



Australian Government

MARL035 Demonstrate advanced knowledge of marine steam turbines and main boilers

Release: 1

MARL035 Demonstrate advanced knowledge of marine steam turbines and main boilers

Modification History

Release 1. New unit of competency.

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. It includes analysing: methods of improving plant efficiency; changes in feed system that occur during fluctuating loads; design and construction of high-pressure water tube boilers and ancillary equipment; operation, maintenance and performance of high-pressure water tube boilers and ancillary equipment; turbine operation, maintenance and performance; and turbine-gearing performance.

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).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Not applicable.

Competency Field

L – Marine Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

Elements describe the essential outcomes.

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

1 Analyse methods of improving plant efficiency

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| 1.1 | Increase in Rankine efficiency of plant by increasing the pressure and temperature is analysed |
| 1.2 | How regenerative feed heating and steam reheating increases overall plant efficiency is shown on an enthalpy/entropy |

		diagram
	1.3	Efficiency calculations and performance evaluation for boilers, turbines, feed systems and total plant are performed
2 Analyse changes in feed system that occur during fluctuating loads	2.1	Changes that occur during fluctuating loads are identified, detailing how make up to system and dump from system are performed
	2.2	Condenser level control methods, how condenser is supported and how expansion stresses are avoided are explained
	2.3	Loss of efficiency when heat transfer rate is interrupted is explained
	2.4	Test procedure to identify leaks in a condenser is created
	2.5	Types, features, common defects and maintenance requirements of two-stage and super cavitating extraction pumps are compared and contrasted
	2.6	Effects of air leaks in feed system and ineffective air removal in air ejector are explained
	2.7	Operation of a vacuum pump for air removal from a condenser is explained
	2.8	Operation of a turbo feed pump differential pressure governor taking into account constant pressure, increasing pressure and decreasing pressure differential governing is explained
	2.9	Alarms, shutdowns, automatic cut-in arrangements and testing of over speed trips for a boiler feed pump are outlined
3 Analyse design and construction of high-pressure water tube boilers and ancillary equipment	3.1	Temperature load relationships and temperature control of superheater are analysed
	3.2	Operation of superheater with parallel, contra and cross flow of gas/steam flow is predicted
	3.3	Correct material for high temperature operation of superheater tubes and headers is identified
	3.4	Tube fixing and support arrangements for superheater elements are explained
	3.5	Burner tip design and operation for steam atomising oil burners are compared

- 3.6 Features of a three-element water level control system and relationship with burner management system are outlined
- 3.7 Operation of a combustion control system fitted with cross limits on air and fuel is explained
- 4 **Analyse operation, maintenance and performance of high-pressure water tube boilers and ancillary equipment**
 - 4.1 Warm through procedure and checks to be carried out before connecting boiler to range are explained
 - 4.2 How boiler is laid up for short and/or long periods is explained
 - 4.3 Actions required after oil or salt water contamination are detailed
 - 4.4 Chemical cleaning procedure to remove scale and oil deposits from internal surfaces of a boiler is explained
 - 4.5 Tube failures are identified and suitable methods of repair are selected
 - 4.6 Defects that can occur in economisers and how they can be repaired are listed
 - 4.7 Maintenance inspection procedures to prevent superheater and economise fires are produced
 - 4.8 Procedure to combat soot and steam/iron fires in generating banks, superheaters and economisers is outlined
 - 4.9 Coordinate and congruent feed water treatment is illustrated on a caustic/phosphate graph
 - 4.10 Different feedwater tests, procedure for each test and appropriate chemical treatments are explained
 - 4.11 Program for an internal and external survey of a water tube boiler is compiled, defects that may be found and repair methods that will enable boiler to be returned to service are listed
 - 4.12 Procedure for setting lift, adjusting blow-down of safety valves and carrying out an accumulation test on a boiler is outlined
 - 4.13 Operation, desired temperature range and correct cleaning and maintenance requirements for tube and regenerative air heaters are detailed

