



**Australian Government**

# **MARL048 Demonstrate advanced knowledge of marine auxiliary machinery and systems**

**Release: 1**

# **MARL048 Demonstrate advanced knowledge of marine auxiliary machinery and systems**

## **Modification History**

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 operate and maintain auxiliary machinery and associated systems onboard a commercial vessel. This includes evaluating ship systems, assessing lubricants and lubricant contamination, and analysing the operation of major items of marine auxiliary machinery.

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.

## **Pre-requisite Unit**

Not applicable.

## **Competency Field**

L – Engineering

## Unit Sector

Not applicable.

## Elements and Performance Criteria

### ELEMENTS

### PERFORMANCE CRITERIA

Elements describe the essential outcomes.

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

|          |                                 |            |                                                                                                                                       |
|----------|---------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>Evaluate ship systems</b>    | <b>1.1</b> | Conventional systems are analysed from ship layout drawings and performance data                                                      |
|          |                                 | <b>1.2</b> | Viability and potential problems of new systems and advanced specialist vessels are evaluated                                         |
|          |                                 | <b>1.3</b> | Performance of different pumps and heat exchangers is assessed, and their applications are compared for different purposes            |
|          |                                 | <b>1.4</b> | Performance of shipboard pollution control equipment is evaluated                                                                     |
| <b>2</b> | <b>Assess materials failure</b> | <b>2.1</b> | Type of materials failure that impact on marine auxiliary components is analysed, including metallic and non-metallic                 |
|          |                                 | <b>2.2</b> | Ideal properties of materials required for components of auxiliary machinery are analysed                                             |
|          |                                 | <b>2.3</b> | Repair methods used for auxiliary machines and constraints on engineering staff engaged in repairing auxiliary machinery are analysed |
|          |                                 | <b>2.4</b> | Type and purpose of destructive and non-destructive testing of materials are compared                                                 |

|          |                                                      |            |                                                                                                                                                                |
|----------|------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3</b> | <b>Analyse lubrication</b>                           | <b>3.1</b> | Mechanism of lubrication between two surfaces is explained                                                                                                     |
|          |                                                      | <b>3.2</b> | Factors influencing good lubrication are identified and evaluated                                                                                              |
|          |                                                      | <b>3.3</b> | Different types of lubrication applied to marine machinery are compared and contrasted                                                                         |
|          |                                                      | <b>3.4</b> | Relative advantages of synthetic lubricants and mineral oils are assessed                                                                                      |
|          |                                                      | <b>3.5</b> | Methods of assuring quality of lubrication are identified                                                                                                      |
|          |                                                      | <b>3.6</b> | Procedures for onboard testing for fuels and lubricants are clarified                                                                                          |
|          |                                                      | <b>3.7</b> | Laboratory tests that may be conducted on fuels and lubricants and how results can be interpreted and utilised as part of a maintenance program are detailed   |
| <b>4</b> | <b>Analyse fuel and lubricating oil contaminants</b> | <b>4.1</b> | Symptoms, effects and possible remedial actions for different types of contaminants in fuel are evaluated                                                      |
|          |                                                      | <b>4.2</b> | Types of contaminants that affect lubricants and remedial actions required for different forms of contamination are identified, including bacterial infections |
|          |                                                      | <b>4.3</b> | Methods used to counter poor quality fuels and to improve properties of lubricating oils are assessed                                                          |
|          |                                                      | <b>4.4</b> | Safety measures to be applied when fuels are found to be                                                                                                       |

