



Australian Government

Department of Education, Employment and Workplace Relations

**TDMMB1507B DETECT AND IDENTIFY
THE CAUSE OF MACHINERY
MALFUNCTIONS AND REPAIR
FAULTS ON VESSELS OVER 750 KW
PROPULSION POWER**

Release: 1



Australian Government

Department of Education, Employment and Workplace Relations

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750KW PROPULSION POWER

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to detect and identify the cause of machinery malfunctions and repair faults 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.**

This includes the conduct of relevant maintenance and fault 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 and a First Engineer on a vessel over 750 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.
---	---

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>
--	--

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
. 1 Detect, identify and investigate machinery malfunctions and faults	. a The operation of shipboard machinery is monitored as per vessel's survey requirements and manufacturer's instructions and performance is compared with specifications and recommended limits of performance b Out of specification performance and faults are identified c Advanced diagnostic techniques are used to investigate poor performance and faults and appropriate action is initiated to rectify problems identified d Appropriate action is taken to prevent damage as per planned maintenance procedures, marine practice, safety regulations and manufacturer's instructions e Faulty equipment and components are identified and are reported and action is initiated as required for isolation, tagging and repair or replacement f Decisions are made to carry out temporary or permanent repairs depending on the vessel's position and circumstances

**TDMMB1501B DETECT AND IDENTIFY THE CAUSE OF MACHINERY
MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW
PROPULSION POWER**

ELEMENT	PERFORMANCE CRITERIA
1 Detect, identify and investigate machinery malfunctions and faults (continued)	g Appropriate consultation is undertaken with classification society and marine administration concerning the nature of the repairs and any contingency or emergency action required h Repair processes and control of engine room personnel to facilitate repairs are organised as per company procedures and practice
2 Repair faults in machinery	a Identified faults in shipboard machinery are investigated using advanced fault finding and problem solving techniques b Malfunctioning or faulty machinery is correctly isolated, and disassembled if necessary, as per manufacturer's instructions and established practice c Damaged or faulty components are repaired or replaced in accordance with company planned maintenance system or procedures, manufacturer's instructions and limits of responsibility d Repaired machinery is reassembled in accordance with manufacturer's instructions and established marine engineering practice e Repaired machinery is restarted and adjusted as per vessel's procedures and manufacturer's instructions and in consultation with relevant personnel f Performance of repaired machinery and associated safety devices, control systems and alarms is tested in accordance with manufacturer's instructions g Performance against recommended performance specifications is confirmed and the machinery is

ELEMENT	PERFORMANCE CRITERIA
	recommissioned as per vessel's procedures
3 Complete maintenance and repair documentation	- a Correct records are made relating to maintenance and repair operations and machinery failure incidents - b All planned maintenance system and repair documentation is completed as per survey and company requirements, the ISM Code and regulations
4 Follow safety and hazard control procedures	- a Tests, inspections and repairs of vessel machinery and associated safety devices, control systems and alarms are conducted as per safety regulations and company procedures - b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

ELEMENT	PERFORMANCE CRITERIA
4 Follow safety and hazard control procedures (continued)	- 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 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

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 Relevant maritime regulations, IMO Conventions and Codes, including AMSA Marine Orders
- 2 Relevant OH&S legislation, policies and procedures
- 3 Established engineering practice for the checking, maintenance and repair of marine machinery, including electrical machinery, systems and equipment
- 4 Operational characteristics and performance specifications for the different types of shipboard machinery usually found on a vessel between 750 kW and 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
- 6 Planned maintenance systems and procedures for the condition monitoring of machinery, including responsibilities and requirements covered by various forms of vessel survey
- 7 The nature and causes of typical shipboard machinery malfunctions and the available methods for their detection and repair, including advanced marine machinery malfunction fault finding techniques
- 8 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions falling within the limits of responsibility
- 9 Safe procedures for handling heavy machinery and component parts during maintenance and repair of shipboard machinery
- 10 Safe procedures for the use of hand and power tools and maintenance equipment during maintenance and repair of shipboard machinery
- 11 Procedures for the initiation and coordination of temporary and permanent repair and/or replacement procedures on board vessels at sea, alongside and in dry

REQUIRED KNOWLEDGE

dock

- 12 Safety, environmental and hazard control precautions and procedures relevant to shipboard machinery inspection and maintenance operations
- 13 Principal features of vessel construction and principles of transverse and longitudinal stability
- 14 Properties and application of materials and structures typically used in the construction of a vessel between 750 kW and 3,000 kW propulsion power and its associated operational machinery
- 15 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
- 16 Maritime communication techniques needed during maintenance and repair operations
- 17 Purpose and content of material safety data sheets
- 18 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- 19 Principles of fluid power control systems, including:
 - a system function requirements
 - b methods of displaying system functions

