



Australian Government

**MARL6023A Demonstrate advanced
knowledge of ship operation and
maintenance**

Release 1

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Modification History

Release 1

This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to ensure that vessels comply with regulatory and survey requirements 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 code requirements; safe working practices in enclosed or confined spaces; dry docking procedures and responsibilities of engineering staff; and shipboard vibration.

Application of the Unit

This unit applies to the work of a Marine Engineer Class 1 on commercial vessels of unlimited propulsion power and forms part of the requirements for the Certificate of Competency Marine Engineer Class 1 issued by the Australian Maritime Safety Authority (AMSA).

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

1 Analyse regulatory framework impacting on commercial shipping operations

- 1.1 Functions of International Maritime Organization (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 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 is explained
- 1.5 Role of Flag State administrations, Port State Control and other methods of implementation and enforcement of international agreements and conventions is 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, IACS and Memorandum of Agreement with Flag States is analysed
- 1.8 Role of ship owners and ship management companies regarding 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 Standards of Training, Certification & Watchkeeping (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
- 2 Analyse maintenance strategies relating to classification surveys**
- 2.1 Common **areas covered by classification** surveys are analysed
- 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
- 3 Analyse statutory survey requirements**
- 3.1 **Areas of vessel covered by statutory surveys** are identified
- 3.2 Statutory requirements for change of Flag, owner, and term expiry during layup are identified
- 3.3 Records and documentation required for statutory surveys are identified
- 3.4 Load line measurements and conditions of freeboard assignment are analysed
- 3.5 Key areas of maintenance and testing of load line items and actions for addressing identified maintenance requirements and defects are identified
- 3.6 Areas covered by safety construction surveys and associated faults, maintenance and repairs are identified
- 3.7 Procedures for planning safety equipment surveys and actions for addressing identified maintenance requirements and defects are analysed
- 3.8 Requirements for survey preparation under MARPOL are analysed
- 3.9 Survey requirements for safety radio, chemical and gas tanker certificates of fitness, and passenger ship safety certificates are analysed
- 3.10 Application of Port State Control surveys, Flag State jurisdiction and IMO guidelines in relation to vessel detention and identification of substandard ships are

- analysed
- 4 Analyse factors influencing vessel stability**
- 4.1 *Loss of GM* due to addition, removal or shift of mass on board is calculated
- 4.2 Action to be taken with partial loss of intact buoyancy is specified
- 4.3 Angle of Loll is explained
- 4.4 Causes of vessel instability during ballasting, bunkering, cargo pumping and other daily routines and possible corrective and avoidance measures are assessed
- 4.5 Risks associated with carrying thixotropic bulk cargo, deck cargo or grain and consequences of cargo movement or loss are outlined
- 4.6 Damage and intact stability requirements for merchant ships, countermeasures for Ro-Ro vessels and damage control assessment following collision or grounding is assessed
- 4.7 *Operational procedures to minimise and control flooding* are prepared
- 4.8 Stability requirements for routine and emergency dry docking, including stability assessment for the docking duration, are specified
- 4.9 Factors causing ship squat and other influences on vessel manoeuvrability are assessed
- 5 Maintain class certification**
- 5.1 Methods for repair and maintenance are analysed
- 5.2 *Properties* of ordinary and high tensile hull grades of steel are analysed
- 5.3 Processes and materials used in underwater hull repairs are assessed
- 5.4 *Methods of minimising and controlling internal and external hull corrosion*, including bacterial corrosion of bilges and fuel tanks, are evaluated
- 5.5 Examination and repair techniques for fixed pitch and controllable propellers are assessed
- 5.6 Dismantling, inspection, repair and re-assembly of thrusters and rudders is explained

- 5.7 ***Methods of performance testing shipboard pumping systems*** are evaluated
- 5.8 Causes of common faults and methods of assessment of shipboard pumping systems are identified
- 5.9 Condition monitoring of machinery is compared with ***planned maintenance systems***
- 5.10 Causes of damage to and losses of bulk ships and tankers, and appropriate remedies are explained
- 5.11 Types and purpose of special and enhanced surveys are outlined
- 6 Analyse International Maritime Dangerous Goods (IMDG) Code requirements**
 - 6.1 ***Key principles of IMDG Code*** are analysed
 - 6.2 Action plans for managing emergency situations on board a vessel involving dangerous goods are developed
 - 6.3 Criteria for evaluating effectiveness of action plans for managing emergency situations on board a vessel involving dangerous goods are established
- 7 Analyse safe working practices in enclosed spaces**
 - 7.1 ***Hazards of shipboard enclosed spaces*** are analysed
 - 7.2 Methods and regulatory requirements for testing atmosphere in enclosed spaces are outlined and evaluated
 - 7.3 Function, status and limitations of chemist certificate of compliance is explained
 - 7.4 Limits of exposure to common atmospheric hazards are stated
 - 7.5 Typical safe entry permit for enclosed spaces, covering hot work and cleaning, evacuation procedures, training and contingency evaluation is prepared
 - 7.6 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

- 8 Analyse dry docking procedures and responsibilities of engineering staff**
- 8.1 Dockyard contract, docking specifications and survey requirements are used to plan preparation of vessel for docking, explaining variations required for emergency docking
 - 8.2 Dock work schedules, responsibilities for engineering personnel and procedures for dock entry, duration and refloating are prepared
 - 8.3 *Inspection and maintenance procedures for hull and machinery items in dock* are explained
 - 8.4 In-water hull cleaning methods and preparation essential for in-water surveys is evaluated
 - 8.5 Types and application procedures of coatings used to protect ship hulls and tanks are identified
 - 8.6 Procedures for vessel layup to satisfy class, insurance, owner and statutory requirements are prepared
 - 8.7 Inspection and reactivation processes after prolonged layup are outlined
- 9 Analyse shipboard vibration**
- 9.1 Appropriate *terms* are applied when describing vibration
 - 9.2 Influence of materials, construction, loading patterns and ship type on natural hull vibration patterns is assessed
 - 9.3 Significance of hull response to excitation by sea state, machinery and propulsion systems is explained
 - 9.4 Methods of prediction and in service assessment of resonant vibration are evaluated
 - 9.5 Vibration related structural and equipment damage and failure is identified
 - 9.6 *Solutions* to troublesome vibration are proposed
 - 9.7 Acceptable vibration limits using relevant standards are established
- 10 Analyse vessel bunkering requirements**
- 10.1 Requirements for bunkering orders are analysed
 - 10.2 Procedures for taking bunkers are analysed

- 10.3 Bunkering guidelines for spills and fire are analysed
- 10.4 Methods and requirements for sampling fuels are analysed
- 10.5 Procedures for assessing the quality and quantity of fuels are explained
- 10.6 **Communication** requirements and procedures during bunkering operations are analysed
- 10.7 Methods for monitoring levels and facilitating changeover of tanks are analysed

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required Skills:

- Access information required in routine and emergency situations
- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain advanced concepts of ship operation and maintenance, and impart knowledge and ideas verbally, in writing and visually
- Identify, interpret and process complex numerical and graphical information required to analyse marine engineering functions and shipboard engineering related problems
- Identify hazards and risks, and determine appropriate ways of responding to hazards, malfunctions and emergency situations
- Identify methods and procedures needed to perform duties such as preparing for dry-docking and statutory surveys
- Read and interpret legislation and regulations related to maritime operations

Required Knowledge:

- Australian maritime legislation
- Classification societies
- Dry docking:
 - procedures
 - responsibilities of engineering staff
- Enclosed spaces
- Flag State responsibilities
- Hierarchy and organisational structure of shipboard personnel
- IMDG Code requirements
- Key international and Australian standards relating to shipping
- Key shipping authorities and organisations
- Maintenance strategies relating to classification surveys
- MARPOL
- Port State Control
- Regulatory framework impacting on commercial shipping operations
- 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 in enclosed or confined spaces
- Shipboard vibration

- Statutory survey requirements
- Types of ships and key features of ships
- Vessel stability
- Watertight integrity
- WHS/OHS legislation and policies

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, the required skills and knowledge, the range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the Elements, Performance Criteria, Required Skills, Required Knowledge and include:

- developing effective planning documents
- providing the required amount of detail in reports
- ensuring currency of relevant legislative and regulatory knowledge.

Context of and specific resources for assessment

Performance is demonstrated consistently over time and in a suitable range of contexts.

Resources for assessment include access to:

- industry-approved marine operations site where advanced knowledge of ship operation and maintenance can be demonstrated
- technical reference library with current publications on commercial shipping
- tools, equipment and personal protective equipment currently used in industry
- relevant regulatory and equipment documentation that impacts on work activities
- range of relevant exercises, case studies and/or other simulated practical and knowledge assessments
- appropriate range of relevant operational situations in the workplace.