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| | 4.14 | Preparation and procedure for conducting hydraulic testing of a high pressure water tube boiler is explained |
| 5 Analyse turbine operation, maintenance and performance | 5.1 | Relationship between sequential nozzle operation and bar lift in steam turbines is explained |
| | 5.2 | Principle of operation of different trips and cut-outs is explained |
| | 5.3 | Differentiation is made between resonance and critical speed, and their effect on the turbine operation is explained |
| | 5.4 | Types of turbine vibration and where each type is found in a turbine is analysed |
| | 5.5 | System torsional vibration and effect of operating at critical speeds and in-built design elements required to avoid critical speeds are explained |
| | 5.6 | Back pressure and self-condensing turbo alternators are compared |
| | 5.7 | Governor system is explained |
| | 5.8 | Turbine control systems are explained |
| | 5.9 | Procedure for opening up turbine for survey, routine checks of blades, casings, rotors, bearings, glands, drains and the reassembly of turbine is explained |
| | 5.10 | Procedure for straightening a bowed turbine rotor is outlined |
| 6 Evaluate turbine-gearing performance | 6.1 | Single and double reduction gearing systems are compared and contrasted |
| | 6.2 | Features and applications of double helical involute gear teeth are outlined |
| | 6.3 | Advantages and disadvantages of single and double locked train gearboxes are analysed |
| | 6.4 | Construction and reason for installing flexible couplings in gearing system is explained |
| | 6.5 | Features, functions and applications of star, planetary and solar epicyclic gearing are compared and contrasted |
| | 6.6 | Space savings resulting from use of epicyclic gearing are analysed |

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.

Trips and cut-outs include one or more of the following:

- axial displacement
- bearing high temperature
- high condenser level
- loss of vacuum
- over speed
- vibration

Turbine vibration includes one or more of the following:

- axial
- torsional
- transverse

Turbine control systems include one or more of the following:

- bridge control
- emergency operation
- hydraulic control
- local control

Unit Mapping Information

This unit replaces and is equivalent to MARL6022A Demonstrate advanced knowledge of marine steam turbines and main boilers.

MARL6022A replaces and is equivalent to TDMMR5707A Manage the operation, monitoring and evaluation of the performance of steam propulsion plant on vessels of unlimited propulsion power.

Links

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

Assessment Requirements for MARL035 Demonstrate advanced knowledge of marine steam turbines and main boilers

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- accessing diagnostic information related to marine steam turbines
- applying relevant work health and safety/occupational health and safety (WHS/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 complex problems that can occur during operating steam propulsion plant and associated systems on a steam vessel
- identifying and interpreting complex diagnostic information and performing complex 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
- imparting advanced knowledge and ideas verbally, in writing and visually
- reading and interpreting complex manuals, technical specifications, safety data sheets/material safety data sheets and manufacturer guides related to operating, repairing and maintaining marine steam turbines
- performing accurate and reliable calculations and producing accurate and reliable information.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- boiler operation, maintenance and performance
- changes in feed system that occur during fluctuating loads
- 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 during operation of steam propulsion plant and associated systems, and appropriate preventative and remedial action
- high-pressure water tube boilers and ancillary equipment
- 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
- operation of marine steam turbines
- operational characteristics and performance specifications for different types of steam propulsion plant and associated systems on a steam vessel of unlimited propulsion power
- 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
 - symptoms, causes and effects of defects of auxiliary steam turbines and actions to be taken
- procedures for reading and interpreting readings and indications of performance of steam propulsion plant and associated systems
- turbine operation, maintenance and performance
- turbine-gearing performance
- types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used on board a steam vessel, including a basic understanding of 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
- ways of improving plant efficiency
- WHS/OHS requirements and work practices.

Assessment Conditions

Assessors must satisfy National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) assessor requirements.

Assessment must satisfy the National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) standards.

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.

Assessment must occur in workplace operational situations or where these are not available, in simulated workplace operational situations or an industry-approved marine operations site that replicates workplace conditions where advanced knowledge of marine steam turbines and main boilers can be demonstrated.

Resources for assessment include access to:

- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals
- diagrams, specifications and other information required for performing complex calculations related to marine steam turbines
- technical reference library with current publications on marine steam turbines
- tools, equipment, materials and personal protective equipment currently used in industry.

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

Links

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