



**Australian Government**

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

# **TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

**Revision Number: 1**

## TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY

### Modification History

Not applicable.

### Unit Descriptor

UNIT DESCRIPTOR:

**This unit involves the skills and knowledge required of an Engineer Class 3 to dismantle, inspect, repair and reassemble machinery as may be required on commercial vessels powered by main propulsion machinery of less than 3,000 kW of propulsion power within offshore limits.**

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### Application of the Unit

<b>Application of the unit</b>	The unit has applications in the qualification for an Engineer Class 3 as per relevant sections of Part D of the National Standard for Commercial Vessels (NSCV) (i.e. Diploma of Transport&Distribution (Coastal Marine Engineering - Engineer Class 3).
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### Licensing/Regulatory Information

<b>Licensing/legislative requirements</b>	The unit is consistent with the relevant sections of State and Territory maritime regulations and NSCV/USL Code for an Engineer Class 3.
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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
<b>1 Investigate machinery malfunctions and faults</b>	<ul style="list-style-type: none"> <li>a Reported poor performance and malfunctions of machinery are investigated as per manufacturer's instructions and appropriate action is initiated to rectify the identified problem within the limits of responsibility and skill of an Engineer Class 3</li> <li>b Appropriate action is taken to prevent damage as per vessel's planned maintenance system, safety regulations and manufacturer's instructions</li> <li>c Faulty equipment and components are identified and reported, and appropriate action is initiated as required for isolation, tagging and repair or replacement within the limits of responsibility of an Engineer Class 3</li> <li>d Planning of the repair processes and the organisation of the repairs is carried out within the limits of responsibility of an Engineer Class 3 and in consultation with other relevant engineering personnel where applicable</li> </ul>

ELEMENT	PERFORMANCE CRITERIA
<p><b>2 Dismantle, inspect and repair vessel machinery</b></p>	<p>a Machinery is dismantled as per manufacturer's instructions and planned procedures</p>
<p><b>ELEMENT</b></p>	<p><b>PERFORMANCE CRITERIA</b></p>
<p><b>2 Dismantle, inspect and repair vessel machinery (continued)</b></p>	<p>b Machinery parts and components are inspected for damage and malfunction using established procedures</p> <p>c Damaged or faulty components are identified and repaired or replaced within the limits of responsibility and skill of an Engineer Class 3 and as per company planned maintenance system or procedures and manufacturer's instructions</p>
<p><b>3 Reassemble and check repaired machinery</b></p>	<p>a Repaired machinery is reassembled as per manufacturer's instructions and established procedures</p> <p>b Assembled machinery is checked and tested against manufacturer's specifications</p> <p>c Repaired machinery is restarted and adjusted in accordance with vessel's procedures and manufacturer's instructions and in consultation with relevant personnel</p> <p>d Performance of repaired machinery and associated safety devices, control systems and alarms, where relevant, is tested in accordance with manufacturer's instructions</p> <p>e Performance against recommended performance specifications is confirmed and the machinery is recommissioned in accordance with vessel's procedures</p>
<p><b>4 Complete maintenance and repair documentatio</b></p>	<p>a Correct records are made relating to maintenance and repair operations and machinery failure incidents</p> <p>b All planned maintenance system and repair documentation is</p>

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
<b>n</b>	completed in accordance with survey and company requirements and regulations
<b>5 Follow safety and hazard control procedures</b>	<ul style="list-style-type: none"><li>a Tests, inspections and repairs of vessel machinery and associated safety devices, control systems and alarms are conducted in accordance with safety regulations and company procedures</li><li>b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment</li><li>c Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during maintenance and repair operations</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 maintain the safety of the vessel and persons involved and shipboard emergency, and contingency plans are followed</li></ul>

## Required Skills and Knowledge

### REQUIRED KNOWLEDGE

*This describes the knowledge required for this unit.*

- 1 Applicable sections of relevant maritime regulations
- 2 Relevant OH&S and pollution control legislation and policies
- 3 Established engineering practice for the checking, maintenance and repair of marine machinery on commercial vessels of less than 3,000 kW propulsion power operating within offshore limits, including:
  - a fitting

## **REQUIRED KNOWLEDGE**

- b machining
- c gas cutting and welding
- d arc welding
- e workshop practice

## REQUIRED KNOWLEDGE

- 4 Operational characteristics and performance specifications for the different types of shipboard machinery usually found on vessels of less than 3,000 kW propulsion power
- 5 Procedures for carrying out shipboard machinery testing, troubleshooting and repair as part of routine maintenance procedures falling within the limits of responsibility and skills of an Engineer Class 3
- 6 The nature and causes of shipboard machinery malfunctions and the available methods for their detection and repair, including marine machinery malfunction fault finding techniques
- 7 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions
- 8 Safe procedures for handling heavy machinery and component parts during maintenance and repair of shipboard machinery
- 9 Safe procedures for the use of hand and power tools and maintenance equipment during maintenance and repair of shipboard machinery
- 10 Procedures for the initiation and coordination of temporary and permanent repair and/or replacement procedures on board vessels at sea, alongside and in dry dock
- 11 Safety, environmental and hazard control precautions and procedures relevant to shipboard machinery inspection and maintenance operations
- 12 Principal features of vessel construction and basic principles of transverse stability for vessels of less than 3,000 kW propulsion power
- 13 A basic understanding of the properties and application of materials and structures typically used in the construction of a vessel of less than 3,000 kW propulsion power and its associated operational machinery
- 14 Types of maintenance and repair records that must be maintained on a vessel to meet the requirements of the company, survey requirements and regulatory authorities
- 15 Maritime communication techniques needed during maintenance and repair operations
- 16 Purpose and content of material safety data sheets

- 17 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- 18 Typical vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 19 Mathematical techniques required to solve engineering problems falling within the limits of responsibility of an Engineer Class 3
- 20 Basic properties of common marine engineering materials and principles and methods of cutting, joining and heat treatment
- 21 Basic properties of liquids and gases commonly used aboard vessels
- 22 Principles and precautions that must be taken when carrying out 'hot work'
- 23 Precautions that must be taken to minimise danger of fire or explosion
- 24 Safety precautions that must be taken before entering tanks or confined spaces
- 25 Principles and procedures of machinery lubrication, including:
  - a theory and types of lubrication
  - b relative characteristics, and applications of mineral and synthetic oils
  - c contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants
- 26 Basic principles of mechanics as they relate to forces, pressures, stress and strains in shipboard dynamic machinery, including:
  - a statics (non-concurrent systems only)
  - b friction
  - c dynamics
  - e balancing
  - d radial, circumferential and, longitudinal stress
  - f shear stress
  - g fluid mechanics
  - h torsion, hollow and solid shafts



- 17 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- i loads due to liquid head
- 27 Basic principles of transverse stability and principles of naval architecture and vessel construction relevant to detection, identification and repair of faults, including:
- a draught, trim and heel
  - b propellers
  - c structural strength and vibration of vessels
  - d vessel measurement and classification
  - e load-line
  - f basic principles of transverse stability
  - g principles of free surface effects
  - h dry docks
  - i lifesaving equipment
  - j hull repairs and maintenance
- 28 Basic principles of thermodynamics and heat and heat engines relevant to detection, identification and repair of faults, including:
- a heat transfer
  - b gases
  - c properties and expansion of steam
  - d steam cycles
  - e boilers and evaporators
  - f steam turbines
  - g combustion
  - h refrigeration and air-conditioning.