In both real and simulated environments, access is required to:

- relevant and appropriate materials and equipment
- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals.

Method of assessment

Practical assessment must occur in an:

- appropriately simulated workplace environment and/or
- appropriate range of situations in the workplace.

A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate to this unit:

- direct observation of the candidate demonstrating advanced knowledge of ship operation and maintenance

- direct observation of the candidate applying relevant WHS/OHS requirements and work practices.

Guidance information for assessment

Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

In all cases where practical assessment is used it should be combined with targeted questioning to assess Required Knowledge.

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

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below.

Key provisions of Australian maritime legislation includes:

- AMSA legislation
- Levy legislation
- Marine pollution legislation
- Navigation legislation
- Shipping industry legislation
- Shipping registration legislation
- Other relevant legislation

Key provisions of the Code of Safe Working Practice for Australian Seafarers includes:

- Anchoring, docking and mooring
- Carriage of dangerous goods
- Entering and working in enclosed or confined spaces
- General provisions
- General duties and responsibilities
- 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
 - with electricity and electrical equipment
 - with dangerous and irritating substances and radiations
 - in machinery spaces
 - in galleys, pantries and other food handling areas

Areas covered by classification must

- Specific notations for cargo pumping arrangements for tankers

include:

Areas covered by classification may include:

- Automation
- Boilers/pressure vessels
- Cargo gear
- Hull
- Machinery
- Tailshaft

Survey methods may include:

- Continuous
- Alternative
- Special surveys

Classification surveys must include:

- Hull work
- Machinery
- Pipe work
- Pumping systems
- Propellers

Areas of vessel covered by statutory surveys must include:

- Links with classification society requirements for endorsement of class certificates

Loss of GM must include:

- Derrick hook loads
- Free surface effect

Operational procedures to minimise and control flooding must include:

- Action to ensure watertight integrity of ship
- Rules relating to watertight doors

Stability requirements for routine and emergency dry docking must include:

- Stability assessment for docking duration

Properties must include:

- Repair techniques and limitations
- Weld ability
- Welder qualification tests

Methods of minimising and controlling internal and external hull corrosion must include:

- Bacterial corrosion of bilges and fuel tanks

Methods of performance testing shipboard pumping systems must include:

- Bilge and ballast systems
- Hydraulic deck machinery

Shipboard pumping systems must include:

- Bilge and ballast systems, including predictive health monitoring
- Hydraulic deck machinery

Planned maintenance systems must include:

- Guidelines for classification society approval of substitution for continuous machinery surveys

Principles of IMDG Code may

- Contains dangerous goods packagings/tanks

- include:
- which are of appropriate strength and which will prevent goods escaping
 - Groups dangerous goods together based on hazards they present in transport (classification)
 - Lays down principles for ensuring dangerous goods that will react dangerously together are kept apart
 - Lays down principles for where to place dangerous goods on board ship to ensure safe transport
 - Provides emergency response advice for dangerous goods involved in a fire or spillage on board ship
 - Requires standard documentation to be provided when dangerous goods are being transported
 - Uses hazard warning labels and other identifying marks to identify dangerous goods in transport
- Emergency situations may include:
- Dangerous goods
 - Disposal of dangerous/toxic materials
 - Firefighting
 - First aid
 - Hazard reduction
 - Reporting
 - Re-entry of compartments after a major fire
 - Release of a fixed firefighting medium
- Hazards of shipboard enclosed spaces must include:
- Engulfment
 - Explosion
 - Fire
 - Lack of oxygen
 - Toxic gases
 - Hull coating systems
 - Measurement and evaluation of clearances
- Hazards of shipboard enclosed spaces may include:
- Engulfment
 - Explosion
 - Fire
 - Lack of oxygen
 - Toxic gases
 - Hull coating systems
 - Measurement and evaluation of clearances
- Inspection and maintenance procedures for hull and machinery items in dock must include:
- Measurement and evaluation of clearances
- Terms may include:
- Amplitude
 - Anti-node
 - Frequency
 - Mode
 - Node
 - Resonance
- Solutions may include:
- Damping
 - Detuning
 - Modification of ship:

- Communication may include:
- design
 - operation
 - Checklist
 - Rate
 - Safety
 - Stock method
 - Two way radio

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering