



Australian Government

MARL047 Demonstrate advanced knowledge of marine auxiliary boilers

Release: 1

MARL047 Demonstrate advanced knowledge of marine auxiliary 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 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, outlining survey procedures, and explaining operating steam plant under different conditions.

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

- Engineer Class 1 (STCW Chief Engineer Unlimited)
- Engineer Class 2 (STCW Second Engineer 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 Engineer Class 1 (STCW Chief Engineer Unlimited) or Engineer Class 2 (STCW Second Engineer 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 Outline responsibilities of an Engineer Class 2 in relation to auxiliary boiler and steam plant of a vessel | 1.1 Commonwealth, state/territory and local legislation and regulations that relate to marine boilers and steam plant in terms of safety, repairs and pollution, including implementation, is identified |
| | 1.2 Safe operating practices for all steam plant are examined and standing orders as to their operation are prepared or modified |
| | 1.3 Procedures for establishing engine room staff who are fully conversant with safe practices for boiler operation are outlined |
| 2 Evaluate design and construction of marine auxiliary boilers | 2.1 Typical boiler types illustrating cross-section, attachments and location of all fittings, mountings, scantlings and method of achieving circulation are examined |
| | 2.2 Material requirements for boiler components are identified |
| | 2.3 Construction of different types of boilers is analysed and difference recorded |
| 3 Evaluate boiler and steam plant repairs | 3.1 Types and properties of materials used in boilers and steam plant are identified |
| | 3.2 Common component failures in boilers and steam plant are explained and reported |
| | 3.3 Appropriate repairs for failed components in boilers and steam plant are determined |
| | 3.4 Constraints 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	Evaluate design and operation of thermal fluid heating plants	4.1	Different gauge glass types are compared
		4.2	Typical thermal fluid heating plant is explained and advantages and limitations of the system are identified
		4.3	Locations and functions of all fittings and safety devices in a typical thermal fluid system are explained
		4.4	Properties of thermal fluid, effects of contamination and methods of testing fluid are analysed
		4.5	Hazards associated with heat transfer oil systems are analysed
		4.6	Routine maintenance procedures associated with heat transfer oil systems are outlined
5	Evaluate layout and design of marine steam systems and components	5.1	Thermal fluid heating is compared to conventional steam plant
		5.2	Typical steam system layout showing location of all components on feed and heating side is detailed
		5.3	Material requirements for steam system components are identified
		5.4	Reasons for operating plant and systems at nominated temperatures and pressures, and effects of departing from these parameters, are explained
6	Interpret complex steam plant cycles	6.1	Operation, function and efficiency of dual pressure cycles and steam/steam generators are compared and contrasted
		6.2	Operation of dual pressure and pass in/out turbines is explained
7	Evaluate steam plant efficiency	7.1	Combustion efficiency from flue gas constituents is assessed
		7.2	Steam and fuel consumption to obtain heating efficiency is analysed

	7.3	Causes of loss of steam plant efficiency are evaluated and recorded
	7.4	Requirements of inert gas generation of boiler plant are determined
8 Explain methods of auxiliary steam plant operation and control under variable conditions	8.1	Methods of steam pressure control while manoeuvring and possible adverse impacts are analysed
	8.2	How dew point can be reached when operating at reduced power is examined
	8.3	How low powers can limit steam production by exceeding pinch point is explained
9 Outline procedures for inspecting marine auxiliary boilers and associated plant	9.1	Symptoms of faults in steam traps, hot wells, de-aerators, condensers, evaporators and requirements for contamination prevention between systems, are analysed
	9.2	Procedures for shutting down, isolating and opening up a boiler for inspection or during an emergency are clarified
	9.3	Possible defects that may occur in a boiler, fire and water side, their location and effects are analysed
	9.4	Repair procedures commonly employed for damaged boilers are examined and limitations of such repairs are explained
	9.5	Procedures for leak detecting in boilers and steam equipment are clarified and remedial actions are explained
	9.6	Mechanism of economiser fires are analysed
10 Outline procedures for surveying boilers	10.1	Procedures for preparing a boiler for survey are documented and explained
	10.2	Boiler inspection procedures that would cover all possible problem areas are planned
	10.3	Purpose and procedures for carrying out hydrostatic/hydraulic pressure tests and non-destructive tests on auxiliary boilers are explained

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| 11 Analyse procedures for protecting steam plant during off-load conditions | 11.1 Procedures for decommissioning and laying up a boiler for short and long intervals are compared |
| | 11.2 Processes for cleaning boilers are evaluated |
| | 11.3 Procedures for re-commissioning steam plant are explained |
| | 11.4 Chief Engineer responsibilities for setting lifting pressure of safety valves are outlined |
| 12 Differentiate between safety valves types | 12.1 Common types of boiler safety valves are analysed and sketched, and how they are classified in terms of valve lift is explained |
| | 12.2 Materials used in safety valves are identified and operational problems that can occur are analysed |
| | 12.3 Defects that may be found when dismantling a safety valve for survey are analysed |
| | 12.4 Procedures for setting valve lift pressure are established and precautions necessary when testing valve on fired and non-fired boilers are examined |
| | 12.5 Chief Engineer responsibilities for setting lifting pressure of safety valves are outlined |
| 13 Evaluate problems associated with feed and boiler water | 13.1 Causes of scaling and corrosion of water side of a boiler and how these can be minimised are analysed |
| | 13.2 Acceptable operational range and effects of contamination on boiler chemical reserves are identified |
| | 13.3 Reliability of boiler water test results are analysed in relation to sampling procedure, testing equipment and shelving of test chemicals |
| | 13.4 Different tests carried out on boiler water are explained and implications of out-of-range results are interpreted |
| | 13.5 Use of different chemicals to treat and condition boiler water is assessed |
| 14 Assess hazards of operating steam plant under adverse or faulty | 14.1 Potential hazards of boiler operation with contaminated feed water are assessed |

operating conditions

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| | 14.2 | Procedure for continuing boiler operation when contamination has exceeded acceptable limits is explained |
| | 14.3 | Effects of operating boiler with insufficient water level are explained and actions to be taken under loss of water conditions are identified |
| | 14.4 | Causes, consequences and relevant preventative measures associated with furnace explosions are analysed |
| | 14.5 | Operating conditions that can lead to an economiser fire and actions that can be taken to prevent and control such fires are evaluated |
| | 14.6 | Alternative methods for maintaining heating if a boiler or economiser has to be shut down are determined |
| 15 | Evaluate marine fuel systems | |
| | 15.1 | Procedure to be adopted when boiler is severely contaminated from different sources is outlined |
| | 15.2 | Boiler fuel system, its components and maintenance procedure are detailed |
| | 15.3 | Combustion process, its monitoring system and requirements for good combustion are analysed |
| | 15.4 | Different types of burners are compared and contrasted and how atomisation is achieved is explained |
| | 15.5 | Operation of a burner management system that incorporates pressure and level control is explained |
| 16 | Evaluate marine boiler auxiliaries | |
| | 16.1 | Construction, operating principles and maintenance requirements of a regenerative condenser are explained |
| | 16.2 | Causes of loss of vacuum are identified and test procedure to identify leaks in a condenser is created |
| | 16.3 | Construction and operation of air ejectors, drain coolers, vacuum pumps and extraction pumps are explained |

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 not equivalent to MARL024 Demonstrate intermediate knowledge of marine auxiliary boilers.

This unit replaces and is equivalent to MARL030 Demonstrate advanced knowledge of marine auxiliary 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 MARL047 Demonstrate advanced knowledge of marine auxiliary 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 on at least one occasion and include:

- accessing information related to marine auxiliary boilers
- 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 for addressing complex problems associated with marine auxiliary boilers, such as maintaining the operation of marine auxiliary boilers under adverse conditions
- identifying and interpreting diagnostic information and performing complex mathematical calculations related to operating, repairing and maintaining marine auxiliary boilers
- identifying methods, procedures and materials needed for operating, maintaining and repairing marine auxiliary boilers
- imparting knowledge and ideas through verbal, written and visual means
- reading and interpreting manuals, technical specifications, safety data sheets (SDS)/material safety data sheets (MSDS) and manufacturer guides related to operating, repairing and maintaining marine auxiliary boilers.

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:

- basic principles of operation of boilers and steam systems
- boilers and steam plant, including:
 - condensers
 - economiser
 - feed pumps
 - fired
 - high pressure
 - low pressure

- medium pressure
- steam generators
- unfired
- boiler and steam plant repairs/defects
- boiler water levels
- boiler water testing
- boiler water treatment
- 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
- constraints, including:
 - class requirements
 - location
 - reliability
 - time
 - type of materials
- design features and operative mechanism of marine steam boiler and associated auxiliary, including:
 - material selection and design features of marine steam boiler
 - material selection and design features of marine steam boiler feed water systems
- failures, including:
 - acid dew point corrosion
 - caustic gouging
 - corrosion cracking
 - corrosion fatigue
 - distortion
 - erosion
 - fatigue
 - hydrogen damage
 - maintenance damage
 - material flaws
 - over temperature
 - pitting
 - rupture
 - stress:
 - thermal fatigue
 - vibration
- 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
- intermediate operation of marine auxiliary boilers
- marine boilers and steam, including:
 - condensers
 - economiser
 - fired feed pumps
 - high pressure
 - low pressure
 - medium pressure
 - steam – steam generators
 - unfired
- marine boiler inspection procedures
- methods of auxiliary steam plant operation and control under variable conditions
- operating principles relating to steam generation in fired and unfired boilers
- operation of marine auxiliary 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 shutdowns in marine boilers
- safety valves, including:
 - boiler drum
 - economiser
 - superheater
 - WHU
- steam plant:
 - cycles
 - efficiency and causes of loss of steam, including:
 - combustion
 - conduction-heat loss (such as fouled tubes)
 - controls/instrumentation
 - high flue-gas temperature
 - low combustion air supply temperature
 - low feed water supply temperature
 - low quality fuel
 - operation at low or cyclic loads

- poor radiant-heat loss
- too much excess air (i.e. high oxygen [O₂])
- water treatment
- treatment, sampling and testing of feed and boiler water
- types of auxiliary boilers and typical operating pressures and temperatures
- typical feed systems for marine boilers
- WHS/OHS requirements and work practices.

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 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 advanced calculations related to marine auxiliary boilers
- tools, equipment, machinery, materials and relevant personal protective equipment (PPE) currently used in industry.

Links

Companion Volume implementation guide can be found in VetNet -

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