



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT, SYSTEMS AND SERVICES ON VESSELS OVER 750 KW PROPULSION POWER**

**Release: 1**

## **TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT, SYSTEMS AND SERVICES ON VESSELS OVER 750KW PROPULSION POWER**

### **Modification History**

Not applicable.

### **Unit Descriptor**

**UNIT DESCRIPTOR:**

**This unit involves the skills and knowledge required to ensure the safe operation and condition of the machinery installation 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 vessels between 750 kW and 3,000 kW propulsion power**
- **First Engineer (Second Engineer for STCW 95 Code) on vessels over 750 kW propulsion power.**

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### **Application of the Unit**

<b>Application of the unit</b>	The unit has application in the 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).
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### **Licensing/Regulatory Information**

<b>Licensing/legislative requirements</b>	The unit is consistent with the relevant sections of STCW 95 and Marine Orders under the Australian Navigation Act, describing requirements for a Chief Engineer on a ocean-going vessel between 750 kW and 3,000 kW propulsion power.
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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
<p>1 <b>Ensure application of safe operational and maintenance procedures and precautions</b></p>	<p>a The management of the operation and maintenance of the shipboard machinery installation is carried out in accordance with established safety procedures</p> <p>b Precautions are taken prior to start up and operation of shipboard machinery and equipment to minimise and control hazards and operational risks in accordance with vessel and company safe working procedures, manufacturer's specifications and instructions, and established engineering practice</p> <p>c Safe watchkeeping procedures are carried out as per vessel's classification requirements, company procedures and regulatory requirements</p> <p>d Identified and potential operational problems with machinery are identified and investigated</p> <p>e Appropriate action is initiated to rectify any identified operational problems with due regard to potential hazards to personal safety of crew, passengers and others on the vessel</p>

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
 SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
 PROPULSION POWER**

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
<b>2 Follow safety and hazard control procedures</b>	<ul style="list-style-type: none"> <li>a Safe watchkeeping procedures, safety, hazard minimisation and pollution control procedures are developed and implemented as per maritime regulations and company procedures</li> <li>b Operational hazards in the operation of shipboard machinery are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment</li> <li>c Relevant national and international regulations are followed at all times during machinery operations and maintenance</li> <li>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</li> <li>e Action is taken in the event of a machinery failure or emergency to secure the machinery and the vessel and ensure the safety of the vessel and persons involved</li> <li>f Shipboard emergency and contingency plans are followed in the event of a machinery failure or emergency during start up or shut down of main propulsion and auxiliary machinery</li> </ul>
<b>3 Document safety-related information</b>	<ul style="list-style-type: none"> <li>a Records of safety checks and precautions are entered and filed in accordance with ship, class and regulatory requirements</li> <li>b Safety incidents are investigated and reported as per regulations and company procedures</li> </ul>

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

## **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 start up and shut down of main propulsion and auxiliary machinery and associated systems on vessels of between 750 kW and 3,000 kW propulsion power
- 2 Relevant OH&S legislation, policies and procedures
- 3 Established engineering practice for ensuring the safe and efficient operation and condition of shipboard machinery installations
- 4 Operational characteristics and performance specifications for the different types of machinery installation usually found on a vessel of between 750 kW and 3,000 kW propulsion power
- 5 Procedures for checking the various parts of the shipboard machinery installation to ensure compliance with the company and survey requirements and established safety rules and regulations
- 6 The nature and causes of typical start up and shut down malfunctions of main propulsion and auxiliary machinery and associated systems and the available methods for their detection and rectification
- 7 Safety, environmental and hazard control precautions and procedures relevant to the operation of shipboard machinery installation on a vessel of between 750 kW and 3,000 kW propulsion power
- 8 Hazards and associated safety risks associated with the machinery installation on the vessel, including:
  - a the range of control measures available for these safety risks
  - b considerations for choosing between different control measures
  - c how to identify when expert advice is needed