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

- c elementary programming and program modification for programmable logic controllers (PLCs)
 - d safety requirements
- 20 Principles of air-conditioning and refrigeration systems, including:
 - a principles of operation
 - b performance indicators

- c elementary programming and program modification for programmable logic controllers (PLCs)
 - c characteristics, hazards and handling requirements of CFCs and HCFCs
 - d safety and environmental requirements of air-conditioning and refrigeration systems
- 21 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
- 22 Principles of mechanics as they relate to as they relate to forces, pressures, stress and strains in shipboard dynamic machinery, including:
- a statics (mainly concurrent systems)
 - b friction
 - c dynamics
 - d balancing
 - e radial, circumferential and, longitudinal stress
 - f shear stress
 - g fluid mechanics
 - h torsion, hollow and solid shafts
 - i loads due to liquid head
- 23 Principles of transverse and longitudinal 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

- c elementary programming and program modification for programmable logic controllers (PLCs)
- e load-line
- f basic principles of transverse stability

**TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY
MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW
PROPULSION POWER**

- g principles of free surface effects
 - h dry docks
 - i lifesaving equipment
 - j hull repairs and maintenance
- 24 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
- 27 Principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, identification and repair of faults, including:
- a electromagnetism and electrostatics
 - b the electric circuit
 - c electrolytic action and cells

- g principles of free surface effects
- d theory and calculations of relevant AC and DC machines
- e cabling, distribution and lighting systems
- f control gear
- g switch gear
- h deck machinery
- i principles, calculations and diagnostics for shipboard electronic components and systems, including:
 - i electronics principles
 - ii integrated circuits
 - iii microprocessors
 - iv PLCs
 - v process control theory
 - vi instruments, calibration and testing

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

- vii electronic control, surveillance, measurement and recording systems
- vii telemetering devices
 - i
- ix alarm systems
- x main and auxiliary machinery control and UMS

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS 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 detecting and identifying the cause of machinery malfunctions and repairing faults
- 2 Interpret and follow safe maintenance and repair procedures on a vessel
- 3 Read and interpret machinery performance readings and indications
- 4 Read and interpret vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 5 Read and interpret material safety data sheets
- 6 Provide leadership to other shipboard personnel when managing the testing and maintenance of electronic control equipment and systems
- 7 Solve problems that can occur when detecting and identifying the cause of machinery malfunctions and repair faults on a vessel, take appropriate remedial action, and initiate appropriate solutions
- 8 Carry out calculations required when detecting and identifying the cause of machinery malfunctions and repair faults
- 9 Adapt to differing types of equipment and systems from one vessel to another and when equipment and systems are changed
- 10 Store and care for hand, power and special tools and instruments needed when detecting and identifying the cause of machinery malfunctions and repairing faults
- 11 Select and use appropriate tools, instruments and equipment required when detecting and identifying the cause of machinery malfunctions and repairing faults

Evidence Guide

Evidence Guide

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS 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.

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: - a Monitor the performance of shipboard machinery against specifications on a vessel of unlimited propulsion power - b Identify malfunctioning and faulty machinery and components and initiate appropriate action for repair or replacement - c Carry out basic troubleshooting of malfunctioning and faulty machinery and required repairs in accordance with established procedures falling within the limits of responsibility - e Exercise all required safety, environmental and hazard control precautions and procedures during the operation, maintenance and repair of machinery - f Identify machinery maintenance faults and repair problems and hazards and take appropriate action within the limits of responsibility - g Communicate effectively with others during maintenance and repair operations - h Ensure adherence to national and international 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 assessing operational performance of shipboard mechanical and electrical machinery and equipment

- 2 identifying shipboard mechanical and electrical machinery and equipment malfunctions and faulty plant and equipment of a vessel between 750 kW and 3,000 kW propulsion power
- b 3 taking action to minimise any damage and pollution that could be caused by machinery malfunctions
- 4 identifying and evaluating mechanical and electrical machinery and equipment maintenance and repair problems and determining appropriate courses of action
- 5 applying safety precautions relevant to mechanical and electrical machinery and equipment maintenance and repair operations
- 6 completing mechanical and electrical machinery and equipment maintenance and repair documentation and records
- c Shows evidence of application of relevant workplace procedures, including:

Evidence Guide (continued)

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

2 Evidence required for demonstration of consistent performance (continued)

- 1 relevant sections maritime regulations
- 2 OH&S regulations, pollution control and hazard prevention procedures
- 4 safety management system procedures and work instructions
- 5 machinery security procedures
- 6 following on-board housekeeping processes
- 7 waste, pollution and recycling management processes
- d Action is taken promptly to report and/or rectify machinery malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with regulations, 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
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 vessel of unlimited propulsion power, including the ability to identify an appropriate range of possible machinery malfunctions and carry out related maintenance and repair on a vessel between 750 kW and 3,000 kW propulsion power; and/or - b carry out checks, basic faultfinding and related repairs of shipboard machinery in a range of operational situations on a commercial or training vessel between 750 kW and 3,000 kW propulsion power

Range Statement

Range Statement

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS 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

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 under broad operational requirements, with accountability and responsibility for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice and advanced diagnostic techniques to the repair of machinery typically found on a vessel over 750 kW of propulsion power across a wide and often unpredictable variety of machinery malfunctions or faults. Contribution to the development and 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

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

- d. Work requires:**
- 1 significant judgement in planning, engineering and leadership functions related to machinery repair operations and procedures. This includes management and control of personnel, analysis of the situation and decision making

2. WORKSITE ENVIRONMENT

a Machinery may include:	1 that typically found on any Australian or international commercial vessel between 750 kW and 3,000 kW propulsion power
b Machinery performance monitoring and repair 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 in dry dock

Range Statement (continued)

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

VARIABLE	SCOPE
b Machinery performance monitoring and repair may be carried out: (continued)	7 when bunkering 8 during cargo operations

VARIABLE	SCOPE
c Types of machinery may include:	1 steam, diesel, diesel electric and gas turbine propulsion systems and controls 2 electrical systems and controls, including prime movers 3 batteries, transformers, switchboards, distribution systems, lighting systems 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 compressed air 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

VARIABLE	SCOPE
	- xv sewage plant - xvi fixed firefighting installations and fire control systems - xvii auxiliary boilers and waste heat generators - xvii lifesaving appliances - i

Range Statement (continued)

**TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY
MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW
PROPULSION POWER**

VARIABLE	SCOPE
c Types of machinery may include: (continued)	xix maintenance to hull and vessel side valves
d Propulsion plant configurations may include:	1 low speed, medium and high speed diesel propulsion 2 stern tube bearing 3 fixed pitch and CPP 4 direct drive shaft 5 diesel electric 6 steam turbine propulsion - oil/gas/coal-fired boilers 7 gas turbine 8 reduction gears 9 thrust blocks, detuners and shaft bearings

VARIABLE	SCOPE
e Testing and repair equipment may include:	1 meters, gauges and other test equipment 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 10 material safety data sheets 11 protective clothing and equipment such as: - i eye and ear protection - ii safety boots - iii dust and fume masks

Range Statement (continued)

TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW PROPULSION POWER

VARIABLE	SCOPE
f Maintenance and repair hazards may include:	1 moving heavy loads in an unsafe working environment 2 unsecured machinery, components or repair equipment 3 slippery deck 4 welding equipment

VARIABLE	SCOPE
	5 sharp tools and implements 6 power tools 7 moving and rotating machinery 8 flammable liquids, vapours and fuel 9 faulty machinery equipment handling equipment and lifting gear 10 using equipment beyond safe working limits 11 poor housekeeping procedures 12 non-compliance with safe working procedures 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 and in confined spaces
g Emergencies may include:	1 loss of propulsion 2 loss of electrical power 3 loss of steering 4 flooding of engine room 5 fire or explosion in engine room 6 loss of refrigeration 7 loss of water making ability 8 loss of control systems 9 fuel oil, lubrication oil, steam and gas leaks 10 overheating and overspeed of machinery, governors, emergency trips

Range Statement (continued)

**TDMMB1507B DETECT AND IDENTIFY THE CAUSE OF MACHINERY
MALFUNCTIONS AND REPAIR FAULTS ON VESSELS OVER 750 KW
PROPULSION POWER**

VARIABLE	SCOPE
h Documentation and records may include:	1 ISM Code safety management system plans, procedures, checklists and instructions 2 vessel's and company's planned maintenance system, repair procedures and instructions 3 machinery and vessel manufacturer's specifications, instructions and recommended procedures 4 maintenance log, running sheets and records 5 computer database of running information and maintenance records 6 vessel's survey as it relates to shipboard machinery 7 vessel's safety and emergency contingency plans and procedures 8 machinery and vessel manufacturer's specifications, instructions and recommended procedures 9 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders, classification society rules dealing with shipboard machinery maintenance, repair and survey inspections 10 instructions of relevant maritime authorities and classification societies concerning shipboard machinery maintenance and repair

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 classification society rules related to shipboard machinery maintenance and repair on vessels of unlimited propulsion power 2 relevant international, Commonwealth, State and Territory OH&S legislation 3 relevant international, Commonwealth, State and Territory engineering practice standards

Unit Sector(s)

Not applicable.

Field

Field B Equipment Checking and Maintenance

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.
------------------------------------	---