



Australian Government

Department of Education, Employment and Workplace Relations

TDMMR5907A OPERATE STEAM PROPULSION PLANT AND ASSOCIATED SYSTEMS ON STEAM VESSELS

Release: 1

TDMMR5907A OPERATE STEAM PROPULSION PLANT AND ASSOCIATED SYSTEMS ON STEAM VESSELS

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to operate main steam propulsion plant and associated control systems on board a commercial steam vessel, including start up and shut down of steam propulsion plant and associated systems on a vessel of unlimited propulsion power., identifying malfunctions and taking appropriate action, exercising all required safety and pollution control measures, and keeping all required operational records.

Application of the Unit

Application of the unit	The unit has application in the qualifications for an Engineer Watchkeeper on a vessel greater than 750 kW, i.e. Diploma of Transport&Distribution(Marine Engineering - Engineer Watchkeeper).
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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 the role and responsibilities of an Engineer Watchkeeper.
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Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

Elements and Performance Criteria Pre-Content

<i>Elements describe the essential outcomes of a unit of competency.</i>	<i>Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.</i>
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
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1 Operate steam propulsion plant and associated systems	- a Work plans for the operation of main steam propulsion plant and associated systems are as per watchkeeping procedures, operational instructions, vessel and company rules, and marine engineering practice - b Method of preparing the start up and shut down of main and auxiliary machinery as per manufacturer's specifications and instructions and established engineering practice and shipboard procedures - c Procedures for making available fuels, lubricants, cooling water, steam and air for the start up of main and auxiliary machinery are as per manufacturer's specifications and instructions and established engineering practice - d Required precautions are taken prior to start up of main propulsion and auxiliary machinery to minimise and control hazards and operational risks - e Steam propulsion plant and associated systems are operated within specified limits as per plans, procedures and manufacturer's instructions and specifications - f The performance of steam propulsion plant and auxiliary machinery and associated systems is monitored as per vessel's survey requirements and manufacturer's instructions and performance is compared with specifications and recommended limits of performance

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ELEMENT	PERFORMANCE CRITERIA
1 Operate steam propulsion plant and associated systems (continued)	g Malfunctions and deviations from performance norms are identified and appropriate action initiated to report or rectify the problem in accordance with marine engineering practice and vessel's procedures h Records of performance are maintained on running sheets and operations logs in accordance with vessel's procedures
2 Follow safety and hazard control procedures	a All required watchkeeping procedures, safety precautions and regulations are followed when operating steam propulsion plant and associated systems b Operational hazards 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 the operation of steam propulsion plant and associated systems d Where relevant and in consultation with a senior engineer, procedures and precautions necessary for entry into confined spaces on a vessel are correctly followed e Appropriate action is taken in a failure or emergency involving steam propulsion plant and associated systems to isolate and secure the plant and equipment and the vessel and maintain the safety of the vessel and persons involved f Appropriate action is taken to follow safety procedures during vessel manoeuvring g Shipboard emergency and contingency plans are followed in the event of a failure or emergency associated with steam propulsion plant and associated systems

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Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 National and international regulations Conventions and Codes, including AMSA Marine Orders applicable to the operation of steam propulsion plant and associated systems on vessels of unlimited propulsion power
- 2 Established engineering practice and procedures for the operation of shipboard steam propulsion plant and associated systems in warm through, manoeuvring, start up, normal running, emergency and shut down situations
- 3 Operational characteristics and performance specifications for the different types of steam propulsion plant and associated systems on a steam vessel of unlimited propulsion power
- 4 Fundamental principles of steam propulsion systems and boilers
- 5 The operating cycle of refrigeration and related problems on refrigeration plant performance, including:
 - a the principles of refrigeration
 - b the refrigeration cycle as a pressure/enthalpy diagram
 - c the properties of refrigerants used in refrigeration plants
 - d refrigeration effect and plant capacity

REQUIRED SKILLS AND KNOWLEDGE

- k a basic understanding of the various fittings mounted on boilers, including:
 - i the common operating routines of local water level indicators, including methods of blowing a gauge glass, clearing blockages, and overhaul of these devices, including: safety valves, feed check valves, blow down and such valves, etc.
 - ii the effects of blockages in the water, steam and drain cocks of water level indicators
 - j how a boiler is flashed up from cold and put in line
 - k the purpose of all alarms and shut downs incorporated in a marine boiler on a steam vessel
 - l typical configurations of, and operating principles applying to, the various steam distribution systems found on board a steam vessel
 - m the checks which should be made regularly during routine boiler and steam turbine operation and associated auxiliary machines
- 9 The nature and causes of typical malfunctions and/or poor performance steam propulsion plant and associated systems and the available methods for their detection and rectification
- 10 Types of operational and performance evaluation records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities
- 11 Maritime communication techniques needed during the operation of steam propulsion plant and associated systems
- 12 Procedures for the reading and interpretation of readings and indications of the performance of steam propulsion plant and associated systems
- 13 Typical vessel and machinery specifications, machinery design drawings, operational manuals, specifications and electrical and control circuit diagrams
- 14 Purpose and content of material safety data sheets
- 15 Basic principles of auxiliary marine diesel engines to a level suitable for a watchkeeper engineer on a steam vessel, including:
- a typical starting air and systems of auxiliary diesel engines, including all components normally found therein:
 - i starting methods of marine diesel engines
 - ii requirements for diesel engines for propulsion, power generation, and

- k a basic understanding of the various fittings mounted on boilers, including:
 - emergency use
 - iii methods of safety arrangements
 - iv common faults and appropriate action to be taken with starting systems
- b typical diesel engine lubrication systems, including:
 - i all components normally found therein
 - ii normal operational pressures and temperatures which should be expected
 - iii methods of lubricating the principal components of a marine diesel engine, with its associated gearing and/or chain drives, including common lubrication faults, symptoms, causes, and actions to be taken with such faults

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- c the operating principles and adjustments of diesel engine fuel injection equipment, including common service faults, symptoms, and causes of diesel fuel injection problems, and appropriate actions to be taken
 - d means of pressure charging diesel engines, including common service faults and appropriate actions to be taken and emergency operation and isolation procedures
 - e different methods of cooling marine diesel engines, including common requirements of cooling
 - f common faults and appropriate action to be taken with cooling of diesel engines
 - g the causes of crankcase and air-line explosions and uptake fires
- 16 Theory and preventative strategies for uptake, starting air-line, superheater, economiser and air heater fires and furnace explosions on a steam vessel, including:
- a plans for hazard reduction
 - b procedures for extinguishing fires
 - c regaining of control after fires or explosions

- c the operating principles and adjustments of diesel engine fuel injection equipment, including common service faults, symptoms, and causes of diesel fuel injection problems, and appropriate actions to be taken
- 17 Relevant safety, environmental and hazard control legislation, precautions and procedures relevant to the operation of steam propulsion plant and associated systems
 - 18 Typical operating precautions for steam propulsion plant and associated systems to ensure operational performance is in compliance with the bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations.
 - 19 Hazards and problems that can occur during the operation of steam propulsion plant and associated systems and appropriate preventative and remedial action and solutions
 - 20 Basic thermodynamics as it relates to the responsibilities of an officer on the engineering watch, including:
 - a basic thermodynamic properties of common working fluids.
 - b methods of heat transfer and related problems
 - c principles of heat transfer by conduction, convection and radiation and their application to marine systems
 - d elementary principles of steam plants
 - e saturated dry and wet steam, dryness fraction, superheated steam, enthalpy, steam tables, evaporation
 - f basic steam plant cycles and the function of each component
 - g the combustion process and the calorific value of fuels
 - h air/fuel ratio and the significance of excess air on combustion
 - i the operating cycle of single stage reciprocating air-conditioners
 - j meaning of gauge and absolute pressure
 - k temperature and temperature scales
 - l SI units and common thermodynamic terms and principles.

- c the operating principles and adjustments of diesel engine fuel injection equipment, including common service faults, symptoms, and causes of diesel fuel injection problems, and appropriate actions to be taken
- 21 Compression and expansion of gases, including gas laws, Boyle's Law, Charles Law, characteristic gas equation, gas constant, isothermal, adiabatic and polytropic processes, and specific heat capacity

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- 22 Basic principles of mechanics as they relate to machine operation, including:
- a statics, force as a vector, triangle and polygon of forces, the principle of moments, application to simply supported beams and cranked levers, moments of force, couples, centroids and centres of gravity limited to geometrical shapes, resultant and equilibrant of a system of concurrent coplanar forces
 - b laws of friction for dry surfaces, coefficient of friction (horizontal plane only), lubrication of bearings and plain surfaces
 - c linear displacement, time speed, velocity and acceleration. angular motion
 - d problems with constant force or force with linear variation, torque, work, energy, power, conservation of energy, potential and kinematic energy, Newton's laws of motion, momentum, rate of change of momentum, centrifugal force
 - e simple lifting machines, graphs of load-effort and load-efficiency, linear law, velocity ratio, mechanical advantage and efficiency of the following machines: wheel and axle, differential pulley blocks, screw jack, Warwick screw, hydraulic jack, worm driven chain blocks and single and double purchase crab winches, reduction gearing
 - f direct stress and strain, Hooke's law, modulus of elasticity, elastic limit, ultimate tensile strength, yield stress, limit of proportionality, safety factor, shear stress
 - g circumferential and longitudinal stress in thin cylindrical and spherical shells subject to internal pressure
- 23 Basic principles of naval architecture, including:
- a elementary principles of transverse stability
 - b shift of centre of gravity due to addition, removal, or transfer of masses

- 22 Basic principles of mechanics as they relate to machine operation, including:
- c qualitative treatment of free surface effect, water accumulation and their effect on stability
 - d structural strength
 - e variation of fluid pressure with depth
 - f loading due to head of liquid
 - g types of vessels and vessel construction, common terms used in the measurement of steel vessels and definitions of shipbuilding terms in general use
 - h precautions necessary before entering empty oil fuel or ballast tanks

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REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when operating steam propulsion plant and associated systems on a steam vessel
- 2 Communicate with multilingual crew where applicable using established techniques
- 3 Interpret and follow procedures for the operation of steam propulsion plant and associated systems on a steam vessel
- 4 Read and interpret equipment performance readings and instrumentation
- 5 Interpret and follow all safety management procedures and precautions when operating steam propulsion plant and associated systems on a steam vessel
- 6 Read and interpret material safety data sheets
- 7 Read and interpret vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 8 Work collaboratively with other shipboard personnel when operating steam propulsion plant and systems
- 9 Identify problems that can occur during the operation of steam propulsion plant and associated systems on a steam vessel
- 10 Carry out calculations required when operating steam propulsion plant and associated systems on a steam vessel
- 11 Adapt to differing types of steam propulsion plant and associated systems from one vessel to another and when equipment and systems are changed
- 12 Take appropriate precautions to prevent pollution of the marine environment
- 13 Select and use tools and equipment required for the operation of steam propulsion plant and associated systems on a steam vessel

Evidence Guide

Evidence Guide

TDMMR5907A OPERATE STEAM PROPULSION PLANT AND ASSOCIATED SYSTEMS ON STEAM VESSELS

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 Ensure a safe engineering watch during the operation of steam propulsion plant and associated systems on a steam vessel - b Operate shipboard steam propulsion plant and associated systems within the required specifications - c Identify malfunctioning steam propulsion plant and associated systems and, in consultation with a senior engineer, initiate appropriate action for repair or replacement - d Exercise all required safety, environmental and hazard control precautions and procedures when overseeing the operation of steam propulsion plant and associated systems on a steam vessel - e Identify typical operational problems and hazards when operating steam propulsion plant and associated systems and take appropriate action - f Communicate effectively with others during operation of main and auxiliary machinery - g Ensure adherence to applicable maritime regulations
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 maintaining a safe engineering watch or in UMS mode involving the operation of steam propulsion plant and associated systems on a steam vessel

- 2 assessing operational performance of main and auxiliary machinery and associated system on a steam vessel
- 3 assisting in the identification of operational problems with main and auxiliary machinery and associated system and taking remedial action
- 4 taking action, in consultation with a senior engineer, to minimise any damage and safety risk that could be caused by malfunctions in main steam propulsion plant and associated system on a steam vessel
- 5 identifying and implementing improvements to procedures for the operation of steam propulsion plant and associated systems
- 6 applying safety precautions relevant to the operation of steam propulsion plant and associated systems
- 7 completing operations documentation and records

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)