- 9 Types of operational records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities
- 10 Maritime communication techniques needed during the start up and shut down of main propulsion and auxiliary machinery and associated systems
- 11 Purpose and content of material safety data sheets
- 12 Vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 13 Safety issues, hazards and precautions associated with the operation of:
  - a engines and propulsion plant
  - b fuel systems
  - c engine cooling and lubrication systems
  - d electrical plant and distribution systems
  - e marine control systems
  - f auxiliary machinery and associated systems

<b>TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT, SYSTEMS AND SERVICES ON VESSELS OVER 750 KW PROPULSION POWER</b>
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- 14 A basic understanding of the properties, characteristics and application of materials and structures typically used in the construction of a vessel of between 750 kW and 3,000 kW propulsion power and its associated operational machinery and a basic knowledge of the properties and characteristics of liquids, fuels, lubricants, gases and vapours used on board vessel
- 15 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- 16 Principles and operational characteristics of power transmission systems, including gearing, chain, hydraulic and belt
- 17 Principles and operational characteristics of internal combustion engines, 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

18 Principles of fuel systems, including:

- a typical injection pressures and viscosities for different grades of fuel
- b alterations to fuel pumps, camshafts and injectors for varying fuel types
- c differences between constant and variable injection timing of fuel
- d injection requirements for different speeds of diesel engine
- e common service faults, symptoms and causes of combustion problems and related solutions
- f fuel line pulsation damping devices and leakage protection
- g fuel valve cooling arrangements
- h uni-fuel and dual fuel systems

19 Principles of engine cooling and lubrication, including:

- a different methods of diesel engine cooling
- b need for treatment of engine cooling water
- c methods of treating engine cooling water
- d diesel engine lubrication requirements
- e methods of lubricating diesel engine components
- f theory and types of lubrication
- g relative characteristics and applications of mineral and synthetic oils
- h contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants
- i common lubrication problems and their solutions

20 Principles of operation of hydraulic and electronic overspeed governors

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

21 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 methods of load-dependent cooling of diesel alternators on heavy fuel oils
- e analysis of typical level control systems used on board vessel
- f operation and application of electronic PID controllers

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

- a central cooling and load dependent cooling control systems
- b main engine control arrangements for fixed pitch and controllable pitch propeller systems requiring sequential control
- c alarm and monitoring systems involving data loggers, alarm loggers and trend analysis

23 Theory and preventative strategies for scavenge and uptake fires, and starting air-line, crankcase and gearbox explosions, including:

- a plans for hazard reduction
- b procedures for extinguishment of scavenge fires
- c regaining of control after starting air-line, crankcase and gearbox explosions

24 Methods of providing air for combustion

25 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
- c gas cycles
- d properties and expansion of steam
- e steam cycles, including a specific understanding of the use of entropy charts and modifications to the steam cycle
- f boilers and evaporators
- g steam turbines, including an understanding of isentropic efficiency
- h combustion with a specific understanding of volumetric analysis
- i refrigeration and air-conditioning, including the use of entropy charts

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

## REQUIRED SKILLS

*This describes the basic skills required for this unit.*

- 1 Communicate effectively with other personnel when maintaining the safety of engine equipment, systems and services
- 2 Read and interpret vessel and equipment specifications, equipment drawings, operational manuals, and electrical circuit diagrams.
- 3 Read and interpret equipment performance readings and instrumentation
- 4 Read and interpret material safety data sheets
- 5 Provide leadership to other shipboard personnel on safety procedures and processes
- 6 Identify safety hazards related to engine equipment, systems and services and take appropriate action to minimise or eliminate them
- 7 Adapt to differing types of equipment and systems from one vessel to another and when equipment and systems are changed

## Evidence Guide

### Evidence Guide

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

*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.*

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|---|---|
| <b>1 Critical aspects of evidence required to</b> | Assessment must confirm appropriate knowledge and skills to:<br>a Ensure the safety of engine equipment, systems and services |
|---|---|

<p><b>demonstrate competency in this unit</b></p>	<p>on board a vessel of between 750 kW and 3,000 kW propulsion power</p> <ul style="list-style-type: none"> <li>b Ensure the safe and efficient operation and condition of shipboard machinery installation</li> <li>c Identify safety-related problems and hazards associated with the operation of the shipboard machinery installation and initiate appropriate action for their minimisation or elimination</li> <li>d Ensuring that personnel exercise all required safety, environmental and hazard control precautions and procedures when operating the shipboard machinery installation</li> <li>e Communicate effectively with others when operating the shipboard machinery installation, including use of the internal communication system</li> <li>f Ensure adherence to national and international safety regulations, IMO Conventions and Codes</li> </ul>
<p><b>2 Evidence required for demonstration of consistent performance</b></p>	<ul style="list-style-type: none"> <li>a Performance is demonstrated consistently over a period of time and in a suitable range of contexts</li> <li>b Consistently applies underpinning knowledge and skills when:             <ul style="list-style-type: none"> <li>1 ensuring the safety of engine equipment, systems and services on board a vessel of between 750 kW and 3,000 kW propulsion power</li> <li>2 ensuring the application of hazard control measures and safe working regulations and procedures to the efficient operation of the machinery installation</li> <li>3 identifying problems and hazards and initiating appropriate action for rectification</li> <li>4 communicating effectively with others during operations on the shipboard machinery installation</li> <li>5 identifying and implementing safety-related improvements to operational procedures</li> <li>6 completing safety-related documentation and records</li> </ul> </li> </ul>

- c Shows evidence of application of relevant workplace procedures, including:

**Evidence Guide (continued)**

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

**2 Evidence required for demonstration of consistent performance (continued)**

- 1 relevant sections of international Conventions and Codes and AMSA Marine Orders
- 2 OH&S regulations and hazard prevention policies and procedures
- 3 issue resolution procedures
- 4 safety management system procedures and work instructions on the operation of the shipboard equipment installation typically found on a vessel of between 750 kW and 3,000 kW propulsion power
- 5 machinery security procedures
- 6 following on-board housekeeping processes
- d Action is taken promptly to report and/or rectify machinery malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with statutory requirements, company procedures and the ISM Code
- e Recognises and adapts appropriately to cultural differences on board vessel in behaviour and interactions among officers, crew and passengers, where relevant
- f Work is managed, controlled and completed systematically with required attention to detail

**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

	<p>conducted through appropriate written/oral examinations, and</p> <p>2 Appropriate practical assessment must occur:</p> <ul style="list-style-type: none"><li>i at the registered training organisation; and/or</li><li>ii on an appropriate working or training vessel</li></ul>
<p><b>4 Specific resources required for assessment</b></p>	<p>Access is required to opportunities to:</p> <ul style="list-style-type: none"><li>a participate in a range of practical and theoretical assignments, exercises, case studies and other assessments that demonstrate the skills and knowledge to ensure the application of hazard control measures and safe working regulations and procedures to ensure the safety of engine equipment, systems and services on a vessel of between 750 kW and 3,000 kW propulsion power; and/or</li></ul>

**Evidence Guide (continued)**

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

<p><b>4 Specific resources required for assessment (continued)</b></p>	<p>b apply hazard control measures and safe working regulations and procedures to the efficient operation of the machinery installation on a commercial or training vessel of between 750 kW and 3,000 kW propulsion power</p>
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**Range Statement**

**Range Statement**

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
PROPULSION POWER**

*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**

<p><b>a. Work must be carried out:</b></p>	<p>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</p>
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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.*

<b>b. Work is performed:</b>	1 relatively independently under broad operational requirements, with accountability for self and others in achieving the prescribed outcomes within limits of responsibility
<b>c. Work involves:</b>	1 the application of national and international regulations, company safety policies and procedures and established safe engineering practice to ensure the safety of engine equipment, systems and services on a vessel of between 750 kW and 3,000 kW propulsion power. Contribution to the development and implementation of safe working procedures, operation plans and hazard control strategies is required and accountability and responsibility for self and others in achieving the outcomes is involved
<b>d. Work requires:</b>	1 significant judgement in making arrangements for the safe and efficient operation and condition of the shipboard machinery installation. This includes management and control of personnel, analysis of operational hazards and safe working requirements, and the checking of the condition of shipboard machinery and decision making

## 2. WORKSITE ENVIRONMENT

<b>a The machinery installation may include:</b>	1 those typically found on an Australian or international commercial vessel of between 750 kW and 3,000 kW propulsion power
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### Range Statement (continued)

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
 SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
 PROPULSION POWER**

VARIABLE	SCOPE

VARIABLE	SCOPE
<b>b The safe and efficient operation and condition of the shipboard machinery installation must be maintained at all times, including:</b>	<ol style="list-style-type: none"> <li>1 by day or night in both normal and emergency situations</li> <li>2 under any permissible conditions of weather</li> <li>3 during berthing and unberthing operations</li> <li>4 while anchored or moored</li> <li>5 in dry dock</li> <li>6 when bunkering</li> <li>7 during cargo operations</li> </ol>
<b>c Types of machinery encompasses all main, auxiliary and ancillary machinery and may include:</b>	<ol style="list-style-type: none"> <li>1 steam turbines, diesel, diesel electric and gas turbine propulsion systems and controls</li> <li>2 steering gear, stabilisers, bow thrusters, rudders</li> <li>3 fluid power systems and controls</li> <li>4 deck machinery</li> <li>5 pumps and pumping systems</li> <li>6 auxiliary systems and controls, including                         <ol style="list-style-type: none"> <li>i fresh and salt water cooling systems</li> <li>ii lubricating oil cooling systems</li> <li>iii fuel, oil, gas, coal</li> <li>iv air starting</li> <li>v lubrication</li> <li>vi bilge and ballast system, oily water separator</li> <li>vii refrigeration and air-conditioning plant and equipment</li> <li>viii on board air compressors and compressed air and control air systems</li> <li>ix waste management and pollution control systems as per the MARPOL Convention</li> </ol> </li> </ol>



VARIABLE	SCOPE
	x evaporators
	xi inert gas generator
	xii cargo pumps, tank washing machines and associated systems
	xiii purifiers and clarifiers
	xiv heaters
	xv sewage plant
	xvi fixed firefighting installations and fire control systems

**Range Statement (continued)**

<p><b>TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,                  SYSTEMS AND SERVICES ON VESSELS OVER 750 KW                  PROPULSION POWER</b></p>
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VARIABLE	SCOPE
<p><b>c Types of machinery encompasses all main, auxiliary and ancillary machinery and may include: (continued)</b></p>	<p>xvii main and auxiliary boilers and waste heat generators</p> <p>xvii lifesaving appliances</p> <p>i</p> <p>xix maintenance to hull and vessel side valves</p> <p>xx anchoring and mooring equipment</p> <p>xi maintenance of plant associated with the carriage of dangerous goods</p>
<p><b>d Propulsion plant configurations may include:</b></p>	<p>1 low speed, medium and high speed diesel propulsion</p> <p>2 stern tube bearing</p> <p>3 CPP</p> <p>4 direct drive shaft</p>

VARIABLE	SCOPE
	5 diesel electric 6 steam turbine 7 gas turbine 8 reduction gears 9 thrust blocks, detuners and shaft bearings
<b>e Types of electrical and electronic control equipment may include:</b>	1 programmable logic controllers (PLCs) 2 signal transmission systems used for monitoring and control 3 temperature and pressure sensors 4 electronic PID controllers 5 analogue to digital converters 6 electrical and electronic equipment space monitoring alarm and control systems 7 AC generators 8 AC and DC motors, including: <ul style="list-style-type: none"> <li>i three phase induction motors such as squirrel cage, double cage, wound rotor and slip ring, TEFC, splash proof and submersible</li> <li>ii three phase synchronous motors</li> </ul> 9 three phase alternators 10 three phase transformers 11 electronic instrumentation and power supply circuits 12 main switchboard and shipboard power distribution systems, including:

**Range Statement (continued)**

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
 SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
 PROPULSION POWER**

VARIABLE	SCOPE
<p><b>e Types of electrical and electronic control equipment may include: (continued)</b></p>	<ul style="list-style-type: none"> <li>i distribution circuits and wiring</li> <li>ii protection devices</li> <li>iii circuit breakers</li> <li>13 emergency supply systems, including emergency generators and battery banks</li> <li>14 electronic governors</li> <li>15 deck electrical machinery</li> </ul>
<p><b>f Operational hazards may include but are not restricted to:</b></p>	<ul style="list-style-type: none"> <li>1 moving heavy loads in an unsafe work environment</li> <li>2 unsecured machinery, components or repaired equipment</li> <li>3 slippery deck</li> <li>4 welding equipment</li> <li>5 sharp tools and implements</li> <li>6 power tools</li> <li>7 moving and rotating machinery</li> <li>8 flammable liquids, vapours and fuel</li> <li>9 faulty machinery equipment handling equipment and lifting gear</li> <li>10 using equipment beyond safe working limits</li> <li>11 poor housekeeping procedures</li> <li>12 non-compliance with safe working procedures</li> </ul>

VARIABLE	SCOPE
	13 electrical wiring and systems
	14 hot pipes and valves (steam, fuel oil, lubricating oil)
	15 cold pipes and valves (refrigeration and liquefied gas cargoes)
	16 working at heights
	17 exposed electrical circuits
	18 toxic gases and substances
	19 chemicals and other harmful substances
	20 damaged cargo and containers
	21 noxious and dangerous cargoes
	22 overspeed of electrical machinery, emergency trips

**Range Statement (continued)**

**TDMMF2407B MAINTAIN SAFETY OF ENGINE EQUIPMENT,  
 SYSTEMS AND SERVICES ON VESSELS OVER 750 KW  
 PROPULSION POWER**

VARIABLE	SCOPE
<b>g Documentation and records may include:</b>	1 ISM Code safety management system plans, procedures, checklists and instructions  2 vessel's and company's safety management policies, emergency contingency plans and procedures  3 identifying records required under OH&S legislation, for example: <ul style="list-style-type: none"> <li>i workers' compensation and rehabilitation records</li> <li>ii hazardous substances registers</li> <li>iii material safety data sheets</li> </ul>

VARIABLE	SCOPE
	<ul style="list-style-type: none"> <li>iv major accident/injury notifications and</li> <li>v certificates and licences</li> <li>4 manufacturer's operating and maintenance instructions and OH&amp;S information</li> <li>5 OH&amp;S audits and inspection reports</li> <li>6 maintenance and testing reports</li> <li>7 workplace environmental monitoring and health surveillance records</li> <li>8 records of instruction and training</li> <li>9 first aid/medical post records.</li> </ul>
<p><b>h Applicable legislation, regulations and codes may include:</b></p>	<ul style="list-style-type: none"> <li>1 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules dealing with OH&amp;S in shipboard workplaces</li> <li>2 relevant international, Commonwealth, State and Territory OH&amp;S legislation, particularly:                             <ul style="list-style-type: none"> <li>i OH&amp;S Acts, regulations and codes of practice, including regulations and codes of practice relating to hazards present in the workplace or industry</li> <li>ii general duty of care under OH&amp;S legislation and common law;</li> <li>iii requirements for the maintenance and confidentiality of records of occupational injury and disease;</li> <li>iv requirements for provision of OH&amp;S information and training;</li> <li>v provisions relating to OH&amp;S representatives and/or OH&amp;S committees</li> <li>vi provisions relating to OH&amp;S issue resolution.</li> </ul> </li> </ul>

## Unit Sector(s)

Not applicable.

## Field

Field MF Operational Quality and Safety

## Relationship to other units

<b>Relationship to other units</b>	The unit may be assessed in conjunction with other units that form part of a maritime worker's job function.
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