|   |                                                                                                              |     |                                                                                                                                                                       |
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|   |                                                                                                              |     | outside class requirements are identified                                                                                                                             |
|   |                                                                                                              | 4.5 | Operation of centrifugal separators is outlined and factors that affect optimum separation are analysed                                                               |
|   |                                                                                                              | 4.6 | Procedures for dealing with contamination of oils by water, fuel or solid debris, including recognition of dangerous levels and possible consequences, are determined |
| 5 | <b>Analyse shafting systems, bearings, couplings, clutches and shaft seals that form transmission system</b> | 5.1 | Different types and methods of checking alignment and wear of shafting, shaft bearings and thrust blocks are identified                                               |
|   |                                                                                                              | 5.2 | Assembly and dismantling procedures for muff and flange type couplings are compared and contrasted                                                                    |
|   |                                                                                                              | 5.3 | Different types, methods of operation and maintenance requirements of clutches are compared                                                                           |
|   |                                                                                                              | 5.4 | Different types, maintenance requirements and operation of stern tubes, tail shaft seals and stern bearing lubrication systems under adverse conditions are evaluated |
|   |                                                                                                              | 5.5 | Mounting and unmounting propeller to tail shaft is clarified                                                                                                          |
| 6 | <b>Analyse steering gears and controllable pitch propeller (CPP)</b>                                         | 6.1 | Regulatory requirements for steering gears of different types of vessels are identified                                                                               |

|                |                                            |             |                                                                                                                                                                  |
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| <b>systems</b> |                                            |             |                                                                                                                                                                  |
|                |                                            | <b>6.2</b>  | Operation of various types of steering gear arrangements are analysed                                                                                            |
|                |                                            | <b>6.3</b>  | Operation and performance of CPP and fixed pitch systems are compared and contrasted                                                                             |
|                |                                            | <b>6.4</b>  | Modes of operation of CPP systems are explained                                                                                                                  |
|                |                                            | <b>6.5</b>  | Effects and countermeasures, in the event of failure in the control system or seals of a CPP system, are identified                                              |
|                |                                            | <b>6.6</b>  | Construction, installation and operation of hydraulic gear, stabilisers and bow thrusters are identified                                                         |
|                |                                            | <b>6.7</b>  | Normal alarms and safety devices fitted to steering gears for all classes of vessels are identified, including analysis of auto and manual changeover procedures |
|                |                                            | <b>6.8</b>  | Construction, installation and operation of hydraulic steering gear is explained                                                                                 |
|                |                                            | <b>6.9</b>  | Construction and operation of stabilisers is explained                                                                                                           |
|                |                                            | <b>6.10</b> | Construction and operation of bow thrusters is explained                                                                                                         |
| <b>7</b>       | <b>Analyse marine transmission systems</b> | <b>7.1</b>  | Operation and performance of different marine transmission systems are compared and contrasted                                                                   |
|                |                                            | <b>7.2</b>  | Procedure for inspecting a set of reduction gears from a propulsion system is analysed                                                                           |

|          |                                                                            |            |                                                                                                                                                              |
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|          |                                                                            | <b>7.3</b> | Types and locations of faults that may occur in gearing systems and repair options available are analysed                                                    |
| <b>8</b> | <b>Analyse marine air compressors</b>                                      | <b>8.1</b> | Procedures for assessing performance of reciprocating and rotary compressors by output and condition monitoring techniques are explained                     |
|          |                                                                            | <b>8.2</b> | Effects of multi-staging, inter-cooling and clearance volume are explained                                                                                   |
|          |                                                                            | <b>8.3</b> | Importance of all fittings and safety devices in compressed air system is explained                                                                          |
|          |                                                                            | <b>8.4</b> | Full automatic operation of starting air compressors is explained                                                                                            |
|          |                                                                            | <b>8.5</b> | Air receivers are inspected and maintained                                                                                                                   |
| <b>9</b> | <b>Evaluate shipboard refrigeration and air conditioning (RAC) systems</b> | <b>9.1</b> | Principle of air conditioning systems is explained and how ideal conditions are achieved in air conditioned space is analysed                                |
|          |                                                                            | <b>9.2</b> | Automatic operation of a typical marine provision fridge plant capable of maintaining different temperatures in different cold rooms is analysed             |
|          |                                                                            | <b>9.3</b> | Hazards associated with chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), and regulations controlling their production and usage are analysed |
|          |                                                                            | <b>9.4</b> | Procedures for evacuation and recovery of refrigerants from the                                                                                              |

|           |                                                                            |             |                                                                                                               |
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|           |                                                                            |             | system are outlined                                                                                           |
|           |                                                                            | <b>9.5</b>  | Symptoms, effects and remedial action for common faults in RAC systems are assessed                           |
| <b>10</b> | <b>Evaluate operation of inert gas systems on crude oil tankers</b>        | <b>10.1</b> | Location and functions of all components, fittings and safety devices in an inert gas system are identified   |
|           |                                                                            | <b>10.2</b> | Operation of a typical inert gas system found on crude oil tankers is analysed                                |
|           |                                                                            | <b>10.3</b> | Operation and maintenance requirements of inert gas systems are explained                                     |
| <b>11</b> | <b>Evaluate plant efficiency and relate problems in a turbo alternator</b> | <b>11.1</b> | Operating parameters and associated protections for turbo alternator systems are analysed                     |
|           |                                                                            | <b>11.2</b> | Procedure for assessing efficiency of auxiliary steam turbines is explained by analysing measured parameters  |
|           |                                                                            | <b>11.3</b> | Methods of steam and air leak detection in turbo alternator systems are compared                              |
|           |                                                                            | <b>11.4</b> | Effects of fouling of condenser and changes in sea water temperature in turbo alternator systems are analysed |
|           |                                                                            | <b>11.5</b> | Process of warming-through and shutting down turbine plant is explained                                       |
|           |                                                                            | <b>11.6</b> | Maintenance requirements for achieving optimum performance of an auxiliary steam turbine plant are outlined   |
| <b>12</b> | <b>Assess operational</b>                                                  | <b>12.1</b> | Procedure for evaluating pump or pumping system, including                                                    |

|           |                                                                            |             |                                                                                                                                                                               |
|-----------|----------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <b>problems with pumps and pumping systems handling sea water</b>          |             | heat exchangers and methods of locating cause of problems that affect output and performance, is clarified                                                                    |
|           |                                                                            | <b>12.2</b> | Operation of a self-priming system used on bilge, ballast or cargo pumping arrangements is explained                                                                          |
|           |                                                                            | <b>12.3</b> | Different types of distillation plants used on ships are compared and contrasted taking into account operation, performance, problems and applications                        |
|           |                                                                            | <b>12.4</b> | Main reasons for corrosion in seawater systems and regions most affected are explained                                                                                        |
|           |                                                                            | <b>12.5</b> | Operation of corrosion prevention systems fitted to pumping systems is assessed                                                                                               |
| <b>13</b> | <b>Outline pollution prevention regulations and operation of equipment</b> | <b>13.1</b> | International Convention for the Prevention of Pollution from Ships (MARPOL) regulations are identified and their implications for Engineers and ship operators are explained |
|           |                                                                            | <b>13.2</b> | Operation of modern oily water separators, oil content monitors and how they comply with MARPOL regulations are explained                                                     |
|           |                                                                            | <b>13.3</b> | Operation of typical sewage plants and regulations controlling their usage are explained                                                                                      |
|           |                                                                            | <b>13.4</b> | Operation of incinerators, material that may legally be burned and monitoring devices is explained                                                                            |

|           |                                                       |             |                                                                                                                               |
|-----------|-------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>14</b> | <b>Explain basic operation of marine gas turbines</b> | <b>14.1</b> | Basic flow of air and gas through a simple cycle marine gas turbine is outlined                                               |
|           |                                                       | <b>14.2</b> | Materials and construction of compressor, combustion system and turbine in a single and two-shaft design turbine are outlined |
|           |                                                       | <b>14.3</b> | Basic controls required for control and protection of plant are outlined                                                      |
|           |                                                       | <b>14.4</b> | Accessories necessary for safe operation are identified                                                                       |

## 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 MARL025 Demonstrate intermediate knowledge of marine auxiliary machinery and systems.

