge of ship operation and maintenance.

This unit replaces and is not equivalent to MARL022 Demonstrate basic knowledge of ship construction.

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARL053 Demonstrate advanced knowledge of ship operations and maintenance

Modification History

Release 3. This is the third release of this unit of competency in the MAR Maritime Training Package:

- Minor change to unit application.

Release 2. This is the second release of this unit of competency in the MAR Maritime Training Package:

- Minor grammatical correction to numbering in performance criteria.

Release 1. This is the first release of this unit of competency in the MAR Maritime Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least one occasion and include:

- accessing information required in routine and emergency situations
- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements and work practices
- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- detecting and identifying cause of machinery malfunctions and correct faults, including:
 - detecting machinery malfunctions, location of faults and actions to prevent damage
 - inspecting and adjusting equipment
 - non-destructive examination
- ensuring currency of relevant legislative and regulatory knowledge
- ensuring safe working practices in accordance with ship safety management system (SMS)
- explaining advanced concepts of ship operation and maintenance
- identifying hazards and risks, and determining appropriate ways of responding to hazards, malfunctions and emergency situations and daily operations
- identifying methods and procedures needed to perform duties, such as preparing for dry docking and statutory surveys and other duties, on commercial vessels
- identifying, interpreting and processing complex numerical and graphical information required to analyse engineering functions and shipboard engineering-related problems in routine and emergency situations
- imparting knowledge and ideas through verbal, written and visual means
- planning and organising the resources needed to establish and maintain SMS on a tanker or

gas carrier

- reading and interpreting legislation and regulations related to maritime operations
- reading and interpreting written instructions, procedures and information relevant to duties of an Engineer Class 2.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- areas covered by classification and surveys, including:
 - automation
 - boilers/pressure vessels
 - cargo gear
 - hull
 - machinery
 - specific notations for cargo pumping arrangements for tankers
 - tail shaft
- areas of a vessel covered by statutory surveys, including links with classification society requirements for endorsement of class certificates
- Australian maritime legislation key provisions, including:
 - Australian Maritime Safety Authority (AMSA) legislation
 - levy legislation
 - marine pollution legislation
 - navigation legislation
 - other relevant legislation
 - shipping industry legislation
 - shipping registration legislation
- classification societies
- classification surveys, including:
 - dry dock and in water bottom surveys
 - hull work
 - machinery
 - pipe work
 - propellers
 - pumping systems
- Code of Safe Working Practice for Australian Seafarers key provisions, including:
 - anchoring, docking and mooring
 - carriage of dangerous goods
 - entering and working in enclosed or confined spaces
 - general duties and responsibilities

- general provisions
- manual lifting and carrying
- painting
- permit to work systems
- reporting of accidents
- safe access to ship
- safe movement about the ship
- safety in living accommodation
- shipboard:
 - emergencies and emergency equipment
 - health and safety
 - specific vessel types
 - tools and materials
 - upkeep of wire and fibre ropes
 - welding flame cutting and other hot work
- working:
 - aloft and over the side
 - in galleys, pantries and other food handling areas
 - in machinery spaces
 - with dangerous and irritating substances and radiations
 - with electricity and electrical equipment
- communication methods, including:
 - checklists
 - rate
 - safety
 - stock methods
 - two-way radio
- dry docking:
 - procedures
 - responsibilities of engineering staff
- enclosed spaces
- emergency situations, including:
 - dangerous goods
 - disposal of dangerous/toxic materials
 - firefighting
 - first aid
 - hazard reduction
 - reporting
- Flag State responsibilities
- heavy items, including:

