



Australian Government

MARL059 Demonstrate basic knowledge of marine steam turbines and main boilers

Release: 1

MARL059 Demonstrate basic knowledge of marine steam turbines and main boilers

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 main steam propulsion plant and associated control systems on a commercial vessel.

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

- Electro-Technical Officer (STCW Electro-Technical Officer Unlimited)
- Engineer Watchkeeper (STCW Engineer Watchkeeper 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 Electro-Technical Officer (STCW Electro-Technical Officer Unlimited) or Engineer Watchkeeper (STCW Engineer Watchkeeper 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

Elements describe the essential outcomes.

PERFORMANCE CRITERIA

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

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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 pre-heating, 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 shutdown of a main propulsion steam boiler are 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 marine steam turbines are fitted out is clarified |

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| | 3.3 | Principles of thermodynamics are applied to explain expansion of steam in a typical marine turbine |
| | 3.4 | Importance of start-up and warming-through procedures for a steam turbine set is conveyed |
| | 3.5 | Checks required during routine turbine operation are explained |
| | 3.6 | Safety devices for a steam turbine set are identified and normal emergency shutdown (ESD) 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, 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 feed water 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

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 equivalent to MARL013 Demonstrate basic knowledge of marine steam turbines and main boilers.

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 MARL059 Demonstrate basic knowledge of marine steam turbines and main boilers

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 diagnostic information related to marine steam turbines
- 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
- identifying and applying relevant solutions to problems that can occur when operating steam propulsion plant and associated systems on a steam vessel
- identifying and interpreting diagnostic information, and performing mathematical calculations related to operating, repairing and maintaining marine steam turbines
- identifying methods, procedures and materials needed for operating, maintaining and repairing marine steam turbines
- providing accurate and reliable information
- providing appropriate level of detail in responses
- reading and interpreting manuals, technical specifications, safety data sheets (SDS)/material safety data sheets (MSDS) and manufacturer guides related to operating, maintaining and repairing marine steam turbines.

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:
 - 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 feed pump
 - main fuel oil supply pump and system

- basic principles of operation of main steam propulsion and auxiliary systems on a steam vessel, including:
 - construction and operation of main and auxiliary steam turbines
 - methods of turbine control, including safety devices
 - procedures for emergency operation of a steam turbine
 - Rankine cycle
 - symptoms, causes, effects, and actions to be taken with defects of auxiliary steam turbines
- effective verbal, written and visual communication strategies
- established engineering practice and procedures for operating shipboard steam propulsion plant and associated systems in warm-through, manoeuvring, start-up, normal running, and emergency shutdown (ESD) situations
- fires, including:
 - blow back
 - economiser
 - explosions
 - low water level
 - uptake
- 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
- marine steam turbines, including:
 - impulse
 - reaction
- 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
- safety devices, including:
 - axial movement
 - gland temperature
 - lube oil pressure
 - lube oil temperature
 - remote stops
 - safety valves
 - vacuum condenser pressure
 - vibration
- steam distribution systems, including:
 - auxiliary exhaust steam range

- auxiliary superheated steam range
- bled steam systems
- superheated main steam range
- types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used onboard a steam vessel, including a basic understanding of the 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 in compliance with bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations
- units of measurement
- warming-through procedures, including:
 - ensuring air vent is open
 - minimising thermal shock
 - shutting down
 - warming up according to manufacturer instructions
- 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 industry approved marine operations site or 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
- diagrams, specifications and other information required for performing basic calculations related to marine steam turbines
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

Links

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