- c Shows evidence of application of relevant workplace procedures, including:
 - 1 relevant sections of applicable maritime regulations
 - 2 OH&S regulations and hazard prevention policies and procedures
 - 3 ISM Code safety management system procedures, quality procedures and work instructions on the operation of steam propulsion plant and associated systems
 - 4 following on-board housekeeping processes
- d Action is taken promptly to report and assist in the rectification of malfunctions in steam propulsion plant and associated systems, 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 between 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
4 Specific 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 steam propulsion plant and associated systems typically found on a steam vessel of unlimited propulsion power; and/or b operate the steam propulsion plant and associated systems in a range of operational situations while keeping a safe engineering watch on a commercial or training steam vessel of unlimited 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
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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 and ensuring that applicable codes, guidelines and standards recommended by IMO, the classification societies and maritime industry organisations are taken into account
b. Work is performed:	1 relatively independently in consultation with a senior engineer, within broad operational requirements, with limited accountability and responsibility for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice to the operation and maintenance of steam propulsion plant and associated systems on a steam vessel across a wide and often unpredictable variety of operational contexts. Monitoring and supervising the implementation of a broad plan or strategy for the operation of steam propulsion plant and associated systems is required. Defined accountability and responsibility for self and others in achieving the outcomes is involved

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

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| d. Work requires: | 1 some responsibility for overseeing the operation of operation of steam propulsion plant and associated systems on a steam vessel. This includes supervision and control of personnel, hazard minimisation, analysis of performance and operational situations and related decision making |
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2. WORKSITE ENVIRONMENT

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| a The operation of steam propulsion plant and associated systems may be undertaken: | 1 on an Australian or international commercial steam vessel of unlimited propulsion power |
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Range Statement (continued)

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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
b Safe watchkeeping procedures and the operation of steam propulsion plant and associated systems on a steam vessel 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 or moored 6 while in dry dock 7 when bunkering

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

	8 while alongside the wharf and during cargo operations
c Propulsion plant configurations may include:	1 high pressure marine boilers and steam turbine plant and associated systems 2 stern tube bearing 3 CPP 4 direct drive shaft 5 reduction gears 6 thrust blocks and shaft bearings
d Steam propulsion plant and associated systems may include:	1 steam turbine propulsion and associated 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 auxiliary systems and controls, including - i fresh and salt water cooling systems - ii lubricating oil cooling systems - iii fuel, oil, gas, coal systems and centrifuges - iv air compressor and air starting systems - v lubrication - vi on-board air compressors and compressed air and control air systems - vii waste management and pollution control systems

Range Statement (continued)

TDMMR5907A OPERATE STEAM PROPULSION PLANT AND ASSOCIATED CONTROL SYSTEMS ON STEAM VESSELS

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
d Steam propulsion plant and associated systems may include: (continued)	- vii sewage plant - i 7 portable and fixed firefighting installations and fire control and monitoring systems
e Potential hazards during operation of steam propulsion plant and associated 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 (steam, fuel oil, lubricating 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

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

	13 overspeed of electrical machinery, emergency trips
	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
f Emergencies may include:	1 loss of propulsion
	2 loss of steering
	3 flooding of engine room
	4 fire or explosion in engine room

Range Statement (continued)

TDMMR5907A OPERATE STEAM PROPULSION PLANT AND ASSOCIATED SYSTEMS ON STEAM VESSELS

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
f Emergencies may include: (continued)	5 loss of refrigeration
	6 loss of water making ability
	7 fuel oil, lubrication oil, steam and gas leaks
	8 loss of electrical power
	9 pump failure

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

	10 overheating and overspeed of machinery, governors, emergency trips 11 electric shock
g Documentation and records may include	1 ISM Code safety management system plans, procedures, checklists and instructions 2 vessel and company's operational procedures and instructions 3 manufacturer's specifications, instructions and recommended procedures 4 running sheets, operations logs and other operational records, including computer database of running information, where relevant 5 vessel's survey procedures and instructions 6 vessel's safety and emergency contingency plans and procedures 7 relevant sections of national and international maritime regulations, 8 instructions of relevant maritime authorities and class societies concerning operation of steam propulsion plant and associated systems
h Applicable regulations and legislation 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 of steam propulsion plant and associated systems 2 relevant international, Commonwealth, State and Territory OH&S legislation 3 relevant international, Commonwealth, State and Territory engineering standards

Unit Sector(s)

Not applicable.

Field

Field R Communications

Relationship to other units

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