- e load-line
- 29 The construction features of a ship that impact on its watertight integrity and stability
- 30 Principles involved in the alignment of machinery and machinery parts
- 31 Elementary principles and care and management of the various types of auxiliary pumps and pumping and piping systems and other shipboard auxiliaries
- 32 The basic principles of engine cooling, fuel and lubricating systems and fuel consumption
- 33 The basic principles of air compressors, their care and maintenance
- 34 The basic principles of operation and safety of boilers, steam and feed systems, steam engines and turbines
- 35 The colour coding system used for electric conductors
- 36 Definitions of electrical terms and solve basic electrical problems using mathematics
- 37 The basic principles of operation and operating procedures for AC and DC generators
- 38 Basic principles of preventative and remedial maintenance
- 39 Basic principles of the operation and maintenance of two and four stroke compression ignition engines, including engine construction and starting and reversing systems
- 40 Safety precautions and procedures during repair and inspection of electrical circuitry and equipment.
- 41 Basic principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, identification and repair of faults falling within the limits of responsibility of an Engineer Class 3, including:
  - a the electric circuit
  - b electrolytic action and cells
  - c basic principles of relevant AC and DC machines
  - d cabling, distribution and lighting systems

40 Safety precautions and procedures during repair and inspection of electrical circuitry and equipment.

e control gear

f switch gear

g deck machinery

40 Safety precautions and procedures during repair and inspection of electrical circuitry and equipment.

## **REQUIRED SKILLS**

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

- 1 Use communication skills required when dismantling, inspecting, repairing and reassembling machinery on a vessel of less than 3,000 kW propulsion power
- 2 Read, interpret and apply maintenance and service manuals and instructions and equipment specifications and drawings for equipment and machinery, including all required OH&S procedures and precautions
- 3 Read, interpret and follow standard operating and emergency procedures when dismantling, inspecting, repairing and reassembling machinery on a vessel of less than 3,000 kW propulsion power within limits of responsibility of an Engineer Class 3
- 4 Read and interpret material safety data sheets
- 5 Read and interpret and indications of machinery performance
- 6 Complete any required maintenance records
- 7 Provide leadership to other crew members when dismantling, inspecting, repairing and reassembling machinery on a vessel of less than 3,000 kW propulsion power
- 8 Work safely and collaboratively with others when dismantling, inspecting, repairing and reassembling vessel machinery
- 9 Plan and organise maintenance and repair activities on a small vessel
- 10 Monitor the selection and use of relevant tools and equipment as per instructions
- 11 Recognise faulty equipment and take appropriate action as per operating instructions
- 12 Recognise routine problems when dismantling, inspecting, repairing and reassembling vessel machinery and take appropriate action
- 13 Adapt to differences in vessels, equipment and machinery and standard maintenance procedures
- 14 Monitor that all safety precautions and procedures are followed when dismantling, inspecting, repairing and reassembling machinery on a vessel of less than 3,000 kW propulsion power

## Evidence Guide

### Evidence Guide

### TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY

*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.*

<b>1 Critical aspects of evidence required to demonstrate competency in this unit</b>	Assessment must confirm appropriate knowledge and skills to: <ul style="list-style-type: none"><li>a Investigate machinery malfunctions and faults</li><li>b Dismantle, inspect and repair vessel machinery within the limits of responsibility and skill of an Engineer Class 3</li><li>c Reassemble and check repaired machinery</li><li>d Complete maintenance and repair documentation</li><li>e Exercise all required safety, environmental and hazard control precautions and procedures when carrying out maintenance and repair of shipboard machinery</li><li>f Identify machinery maintenance and repair problems and hazards and take appropriate action</li><li>g Communicate effectively with others during maintenance and repair operations</li><li>h Ensure adherence to relevant national and international regulations, IMO Conventions and Codes</li></ul>
<b>2 Evidence required for demonstration of consistent performance</b>	<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 investigating machinery malfunctions and faults</li><li>2 dismantling, inspecting and repairing vessel machinery</li></ul></li></ul>

**Evidence Guide**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

- 3 reassembling and checking repaired machinery
- 4 completing maintenance and repair documentation
- 5 applying safety precautions relevant to mechanical and electrical machinery and equipment maintenance and repair operations
- c Shows evidence of application of relevant workplace procedures, including:
  - 1 relevant maritime regulations
  - 2 OH&S regulations, and pollution control and hazard prevention policies and procedures
  - 3 work instructions on the checking and repair of shipboard machinery, including machinery specifications and directions on equipment capability and limitations

**Evidence Guide (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

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

- 4 machinery security procedures
- 5 following on-board housekeeping processes
- 6 waste, pollution and recycling management processes
- d Action is taken promptly to report and/or rectify machinery malfunctions and safety incidents in accordance with regulations, 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

**Evidence Guide (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

**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 check and repair machinery and equipment typically found on a commercial vessel of less than 3,000 kW propulsion power, including the ability to identify an appropriate range of possible machinery malfunctions and carry out related maintenance and repair solutions; and/or
  - b Carry out checks and related repairs of shipboard machinery in a range of operational situations on a commercial or training vessel less than 3,000 kW propulsion power

## Range Statement

### Range Statement

### TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY

*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

<b>a. Work must be carried out:</b>	1 in compliance with relevant maritime regulations
<b>b. Work is performed:</b>	1 under broad guidelines, with accountability and responsibility for self and others in achieving the prescribed outcomes within the limits of responsibility and skill of an Engineer Class 3
<b>c. Work involves:</b>	1 the application of marine engineering practice to the dismantling, inspecting, repair and reassembly of machinery typically found on a vessel of less than 3,000 kW propulsion power across a range of machinery malfunctions or faults. Implementation of a broad plan or strategy for shipboard machinery maintenance and repair is required and accountability and responsibility for self and others in achieving the outcomes is involved
<b>d. Work requires:</b>	1 some judgement in planning and carrying out machinery repair operations and procedures. This includes analysis of the faulty machinery and decision making on the repairs required and the processes to be used

### 2. WORKSITE ENVIRONMENT



**Range Statement**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>a Machinery may include:</b>	1 that typically found on any Australian or international commercial vessel of up to 3,000 kW propulsion power operating within offshore limits
<b>b Machinery performance monitoring and repair may be carried out:</b>	<ul 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 while underway</li> <li>4 during berthing and unberthing operations</li> <li>5 while anchored or moored</li> <li>6 in dry dock</li> </ul>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>VARIABLE</b>	<b>SCOPE</b>
<b>b Machinery performance monitoring and repair may be carried out: (continued)</b>	<ul style="list-style-type: none"> <li>7 when bunkering</li> <li>8 during cargo operations</li> </ul>
<b>c Types of machinery may include:</b>	<ul style="list-style-type: none"> <li>1 steam, diesel, diesel electric and gas turbine propulsion systems and controls</li> <li>2 electrical systems and controls, including prime movers (where relevant)</li> <li>3 batteries, transformers, switchboards, distribution systems, lighting systems</li> </ul>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

- 4 steering gear, stabilisers, bow thrusters, rudders
- 5 fluid power systems and controls
- 6 deck machinery
- 7 pumps and pumping systems
- 8 auxiliary systems and controls, including
  - i fresh and salt water cooling systems
  - ii lubricating oil cooling systems
  - iii fuel, oil, gas and coal systems and centrifuges
  - iv air compressor and air starting systems
  - v lubrication
  - vi bilge and ballast system, oily water separator
  - vii refrigeration and air-conditioning plant and equipment
  - viii on-board air compressors and compressed air and control air systems
  - ix waste management and pollution control systems as per the MARPOL Convention
  - 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
  - xvii auxiliary boilers and waste heat generators

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

- xvii lifesaving appliances
- i
- xix hull and vessel side valves

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>VARIABLE</b>	<b>SCOPE</b>
<b>d Propulsion plant configurations may include:</b>	<ul style="list-style-type: none"> <li>1 low speed, medium and high speed diesel propulsion</li> <li>2 stern tube bearing</li> <li>3 CPP</li> <li>4 direct drive shaft</li> <li>5 diesel electric</li> <li>6 steam</li> <li>7 gas turbine</li> <li>8 water jets and control systems</li> <li>9 reduction gears</li> <li>10 thrust blocks, detuners and shaft bearings</li> </ul>
<b>e Testing and repair equipment may include:</b>	<ul style="list-style-type: none"> <li>1 meters and gauges</li> <li>2 computer displays of performance parameters</li> <li>3 hand tools, such as spanners, wrenches, screwdrivers, hacksaws, etc.</li> </ul>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

	<ul style="list-style-type: none"> <li>4 greasing and lubrication tools</li> <li>5 electric power tools, such as grinders, lathes, drills, etc.</li> <li>6 pneumatic power tools, such as grinders, sanders, drills, etc.</li> <li>7 welding equipment</li> <li>8 block and tackle</li> <li>9 portable and manual lifting equipment and hydraulic jacks</li> <li>10 material safety data sheets</li> <li>11 protective clothing and equipment such as:             <ul style="list-style-type: none"> <li>i safety boots, helmet and eye and ear protection</li> <li>ii dust and fume masks</li> </ul> </li> </ul>
<p><b>f Maintenance and repair hazards may include:</b></p>	<ul style="list-style-type: none"> <li>1 moving heavy loads using unsafe lifting procedures</li> <li>2 unsecured machinery, components or repair equipment</li> <li>3 slippery deck</li> <li>4 welding equipment</li> <li>5 sharp tools and implements</li> <li>6 power tools</li> </ul>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>VARIABLE</b>	<b>SCOPE</b>
<p><b>f Maintenance and repair hazards may include:</b> <b>(continued)</b></p>	<p>7 moving and rotating machinery</p> <p>8 flammable liquids, vapours and fuel</p> <p>9 faulty machinery equipment handling equipment or lifting gear</p> <p>10 using equipment beyond safe working limits</p> <p>11 poor housekeeping procedures</p> <p>12 non-compliance with safe working procedures</p> <p>13 electrical wiring and systems</p> <p>14 hot pipes and valves (steam, fuel oil, lubricating oil)</p> <p>15 cold pipes and valves (refrigeration and liquefied gas cargoes)</p> <p>16 working at heights</p>
<p><b>g Emergencies may include:</b></p>	<p>1 loss of propulsion</p> <p>2 loss of electrical power</p> <p>3 loss of engine and/or transmission control</p> <p>4 loss of steering</p> <p>5 flooding of engine room</p> <p>6 fire or explosion in engine room</p> <p>7 loss of refrigeration</p> <p>8 loss of water making ability</p>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

	9 fuel oil, lubrication oil, steam and gas leaks
	10 overheating and overspeed of machinery, governors, emergency trips
<b>h Documentation and records may include:</b>	<p>1 vessel's and company's planned maintenance system, repair procedures and instructions</p> <p>2 machinery and vessel manufacturer's specifications, instructions and recommended procedures</p> <p>3 maintenance log, running sheets and records</p> <p>4 computer database of running information and maintenance records</p> <p>5 vessel's survey as it relates to shipboard machinery</p> <p>6 vessel's safety and emergency contingency plans and procedures</p> <p>7 machinery and vessel manufacturer's specifications, instructions and recommended procedures</p>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>VARIABLE</b>	<b>SCOPE</b>
<b>h Documentation and records may include: (continued)</b>	<p>8 relevant maritime regulations</p> <p>9 instructions of relevant maritime authorities and classification societies concerning shipboard machinery maintenance and repair</p>

**Range Statement (continued)**

**TDMMB3807B DISMANTLE, INSPECT, REPAIR AND REASSEMBLE VESSEL MACHINERY**

<b>i Applicable legislation, regulations and codes may include:</b>	<ol style="list-style-type: none"><li>1 State and Territory marine regulations related to the operation of small vessels</li><li>2 National Standard for Commercial Vessels and USL Code</li><li>3 relevant international, Commonwealth, State and Territory OH&amp;S legislation</li><li>4 relevant international, Commonwealth, State and Territory engineering practice standards</li></ol>
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**Unit Sector(s)**

Not applicable.

**Field**

Field B Equipment Checking and Maintenance

**Relationship to other units**

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