- hatches
- large movable structures
- stern doors
- hierarchy and organisational structure of shipboard personnel
- inert gas system for tankers
- inspection and maintenance procedures for hull and machinery items in dock, including:
 - hull coating systems
 - measurement and evaluation of clearances
- International Maritime Dangerous Goods (IMDG) Code requirements and principles, including:
 - dangerous goods packaging/tanks which are of appropriate strength and which will prevent goods escaping
 - emergency response advice for dangerous goods involved in a fire or spillage on board ship
 - grouping dangerous goods together based on hazards they present in transport (classification)
 - hazard warning labels and other identifying marks to identify dangerous goods in transport
 - principles for ensuring dangerous goods that will react dangerously together are kept apart
 - principles for where to place dangerous goods onboard ship to ensure safe transport
 - standard documentation to be provided when dangerous goods are being transported
- international maritime law, conventions and regulations, including:
 - certificates and other documents to be carried onboard ships by international conventions
 - International Convention for the Prevention of Pollution from Ships (MARPOL)
 - International Convention for the Safety of Life at Sea (SOLAS)
 - International Convention on Load Lines 1966
 - International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers
 - international health regulations
 - international instruments affecting safety of ships, passengers, crew or cargo
 - International Safety Management (ISM) Code
 - Maritime Labour Convention (MLC) 2006
- ISM Code related to safe work practices, operation and maintenance, including:
 - managing safe and effective maintenance and repair procedures
 - planning maintenance, including statutory and class verifications
 - planning repairs
- key international and Australian Standards relating to shipping
- key shipping authorities and organisations
- maintenance and repairs, including:
 - hull, pumping systems, propellers, machinery and other items satisfying maintenance of

class

- lifting and lifesaving equipment
- maintenance strategies relating to classification surveys
- maritime communication techniques
- methods of minimising and controlling internal and external hull corrosion, including:
 - bacterial corrosion of bilges and fuel tanks
 - cathodic protection
 - coating systems
 - surface preparation techniques
- methods of performance testing shipboard pumping systems, including:
 - bilge and ballast systems
 - hydraulic deck machinery
- operational procedures to minimise and control flooding, including:
 - actions to ensure watertight integrity of ship
 - rules relating to watertight doors
- other systems of spaces outside engine room, including:
 - holds
 - pump rooms
 - spaces forward of the collision bulkhead
- planned maintenance systems, including guidelines for classification society approval of substitution for continuous machinery surveys
- Port State Control (PSC)
- properties of hull grades of steel including:
 - repair techniques and limitations
 - weld ability
 - welder qualification tests
- regulatory framework impacting on commercial shipping operations
- relevant sections of maritime regulations, codes and conventions related to tankers and gas carriers
- repair and maintenance methods for hull work, pipe work and pumping systems, machinery, propellers and other items to satisfy maintenance of class position
- safe practices for working with lifting gear
- safe working practices associated with lifting and lifesaving equipment
- safe working practices in enclosed or confined spaces
- shipboard enclosed space hazards, including:
 - engulfment
 - explosion
 - fire
 - lack of oxygen
 - re-entry of compartments after a major fire
 - release of fixed firefighting medium

- toxic gases
- shipboard pumping, including:
 - bilge and ballast systems, including predictive health monitoring
 - hydraulic deck machinery
 - prevention of pollution of the sea by oil
 - sewage and sludge
- shipboard vibration
- solutions, including:
 - damping
 - design
 - detuning
 - modification of ship:
 - operation
- specific notations
- stability requirements for routine and emergency dry docking, including stability assessment for docking duration
- statutory survey requirements
- survey methods, including:
 - alternative
 - continuous
 - special surveys
- terminology relating to the structure, capacities and operations of various types of tankers and gas carriers
- terms, including:
 - amplitude
 - anti-node
 - frequency
 - mode
 - node
 - resonance
- types of ships and key features, including:
 - bulk carrier
 - container
 - general dry cargo
 - passenger
 - ro-ro
 - tanker or gas carrier
- vessel stability and loss of metacentric height (GM), including:
 - derrick hook loads
 - free surface effect

- watertight integrity
- WHS/OHS legislation and policies.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Practical assessment must occur in a workplace, or realistic simulated workplace, under the normal range of workplace conditions.

Simulations and scenarios may be used where situations cannot be provided in the workplace or may occur only rarely, in particular for situations relating to emergency procedures and adverse weather conditions where assessment would be unsafe, impractical or may lead to environmental damage.

Resources for assessment must include access to:

- applicable documentation, such as legislation, regulations, codes of practice, workplace procedures and operational manuals
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>