



**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**

- |     |                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------|
| 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                                                                 |
| <b>2 Analyse changes in feed system that occur during fluctuating loads</b>                          | 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                                                                 |
| <b>3 Analyse design and construction of high-pressure water tube boilers and ancillary equipment</b> | 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 economiser 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

- 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>