This unit replaces and is equivalent to MARL031 Demonstrate advanced knowledge of marine auxiliary machinery and systems.

## Links

Companion Volume implementation guide can be found in VetNet - <https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

# **Assessment Requirements for MARL048 Demonstrate advanced knowledge of marine auxiliary machinery and systems**

## **Modification History**

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 and sketch diagrams to interpret and explain testing requirements related to the operation of marine auxiliary machines
- 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
- explaining principles of marine auxiliary machines
- identifying and interpreting complex numerical and graphical information related to operating, maintaining and repairing marine auxiliary machines on commercial vessels
- identifying and rectifying faults and malfunctions in marine auxiliary machines on commercial vessels
- identifying methods, procedures and materials needed for operating, maintaining and repairing marine auxiliary machines on commercial vessels
- imparting knowledge and ideas through verbal, written and visual means
- reading and interpreting complex written information related to the operation, performance and maintenance of marine auxiliary machines, including machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications, and electrical and control circuit diagrams.

## **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:

- auxiliary machinery, including:
  - boiler
  - compressors
  - deck machinery
  - diesel generator
  - evaporators
  - pumps

- refrigerating installation
- separators
- turbo alternators
- components of refrigeration and air conditioning (RAC), including:
  - all fittings
  - safety devices
- constraints, including:
  - class requirements
  - location
  - reliability
  - time
- corrosion prevention systems, including:
  - anodes
  - chemical injection
  - impressed current
  - marine growth inhibiting systems
  - special coatings
- design features and operative mechanism of marine gas turbine and associated auxiliaries, including:
  - material selection and design features of gas turbines
- factors influencing good lubrication, including:
  - alignment
  - condition of bearing surfaces
  - flow rate
  - load
  - purity of lubricant
  - running clearances
  - speed
  - temperature
  - viscosity
- fuel testing, including:
  - density
  - fuel in lubricating oil
  - pour point
  - viscosity
  - water contamination
- fuel and lubricating oil contaminants, including:
  - air entrainment
  - incompatible fluids
  - moisture

- particulate
- fuels and principles of fuel systems
- inert gas systems
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- lube oil, including:
  - coolers
  - filter
  - pump
- marine air compressors and compressed air systems
- marine transmission systems
- materials failure, including non-destructive testing procedures and standards
- nature and causes of typical start-up and shutdown malfunctions of main and auxiliary machinery and associated systems, and available methods for their detection and rectification
- operational characteristics and performance specifications for the different types of auxiliary machinery and associated systems usually found on a commercial vessel, including pumps, air compressors, steering gears, heat exchangers and evaporators
- plant efficiency
- principles and procedures of machinery lubrication
- procedures for carrying out start-up and shutdown of main and auxiliary machinery and associated systems to ensure compliance with company and survey requirements and regulations
- properties of metallic and non-metallic materials
- protections, including:
  - axial displacement
  - condenser condition
  - electrical
  - expansion
  - high air temperature
  - high oil temperature
  - loss of vacuum
  - low oil pressure
  - mechanical
  - overspeed:
    - pressure
    - steam
    - steam condition
    - temperature
    - vibration
- purpose and content of safety data sheets (SDS)/material safety data sheets (MSDS)
- safety, environmental and hazard control precautions and procedures relevant to start-up and shutdown of marine auxiliary machinery and associated systems
- shafting systems, bearings, couplings, clutches and shaft seals and stern tubes that form the

- transmission system
- ship systems
- shipboard RAC systems
- steering gears and controllable pitch propeller (CPP) systems
- turbo alternators
- types of auxiliary machinery and components
- WHS/OHS legislation and policies.

## Assessment Conditions

Assessors must hold credentials specified within the Standard 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:

- relevant documentation, including workplace procedures, regulations, codes of practice and operation manuals
- tools, equipment, materials, personnel and personal protective equipment (PPE) that replicate and are currently used in industry.

## Links

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