



Australian Government

MARL6017A Demonstrate advanced knowledge of marine auxiliary 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 skills and knowledge required to explain the operation and maintenance of marine auxiliary boilers on a commercial vessel. It includes evaluating steam plant efficiency, interpreting steam plant cycles, evaluating repairs required for boilers and steam plants, survey procedures, and operating steam plant under different conditions.

Application of the Unit

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).

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 Evaluate steam plant efficiency | 1.1 | Combustion efficiency from flue gas constituents is assessed |
| | 1.2 | Steam and fuel consumption to obtain heating efficiency is analysed |
| | 1.3 | <i>Causes of loss of steam plant efficiency</i> are evaluated |
| | 1.4 | Requirements of inert gas generation of boiler plant are determined |
| 2 Interpret complex steam plant cycles | 2.1 | Operation, function and efficiency of dual pressure cycles and steam/steam generators are compared and contrasted |
| | 2.2 | Operation of dual pressure and pass in/out turbines is explained |
| 3 Evaluate boiler and steam plant repairs | 3.1 | Types and properties of materials used in <i>boilers and steam plant</i> are identified |
| | 3.2 | Common component <i>failures</i> in boilers and steam plant are explained |
| | 3.3 | Appropriate repairs for failed components in boilers and steam plant are determined |
| | 3.4 | <i>Constraints</i> on engineering staff engaged in repairing boilers and steam plant are explained |
| | 3.5 | Requirements to report defects in pressurised components of boilers are identified |
| 4 Explain methods of auxiliary steam plant operation and control under variable conditions | 4.1 | Methods of steam pressure control while manoeuvring and possible adverse impacts are analysed |
| | 4.2 | How dew point can be reached when operating at reduced power is examined |
| | 4.3 | How low powers can limit steam production by exceeding pinch point is explained |
| 5 Outline procedures surveying for boilers | 5.1 | Procedure for preparing a boiler for survey is explained |
| | 5.2 | Boiler inspection procedure that would cover all possible problem areas is planned |
| | 5.3 | Purpose and procedure for carrying out hydrostatic/hydraulic pressure tests and non destructive tests on auxiliary boilers are explained |
| 6 Analyse procedures for protecting steam plant during off | 6.1 | Procedures for decommissioning and laying up a boiler for short and long intervals are compared |
| | 6.2 | Processes for cleaning boilers are evaluated |

- load conditions**
- 6.3 Procedures for re-commissioning steam plant are explained
 - 6.4 Chief Engineer responsibilities for setting lifting pressure of *safety valves* are outlined
- 7 Assess hazards of operating steam plant under adverse or faulty operating conditions**
- 7.1 Potential hazards of boiler operation with contaminated feed water are assessed
 - 7.2 Procedure for continuing boiler operation when contamination has exceeded acceptable limits is explained
 - 7.3 Effects of operating boiler with insufficient water level are explained and actions to be taken under loss of water conditions are identified
 - 7.4 Causes, consequences and relevant preventative measures associated with furnace explosions are analysed
 - 7.5 Operating conditions that can lead to an economiser fire and actions that can be taken to prevent and control such fires are evaluated
 - 7.6 Alternative methods for maintaining heating if a boiler or economiser has to be shut down are determined
- 8 Explain operation and maintenance of heat transfer oil systems**
- 8.1 Operating procedures of heat transfer oil systems are explained
 - 8.2 Hazards associated with heat transfer oil systems are analysed
 - 8.3 Routine maintenance procedures associated with heat oil transfer systems are outlined

Required Skills and Knowledge

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

Required Skills:

- Access information related to marine auxiliary boilers
- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain operation of marine auxiliary boilers and impart knowledge and ideas verbally, in writing and visually
- Identify and apply relevant solutions for addressing complex problems associated with marine auxiliary boilers, such as maintaining the operation of marine auxiliary boilers under adverse conditions
- Identify and interpret diagnostic information and perform complex mathematical calculations related to operating, repairing and maintaining marine auxiliary boilers
- Identify methods, procedures and materials needed for operating, maintaining and repairing marine auxiliary boilers
- Read and interpret manuals, technical specifications, safety data sheets (SDS)/material safety data sheets (MSDS) and manufacturer guides related to operating, repairing and maintaining marine auxiliary boilers

Required Knowledge:

- Basic principles of operation of boilers and steam systems
- Boiler and steam plant repairs
- Combustion efficiency
- Combustion in boilers and related safety procedures, including importance of purging a boiler and other safety precautions taken when firing a boiler
- Common boiler defects and repair procedures
- Fittings mounted on boilers
- Fuel oil system for an auxiliary boiler
- Hazards:
 - associated with running boilers and steam plant
 - of operating steam plant under adverse or faulty operating conditions
- Heat transfer oil systems
- Methods of auxiliary steam plant operation and control under variable conditions
- Operating principles relating to steam generation in fired and unfired boilers
- Principles of boiler operation in normal and emergency situations
- Procedures for:
 - maintaining water level in boilers
 - protecting steam plant during off load conditions

- surveying boilers
- Purpose of alarms and shut downs in marine boilers
- Steam plant:
 - efficiency
 - cycles
- Types of auxiliary boilers and typical operating pressures and temperatures
- Typical feed systems for marine boilers
- Treatment, sampling and testing of boiler water
- Work health and safety (WHS)/occupational health and safety (OHS) legislation, policies and procedures

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
- performing accurate and reliable calculations.

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 advanced knowledge of marine auxiliary boilers can be demonstrated
- diagrams, specifications and other information required for performing advanced calculations related to marine auxiliary boilers
- technical reference library with current publications on marine auxiliary boilers and steam plant
- 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 advanced knowledge of marine auxiliary 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.

Causes of loss of steam plant efficiency may include:

- Conduction-heat loss (such as fouled tubes)
- High flue-gas temperature
- Low combustion-air supply temperature
- Low feed-water supply temperature
- Low quality fuel
- Operation at low or cyclic loads
- Poor:
 - combustion
 - controls/instrumentation
 - water treatment
- Radiant-heat loss
- Too much excess air (i.e. high oxygen [O₂])

Boilers and steam plant may include:

- Condensers
- Economiser
- Feed pumps
- Fired
- High pressure
- Low pressure
- Medium pressure
- Steam – steam generators
- Unfired

Failures may include:

- Acid dew point corrosion
- Caustic gouging
- Corrosion fatigue
- Distortion
- Erosion
- Fatigue
- Hydrogen damage
- Maintenance damage
- Material flaws
- Over temperature
- Pitting
- Stress:
 - corrosion cracking
 - rupture
- Thermal fatigue

Constraints may include:

- Vibration
- Welding flaws
- Class requirements
- Location
- Reliability
- Time
- Type of materials

Safety valves may include:

- Boiler drim
- Economiser
- Superheater
- WHU

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering