Australian Government

Department of Education, Employment and Workplace Relations

TDMMR5807A MANAGE THE OPERATION, MONITORING AND EVALUATION OF THE PERFORMANCE OF STEAM PROPULSION PLANT ON VESSELS OVER 750 KW PROPULSION POWER

Release: 1

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Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:
This unit involves the skills and knowledge required to operate and monitor and evaluate performance of steam propulsion plant on a commercial ocean-going steam vessel powered by main propulsion machinery over 750 kW propulsion power within the limits of responsibility of a Marine Engineer Class 2 on a commercial vessel powered by main propulsion machinery of 750 kW propulsion power or above. **This covers the knowledge and skills required to work as**:

- **Chief Engineer on steam vessels between 750 kW and 3,000 kW propulsion power**
- **First Engineer** (**Second Engineer for STCW 95 Code**) **on steam vessels over750 kW propulsion power**.

It covers the management and coordination of relevant maintenance andfault-finding activities and the application of appropriate diagnostic and problem solving techniques to maintenance procedures.

Application of the Unit

Application of the unit	The unit has application in qualifications for a Chief Engineer on a vessel between 750 kW and 3,000 kW propulsion power operating in international waters, i.e. the Advanced Diploma of Transport&Distribution(Marine Engineering Class 2).

Licensing/Regulatory Information

Licensing/legislative requirements	The unit is consistent with the relevant sections of STCW 95 and Marine Orders under the Australian Navigation Act 1912, describing requirements for a Chief Engineer on a steam vessel over 750 kW propulsion power operating in international waters.

Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

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

ELEMENT	PERFORMANCE CRITERIA
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1 Operate and maintain steam propulsion plant	a Steam propulsion plant and auxiliary systems are managed and operated in accordance with established procedures b The performance of steam propulsion plant is monitored in accordance with bridge orders, company procedures, survey requirements and manufacturer's instructions and performance is compared with technical specifications and recommended limits of performance c The methods of measuring the operating parameters of the steam propulsion plant are in accordance with manufacturer's technical specifications d Poor performance and faults are identified in accordance with established marine engineering practice

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ELEMENT	PERFORMANCE CRITERIA
Operate and maintain steam propulsion plant (continued)	e Poor performance and faults are investigated as per marine engineering practice and manufacturer's instructions and appropriate action initiated to rectify the identified problem f Appropriate action is taken to prevent damage/failure in accordance with vessel's planned maintenance system or procedures, established marine engineering practice, safety regulations and manufacturer's instructions g Faulty and worn steam propulsion plant components are identified and are reported and action is initiated as required for repair or replacement as per company procedures and established marine engineering practice h Decisions are made to carry out temporary or permanent repairs depending on the vessel's position and circumstances i Appropriate consultation is taken with class society and marine administration about the nature of the repairs and any contingency or emergency action required j Management of the repair processes and the organisation and control of engine room personnel and when required, shore personnel, to facilitate repairs is in accordance with established procedures k Routine maintenance and survey requirements are carried out in accordance with company procedures and established marine engineering practice

2 Repair faultsin steam propulsion plant and auxiliary systems	a	Identified faults in steam propulsion plant and auxiliary systems are investigated using advanced diagnostic techniques as per established procedures
	b	Malfunctioning steam propulsion plant and auxiliary systems are correctly isolated and disassembled, if necessary, in accordance with manufacturer's instructions and established marine engineering practice
	c	Damaged or faulty components are repaired or replaced as per procedures
	d	Repaired steam propulsion plant and auxiliary systems are reassembled as per manufacturer's instructions and established marine engineering practice
	e	Repaired steam propulsion plant and auxiliary systems are restarted, checked and adjusted in accordance with vessel's procedures and manufacturer's instructions and in consultation with relevant personnel
	f	Performance of repaired steam propulsion plant and auxiliary systems and associated safety devices, control systems and alarms is checked in accordance with manufacturer's instructions
	g	Performance against recommended technical specifications is confirmed and the steam propulsion plant and auxiliary systems is recommissioned in accordance with vessel's procedures

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ELEMENT	PERFORMANCE CRITERIA	
3 Complete operational and performance evaluation documentation	a	Correct records are made relating to the operation and performance evaluation of steam propulsion plant and auxiliary equipment and any steam propulsion plant and auxiliary equipment failure incidents
	b	All operational and performance evaluation documentation is completed as per vessel's procedures, bridge orders, survey and company requirements, and regulations

ELEMENT	PERFORMANCE CRITERIA
4 Follow safety and hazard control procedures	a Vessel's safety management procedures and safety regulations are applied in the operation and performance evaluation of steam propulsion plant and auxiliary systems b Hazards involved in steam propulsion plant and auxiliary systems operation and performance evaluation are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment c Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during maintenance and repair operations d Where relevant, procedures and precautions necessary for entry into a pump-room, fuel tanks or other confined spaces on a vessel are correctly followed e Action is taken in the event of a plant or machinery failure or emergency to secure the steam propulsion plant and auxiliary systems and the vessel and maintain the safety of the vessel and persons involved and to ensure that shipboard emergency and contingency plans are followed

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Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

1 National and international regulations, IMO Conventions and Codes, including AMSA Marine Orders applicable to the operation and performance evaluation of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

2 Relevant OH&S legislation, policies and procedures

3 Established engineering practice for the operation and performance evaluation of steam propulsion plant and auxiliary systems

4 Operational characteristics and performance specifications for the different types of steam propulsion plant and auxiliary systems usually found on a steam vessel over 750 kW propulsion power

5 Procedures for carrying out performance evaluation of steam propulsion plant and auxiliary systems as part of routine operational and maintenance procedures to ensure performance is in compliance with the bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations

6 The nature and causes of typical malfunctions and/or poor performance of steam propulsion plant and auxiliary systems and the available methods for their detection and rectification

7 Hazards and problems that can occur during the operation and performance evaluation of steam propulsion plant and auxiliary systems and appropriate preventative and remedial action and solutions

8 Safety, environmental and hazard control precautions and procedures relevant to the operation and performance evaluation of steam propulsion plant and auxiliary systems

9 Operational and performance evaluation records that must be maintained on a vessel to meet the requirements of the company, survey requirements and

REQUIRED KNOWLEDGE

regulatory authorities

10 Maritime communication techniques needed during the operation and performance evaluation of steam propulsion plant and auxiliary systems

11 Typical material safety data sheets, vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams

12 Procedures for the testing and treatment of boiler water, machinery cooling water and lubricating oil on steam vessels

13 Principles and operational characteristics of internal combustion engines as they apply to auxiliary systems on steam vessels, including:

a two stroke and four stroke cycles

b optimum combustion parameters and their control

c diesel engine scavenging systems both in normal and emergency operation

d atmospheric pollution caused by diesel engine combustion and ways in which it can be minimised

e irregularities in the performance of machinery and plant

14 Principles of operation of hydraulic and electronic governors and overspeed trips

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15 Methods of providing air for combustion on steam vessels

16 Principles of boiler fuel systems on steam vessels

17 Principles of fuel systems as they apply to auxiliary systems on steam vessels, including:

a alterations to fuel pumps, camshafts and injectors for varying fuel types

b differences between constant and variable injection timing of fuel

c common service faults, symptoms and causes of combustion problems and related solutions

15 Methods of providing air for combustion on steam vessels

d fuel line pulsation damping devices and leakage protection

18 Principles of engine cooling and lubrication as they apply to auxiliary systems on steam vessels, including:

a different methods of diesel engine cooling

b need for treatment and method of treating engine cooling water

c diesel engine lubrication requirements

d theory and types of lubrication, including methods of lubricating diesel engine components

e relative characteristics, and applications of mineral and synthetic oils

f contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants

g common lubrication problems and their solution

19 Principles of marine control systems, including

a common sensors and their associated transmitters

b analysis of control loops

c temperature and pressure control systems used on board vessel

d analysis of typical level control systems used on board vessel

e operation and application of electronic PID controllers

20 Principles and functions of machinery space monitoring and alarm systems, including:

a central cooling control systems

b steam propulsion control arrangements

c alarm and monitoring systems involving data loggers, alarm loggers and trend analysis

21 Theory and preventative strategies for uptake, starting air-line, superheater, economiser and air heater fires and crankcase explosions, including:

a plans for hazard reduction

15 Methods of providing air for combustion on steam vessels

b procedures for extinguishing fires

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c regaining of control after fires or explosions

d application and use of safety devices and monitors/sensors fitted

22 Principles of thermodynamics and heat and heat engines relevant to detection, identification and repair of faults, including:

a heat transfer, including log mean temperature and circular pressure vessels

b gases and gas cycles

c properties and expansion of steam

d steam cycles, including a specific understanding of the use of entropy charts and modifications to the steam cycle

e boilers and evaporators

f steam turbines, including an understanding of isentropic efficiency

g combustion with a specific understanding of volumetric analysis

h refrigeration and air-conditioning, including the use of entropy charts

23 Principles and operational characteristics of steam turbines, gearing and associated equipment, including:

a lubrication

b gear configurations

c thrust blocks

d determination of shaft power

e irregularities in the performance of machinery and plant

c regaining of control after fires or explosions

24 Principles and operational characteristics of main boilers and associated equipment, including:

a boiler water tests and treatment

b corrosion

c superheaters

d de-aerators

e air ejectors

f open and closed feed systems

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REQUIRED SKILLS

This describes the basic skills required for this unit.

1 Communicate effectively with other personnel when managing the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

2 Interpret and follow procedures for the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

3 Read and interpret equipment performance readings and instrumentation

4 Read and interpret material safety data sheets

5 Read and interpret vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, applicable legislation, specifications and electrical and control circuit diagrams

6 Work collaboratively with other shipboard personnel when managing the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

7 Identify problems that can occur during the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

8 Carry out calculations required when operating, monitoring and evaluating the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

9 Adapt to differing types of fuel, bilge and ballast systems from one vessel to another and when equipment and systems are changed

10 Select and use tools and equipment required for the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power

Evidence Guide

Evidence Guide

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The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Training Package.

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: a Manage the operation, monitor and evaluate the performance of steam propulsion plant and auxiliary systems on a steam vessel over 750 kW propulsion power b Identify malfunctioning and faulty steam propulsion plant and auxiliary systems and initiate appropriate action for repair or replacement c Exercise all required safety, environmental and hazard control precautions and procedures when overseeing the operation and performance evaluation of steam propulsion plant and auxiliary systems d Identify typical operational and performance evaluation problems and hazards and take appropriate action e Communicate effectively with others during the operation and performance evaluation of steam propulsion plant and auxiliary systems
2 Evidence required for demonstration of consistent performance	a Performance is demonstrated consistently over a period of time and in a suitable range of contexts b Consistently applies underpinning knowledge and skills when: 1 managing the operation, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems 2 identifying malfunctioning and faulty steam propulsion plant and auxiliary systems on a steam vessel and initiating appropriate action for repair or replacement

	3 exercising all required safety, environmental and hazard control precautions and procedures when overseeing the operation and performance evaluation of steam propulsion plant and auxiliary systems 4 identifying and implementing improvements to procedures for the operation and performance evaluation of steam propulsion plant and auxiliary systems 5 completing required documentation, reports and records when operating, monitoring and evaluating the performance of steam propulsion plant and auxiliary systems c Shows evidence of application of relevant workplace procedures, including: 1 relevant sections maritime regulations 2 OH&S regulations and hazard prevention policies and procedures

Evidence Guide (**continued**)

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2 Evidence required for demonstration of consistent performance (**continued**)	3 safety management system procedures and work instructions on the operation and performance evaluation of steam propulsion plant and auxiliary systems 4 following on-board housekeeping processes 5 waste, pollution and recycling management processes d Action is taken promptly to report and/or rectify steam propulsion plant malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with statutory requirements, company procedures and the ISM Code e Work is managed, controlled and completed systematically with required attention to detail f Recognises and adapts appropriately to cultural differences in the workplace, including modes of behaviour and

	interactions among crew and others
3 Context of assessment	a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation: 1 As a minimum, assessment of knowledge must be conducted through appropriate written/oral examinations, and 2 Appropriate practical assessment must occur: i at the registered training organisation; and/or ii on an appropriate working or training vessel
4Specific resources required for assessment	Access is required to opportunities to: a participate in a range of practical and theoretical assignments, exercises, case studies and other assessments that demonstrate the skills and knowledge to operate and evaluate the performance of steam propulsion plant and auxiliary systems typically found on a steam vessel over 750 kW propulsion power; and/or b operate and evaluate the performance of steam propulsion plant and auxiliary systems in a range of operational situations on a commercial or training steam vessel over 750 kW propulsion power

Range Statement

Range Statement

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The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

VARIABLE	SCOPE
1. GENERAL CONTEXT	
a. Work must be carried out:	1 in compliance with mandatory rules and regulations and IMO Conventions and Codes, including the relevant sections of the AMSA Marine Orders. Applicable codes, guidelines and standards recommended by IMO, the classification societies and maritime industry organisations must be taken into account
b. Work is performed:	1 relatively independently under broad operational requirements, with accountability for self and others in achieving the prescribed outcomes

The Range Statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance.

c. Work involves:	1	the application of marine engineering practice to the operation, monitoring and evaluation of steam propulsion plant and auxiliary systems on a steam vessel over 750 kW propulsion power in typical operational contexts. Contribution to the development and implementation of a broad plan or strategy for the operation, monitoring and evaluation of performance of the steam propulsion plant and auxiliary systems is required and accountability and responsibility for self and others in achieving the outcomes is involved
d. Work requires:	1	significant judgement in planning, engineering and leadership functions related to operation, maintenance, repair, monitoring and evaluation of the performance of steam propulsion plant and auxiliary systems. This includes management and control of personnel, analysis of the situation and decision making

2. WORKSITE ENVIRONMENT

a The operation, monitoring and evaluation of engine and plant installation performance may be undertaken	1	on an Australian or international commercial vessel using steam propulsion over 750 kW propulsion power

Range Statement (continued)

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VARIABLE	SCOPE

VARIABLE	SCOPE
b The operation, monitoring and evaluation of propulsion plant performance may be carried out	1 by day or night in both normal and emergency situations 2 under any permissible conditions of weather 3 while underway 4 during berthing and unberthing operations 5 while anchored, drifting or moored 6 when bunkering 7 during cargo operations
c Propulsion plant configurations may include:	1 steam turbine plant and associated systems 2 stern tube bearing 3 CPP 4 shafting 5 reduction gears 6 thrust blocks and shaft bearings
d Types of propulsion plant and related auxiliary systems may include:	1 steam turbine and auxiliary systems and controls 2 steam boilers 3 steering gear, stabilisers, bow thrusters, rudders 4 fluid power systems and controls 5 pumps and pumping systems 6 portable and fixed firefighting installations and fire control and monitoring systems 7 auxiliary systems and controls, including i fresh and salt water cooling systems ii lubricating oil cooling systems

VARIABLE	SCOPE
	iii fuel, oil, gas, coal systems and centrifuges iv air starting systems for emergency or auxiliary generators v lubrication vi on-board air compressors and compressed air and control air systems vii waste management and pollution control systems

Range Statement (**continued**)

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VARIABLE	SCOPE
d Types of propulsion plant and related auxiliary systems may include: (**continued**)	vii i sewage plant ix fixed firefighting installations and fire control systems x auxiliary boilers and waste heat generators
e Potential hazards during operations and performance evaluation of propulsion plant and auxiliary systems may include:	1 cold pipes and valves (refrigeration and liquefied gas cargoes) 2 dangerous atmosphere 3 electrical wiring and systems 4 faulty machinery equipment handling equipment and lifting gear 5 flammable liquids, vapours and fuel 6 hot pipes and valves (water, steam, gas, fuel oil, lubricating

VARIABLE	SCOPE
	oil) 7 machinery overload 8 moving and rotating machinery 9 moving heavy loads using unsafe lifting procedures 10 non-compliance with safe working procedures 11 noxious and dangerous cargoes 12 operating equipment beyond safe working limits 13 overspeeding of machinery, emergency trips (electrical generation and main propulsion 14 poor housekeeping procedures 15 power tools and other sharp tools and implements 16 slippery deck 17 unsecured machinery, components or equipment 18 using equipment beyond safe working limits 19 working at heights and in confined spaces

Range Statement (**continued**)

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VARIABLE	SCOPE
g Emergencies may include:	1 loss of propulsion 2 loss of electrical power 3 loss of steering 4 flooding of engine room

VARIABLE	SCOPE
	5 fire or explosion in engine room 6 fuel oil, lubrication oil, steam and gas leaks 7 overheating and overspeed of machinery, governors, emergency trips 8 foundering/grounding of vessel 9 machinery failure (main or auxiliary)
f Testing and repair equipment may include:	1 test equipment, meters and gauges (including micrometers, vernier callipers, rules) 2 computer displays of performance parameters 3 hand tools, such as spanners, wrenches, screwdrivers, hacksaws, etc. 4 greasing and lubrication tools 5 electric power tools, such as grinders, lathes, drills, etc. 6 pneumatic power tools, such as grinders, sanders, drills, etc. 7 welding equipment 8 block and tackle 9 portable and manual lifting equipment and hydraulic jacks and specialist tools 10 material safety data sheets 11 protective clothing and equipment such as: i eye and ear protection and safety boots ii dust and fume masks iii safety helmet iv boilersuit/overalls

VARIABLE	SCOPE
h Documentation and records may include:	1 ISM Code safety management system plans, procedures, checklists and instructions 2 vessel and company's planned maintenance system, repair procedures and instructions

Range Statement (**continued**)

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VARIABLE	SCOPE
h Documentation and records may include: (**continued**)	3 manufacturer's specifications, instructions and recommended procedures for steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power 4 operational and performance log, running sheets and records, including computer database of operational and performance records where relevant 5 vessel's survey (class and statutory) as it relates to steam propulsion plant and auxiliary systems 6 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and class society rules dealing with the operation and performance evaluation of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power 7 instructions of relevant maritime authorities and class societies about the operation and performance evaluation of steam propulsion plant and auxiliary systems

VARIABLE	SCOPE
i Applicable legislation, regulations and codes may include:	1 sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and class society rules related to the operation and performance evaluation of steam propulsion plant and auxiliary systems on steam vessels over 750 kW propulsion power 2 relevant international, Commonwealth, State and Territory OH&S legislation 3 relevant international and Australian engineering practice standards

Unit Sector(s)

Not applicable.

Field

Field R Carry Out Operations on Equipment and Systems

Relationship to other units

Relationship to other units	The unit may be assessed in conjunction with other units that relate to the functions of the occupation(s) concerned.