



Australian Government

MARL5010A Demonstrate basic knowledge of marine steam turbines and main boilers

Release 1

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Modification History

Release 1

This is the first release of this unit.

Unit Descriptor

This unit involves the 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 Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper 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

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| 1 Interpret an energy balance diagram for a shipboard steam plant | 1.1 | Ideal theoretical thermodynamic cycle for the operation of a steam plant is outlined |
| | 1.2 | Why actual expansion of steam through a turbine differs from ideal cycle is explained |
| | 1.3 | Typical heat losses around a steam plant are identified |
| | 1.4 | Effect of air preheating, feed heating and economisation upon energy balance of steam plant's thermodynamic cycle are explained |
| | 1.5 | Typical heat (and/or mass) balance diagram for a ship's steam plant is interpreted |
| 2 Explain construction and operation of marine high-pressure water boilers | 2.1 | Advantages of water tube boiler over fire tube boiler for shipboard applications are outlined |
| | 2.2 | Construction and operation of a 'D' type membrane furnace boiler with superheater, economiser and air pre-heater is explained |
| | 2.3 | External fittings required by Classification Society Rules on any large boiler are identified |
| | 2.4 | Internal fittings of a boiler's main steam drum are identified |
| | 2.5 | How automation is applied to boiler control is clarified |
| | 2.6 | Start up, operation and shut down of a main propulsion steam boiler is outlined |
| 3 Explain construction and operation of a main propulsion steam plant | 3.1 | How common forms of blading and rotor construction are manufactured is clarified |
| | 3.2 | How casings of common <i>marine steam turbines</i> are fitted out is clarified |
| | 3.3 | Principles of thermodynamics are applied to explain expansion of steam in a typical marine turbine |
| | 3.4 | Importance of start up and <i>warming-through procedures</i> for a steam turbine set is conveyed |
| | 3.5 | Checks required during routine turbine operation are explained |
| | 3.6 | <i>Safety devices</i> for a steam turbine set are identified and normal emergency shut-down procedures are identified |
| | 3.7 | Operation of turbines under normal and emergency conditions is |

- outlined
- 4 Explain auxiliary machinery required to support operation of main propulsion steam turbines and boilers**
- 4.1 Construction and operation of different types of *auxiliary machinery* needed to support main propulsion steam turbines and boilers is outlined
- 4.2 Construction and operation of steam and electric motor prime movers required for driving auxiliary machinery are outlined
- 5 Explain configuration and operating principles of different steam distribution systems used in steam-powered vessels**
- 5.1 Configuration and operating principles of different *steam distribution systems* is outlined
- 5.2 Typical pressure reducing and pressure control valves suitable for steam service are outlined and illustrated
- 6 Explain operation principles of close feed systems used by boiler/turbine sets**
- 6.1 Difference between an open and a closed feed system is clarified
- 6.2 Closed feed system is outlined
- 6.3 Pressure feed heaters are outlined
- 6.4 Chemical injection equipment suitable for use on any ship's main feed system is explained
- 7 Explain feed and boiler water treatment**
- 7.1 Recommended limits of characteristics for boiler water and recommended intervals at which tests are undertaken are clarified
- 7.2 Reasons for treating boiler water are outlined
- 7.3 Different types of hardness in water, their consequences if left untreated, and ways of minimising their effect are explained
- 7.4 How corrosion within a boiler is minimised by treating boiler water is explained
- 7.5 Causes and ways of avoiding carry-over and caustic embrittlement are explained
- 7.6 Safety requirements for handling feedwater and boiler water treatment chemicals are explained

- 8 Explain transmission of power from the steam turbine main engine to the propeller**
- 8.1 Why reduction gearing is required between steam turbines and propeller is clarified
 - 8.2 Generation of tooth form is outlined
 - 8.3 Double helical gearing and difference between single and double reduction gearing are explained
 - 8.4 Applications of epicyclic gearing are explained
 - 8.5 Function of flexible couplings in a turbine/gearing set is clarified
 - 8.6 Components of a driveline from main wheel connection, aft, to propeller are listed
 - 8.7 Methods and mechanisms for lubricating a driveline are detailed
- 9 Explain procedures for preventing and responding to fires and explosions specific to steam propulsion plant**
- 9.1 Causes, symptoms and means of preventing and extinguishing *fires* associated with steam propulsion plant are detailed
 - 9.2 Protective devices associated with boilers to minimise risk of fires, explosions and water shortages are identified
 - 9.3 Routine inspection and maintenance requirements to prevent fires, explosions and water shortages are outlined

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, and
- Identify and apply relevant solutions to problems that can occur when operating steam propulsion plant and associated systems on a steam vessel
- Identify and interpret diagnostic information, and perform mathematical calculations related to operating, repairing and maintaining 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 with defects of auxiliary steam turbines
 - construction and operation of main and auxiliary steam turbines
 - procedures for emergency operation of a steam turbine
- Established engineering practice and procedures for operating 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 when operating steam propulsion plant and associated systems, and appropriate preventative and remedial action
- Methods of lubricating the 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, interpretation of readings, and indications of the performance of steam propulsion plant and associated systems

- Typical operating precautions for steam propulsion plant and associated systems to ensure operational performance is in compliance with bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations
- Types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used on board a steam vessel, including a basic understanding of the working principles, construction, maintenance and safe operation of centrifuges, filters, and other treatment devices
- 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 basic knowledge of marine steam turbines and main boilers can be demonstrated
- diagrams, specifications and other information required for performing basic calculations 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 basic 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.

Marine steam turbines may include:

- Impulse
- Reaction

Warming-through procedures may include:

- Ensuring air vent is open
- Minimising thermal shock
- Warming up according to manufacturer instructions
- Shutting down

Safety devices may include:

- Axial movement
- Gland temperature
- Lube oil pressure
- Lube oil temperature
- Remote stops
- Vacuum condenser pressure
- Vibration

Auxiliary machinery may include:

- Lube oil supply pump and system
- Main boiler forced draught fan
- Main condensate extraction pump and air ejector
- Main condenser
- Main cooling water circulating pump
- Main fuel oil supply pump and system
- Main feed pump

Steam distribution systems may include:

- Auxiliary exhaust steam range
- Auxiliary superheated steam range
- Bled steam systems
- Superheated main steam range

Fires may include:

- Blow back
- Economiser
- Explosions
- Low water level
- Uptake

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering