Australian Government

MARL6016A Demonstrate intermediate knowledge of marine steam turbines and main boilers

Release 1

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MARL6016A Demonstrate intermediate knowledge of marine steam turbines and main boilers

Modification History

Release 1
This is the first release of this unit.
This unit replaces and is equivalent to TDMMR5807A Manage the operation, monitoring and evaluation of the performance of steam propulsion plant on vessels over 750 kW propulsion power.

Unit Descriptor

This unit involves the skills and knowledge required to operate and maintain main steam propulsion plant and associated control systems on a commercial vessel.

Application of the Unit

This unit applies to the work of a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 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 Evaluate energy balance of steam turbine plant	1.1	Heat losses in a turbine and turbine system are analysed
	1.2	How steam properties change through a turbine are shown on an enthalpy/entropy diagram
	1.3	How air heaters and economisers affect turbine plant efficiency is explained
	1.4	Practical methods of verifying energy losses are detailed
2 Explain construction and operation of feed system	2.1	Operation and components of the complete feed system are outlined
	2.2	Construction, operating principles and maintenance requirements of a regenerative condenser are explained
	2.3	Causes of loss of vacuum are identified
	2.4	Construction and operation of air ejectors, vacuums and extraction pumps are explained
	2.5	Construction and operation of gland condensers, low-pressure heaters, drain coolers and high-pressure heaters are explained
	2.6	General arrangement and construction of turbo-feed pumps is outlined
	2.7	Governor control is explained
	2.8	Operating principles and construction details of de-aerators are explained
3 Explain construction, operation and repair of high-pressure water tube boilers	3.1	Operating principles of high-pressure boilers, including water and gas flow circulation are explained
	3.2	Drum, internal fittings and support and expansion arrangements are outlined
	3.3	Procedures for repairing a membrane wall furnace are clarified
	3.4	Operating principles and construction methods of integral and external superheaters are explained
	3.5	Construction and operation of economisers and air heaters is explained
	3.6	Chemistry of combustion is explained
	3.7	Typical burner register arrangements are outlined

	3.8	Construction, operation and maintenance of boiler gauge glasses and safety valves is explained
	3.9	Operation of boiler control and soot blowing system is detailed
	3.10	Blow-down procedure for a high pressure boiler is prepared
4 Explain requirements for feed water treatment for high-pressure water tube boilers	4.1	How salts are precipitated and how metal is corroded in the boiler and feed system is explained and method of prevention is outlined
	4.2	How oxygen is eliminated in high-pressure boilers is shown
	4.3	How pH is measured and controlled is explained
	4.4	Normal and maximum operating limits for boiler feed water treatment are identified and procedure to follow if these limits are exceeded is clarified
	4.5	Purpose and procedure for different types of tests of boiler water chemistry are explained
5 Explain construction and operation of high-pressure turbines	5.1	Flow of steam through nozzles is analysed, and pressure and velocity compounding are illustrated
	5.2	Construction of blades, bearings, glands, rotors and casings is explained
	5.3	Warming-through procedure prior to start up is explained
	5.4	Routine checks during operation are detailed
	5.5	Emergency operation of plant with one turbine inoperative is outlined
	5.6	Turbine shutdown procedure is clarified
	5.7	Routine checks carried out at a turbine plant survey are detailed
	5.8	Precautions necessary when turbine and gearing casings are open are explained and any repairs or adjustments that may be required are identified
	5.9	Performance of steam plant by routine observations of pressure temperature speed and vibration of turbine, gearing and associated systems is analysed
6 Explain turbine gearing	6.1	Single and double reduction gearing systems are outlined
	6.2	Use of double helical involute gear teeth is explained

arrangements	6.3	Advantages and disadvantages of single and double locked tandem gearboxes are detailed
	6.4	Purpose of fitting a nodal drive in gearing system is clarified
	6.5	Construction and reason for installing flexible couplings in gearing system is explained
	6.6	Layout of a turbo-electric drive is detailed
7 Analyse flow of air and gas through a simple cycle marine gas turbine	7.1	Construction of compressor, combustion system and single and two shaft turbines is explained
	7.2	Necessary controls required for control and protection of plant are confirmed
	7.3	***Accessories*** necessary for safe operation of simple cycle marine gas turbines are listed

Required Skills and Knowledge

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

Required Skills:

- Access diagnostic information related to marine steam turbines
- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain basic operation of marine steam turbines
- Identify and apply relevant solutions to problems that can occur during operation of steam propulsion plant and associated systems on a steam vessel
- Identify and interpret diagnostic information, and perform mathematical calculations related to operating, maintaining and repairing marine steam turbines
- Identify methods, procedures and materials needed for operating, maintaining and repairing marine steam turbines
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret manuals, technical specifications, safety data sheets/material safety data sheets and manufacturer guides related to operating, maintaining and repairing marine steam turbines

Required Knowledge:

- Basic principles of operation of main steam propulsion and auxiliary systems on a steam vessel, including:
  - methods of turbine control, including safety devices
  - symptoms, causes, effects and actions to be taken of defects of auxiliary steam turbines
  - construction and operation of main and auxiliary steam turbines
  - procedures for emergency operation of a steam turbine
- Construction and operation of feed system
- Construction and operation of high-pressure turbines
- Construction, operation and repair of high-pressure water tube boilers
- Energy balance for a steam turbine plant
- Established engineering practice and procedures for operation of shipboard steam propulsion plant and associated systems in warm-through, manoeuvring, start up, normal running, emergency and shut down situations
- Fundamental principles of steam propulsion systems and boilers
- Hazards and problems that can occur during operation of steam propulsion plant and associated systems, and appropriate preventative and remedial action
- Methods of lubricating principal components of a marine steam propulsion turbine and its associated gearing, and evaluating common faults, including common lubrication faults, symptoms, causes, and actions to be taken with such faults

- Operational characteristics and performance specifications for different types of steam propulsion plant and associated systems on a steam vessel of unlimited propulsion power
- Procedures for reading and interpreting readings and indications of performance of steam propulsion plant and associated systems
- Requirements for feed water treatment for high-pressure water tube boilers
- Simple cycle marine gas turbine
- Turbine gearing arrangements
- Types, properties, tests, applications and treatment of fuels, lubricants and solvents/chemicals used on board a steam vessel, including working principles, construction, maintenance and safe operation of centrifuges, filters, and other treatment devices
- Typical operating precautions for steam propulsion plant and associated systems to ensure operational performance is complies with bridge orders, technical specifications, survey requirements, and established safety and anti-pollution rules and regulations
- Units of measurement
- Work health and safety (WHS)/occupational health and safety (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:

- providing accurate and reliable information
- providing appropriate level of detail in responses.

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 intermediate knowledge of marine steam turbines and main boilers can be demonstrated
- diagrams, specifications and other information related to marine steam turbines
- technical reference library with current publications on basic marine steam turbines
- 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 intermediate knowledge of marine steam turbines and

	main boilers • 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.

Accessories may include:

- Accessory gear
- Lube oil:
  - coolers
  - pumps
  - filters
- Starting devices

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering