



Australian Government

Department of Education, Employment and Workplace Relations

TDMMB907B MANAGE SAFE MAINTENANCE AND REPAIR PROCEDURES ON VESSELS OF UNLIMITED PROPULSION POWER

Release: 1

TDMMB907B MANAGE SAFE MAINTENANCE AND REPAIR PROCEDURES ON VESSELS OF UNLIMITED PROPULSION POWER

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required by a Chief Engineer to manage safe maintenance and repair procedures on a commercial vessel powered by main propulsion machinery of unlimited propulsion power.

This unit is an updated and renamed version of the previous unit *TDMMB901A Organise safe maintenance and repair procedures on vessels of unlimited propulsion power*

Application of the Unit

Application of the unit	The unit has application in qualifications for Chief Engineer on a vessel of unlimited propulsion power operating in international waters, i.e. Advanced Diploma of Transport&Distribution(Marine Engineering Class 1).
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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 requirements for a Chief Engineer on a vessel of unlimited propulsion power operating in international waters.
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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 Plan and manage safe maintenance and repair procedures	- a Shipboard maintenance and repair requirements and goals are identified and defined - b Maintenance and repair operations and functions are correctly planned and managed using appropriate project planning and management techniques - c Maintenance resources and personnel are assigned to achieve established maintenance and repair requirements and goals in accordance with company procedures - d Access and arrangements for shore-based contractors carrying out maintenance activities on the vessel are planned and organised as per procedures consistent with the responsibilities of a Chief Engineer

ELEMENT	PERFORMANCE CRITERIA
2 Plan and prepare for classification and statutory machinery surveys	a Classification society and statutory surveys are planned and prepared in accordance with regulatory class and statutory requirements

ELEMENT	PERFORMANCE CRITERIA
2 Plan and prepare for classification and statutory machinery surveys (continued)	- b Compartments are prepared and gas freed as required for survey in accordance with established procedures and safe working practices - c Regions of vessel requiring routine shipboard close up inspection and maintenance are carried out in accordance with classification society hull life extension programs - d Inspection, survey repair and maintenance procedures for machinery, hull work, propellers and shafting are analysed and planned as per regulatory and survey requirements - e Dry docking, in-water hull cleaning and vessel lay-up are planned in accordance with established marine practice and regulatory/survey requirements

3 Monitor the completion of shipboard maintenance and repair activities	- a Shipboard preventative maintenance procedures are managed and completed in accordance with the responsibilities of a Chief Engineer - b Appropriate response is organised to reported faults and damage to the vessel and its equipment as per vessel procedures and established engineering management practice - c Inspections of completed maintenance and repair work are carried out as per vessel survey requirements and established engineering practice - d Vessel's internal communication system is used as per established procedures

ELEMENT	PERFORMANCE CRITERIA
4 Lead engine room personnel to achieve planned maintenance goals	- a Maintenance goals and job functions are clearly defined and communicated to engine room personnel - b Engine room personnel are motivated to achieve planned maintenance goals using established leadership methods - c Maintenance performance standards for engine room personnel are set, monitored and improved as per management practice and procedures - d Effective decision making and problem solving techniques are applied to engine room maintenance and personnel problems - e Conflicts between personnel are resolved using established conflict-resolution procedures
5 Complete maintenance and repair documentation	- a Correct records are made relating to the organisation and inspection of maintenance and repair operations and machinery failure incidents - b All maintenance and repair documentation is completed in accordance with survey and company requirements, class and statutory regulations
6 Establish safety management and hazard control strategies	- a Safety management strategies for shipboard maintenance and repair operations are developed and implemented as per class, regulatory requirements and company procedures - b Maintenance and repair hazards are identified and strategies established to minimise or eliminate risk to personnel, vessel and the environment
ELEMENT	PERFORMANCE CRITERIA
6 Establish safety management and hazard control strategies	- c Procedures and precautions are applied to reduce the risk of scavenge and uptake fires and starting air-line, crankcase and gearbox explosions - d Procedures and precautions necessary for entry into a pump room or other confined spaces on a vessel are established and

ELEMENT	PERFORMANCE CRITERIA
(continued)	communicated to relevant engine room crew e Personnel are trained and action is organised 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

Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 IMO Conventions and codes and AMSA Marine Orders applicable to the management of machinery maintenance and repair operations on vessels of unlimited propulsion power
- 2 Relevant OH&S legislation, policies and procedures
- 3 Advanced diagnostic techniques for carrying out shipboard machinery testing, troubleshooting and repair as part of maintenance procedures to ensure compliance with the company and survey requirements and established safety rules and regulations
- 4 Procedures for coordinating the overall management of planned maintenance systems and procedures for the condition monitoring of machinery, including responsibilities and requirements covered by various forms of vessel survey
- 5 Established engineering management practice for organising and inspecting the maintenance and repair of marine machinery, structures and equipment, including personnel management and training requirements
- 6 Engineering project scheduling and planning methods, including the use of GANTT charts and CPM/PERT network techniques
- 7 Functions and responsibilities of the engine room personnel for survey, maintenance and repair operations on board a vessel of unlimited propulsion power
- 8 Established staff leadership and motivational principles and techniques, including conflict resolution procedures
- 9 Maintenance hazards and hazard identification and control strategies
- 10 Operational characteristics and performance specifications for the different types of shipboard machinery and equipment usually found on a vessel of unlimited propulsion power
- 11 Procedures for carrying out shipboard machinery testing, troubleshooting and repair as part of routine maintenance procedures to ensure compliance with company and survey requirements and established safety rules and regulations
- 12 Planned maintenance systems and procedures for the condition monitoring of shipboard machinery, structures and equipment, including responsibilities and

REQUIRED KNOWLEDGE

requirements covered by various forms of vessel survey

- 13 Planning and operational procedures for dry docking and refloating, in-water cleaning and survey, and vessel lay-up
- 14 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
- 15 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- 16 Vessel and machinery specifications, machinery design drawings, operational manuals, specifications and electrical and control circuit diagrams

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- 17 The properties, characteristics and application of materials and structures typically used in the construction of a vessel of unlimited 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
- 18 Principal features of vessel construction and principles of transverse and longitudinal stability
- 19 The nature and causes of typical shipboard machinery/equipment malfunctions and the available methods for their detection and repair, including machinery malfunction fault finding techniques
- 20 Maintenance and repair hazards and problems and appropriate preventative and remedial strategies
- 21 Principles, consequences and prevention strategies for scavenge and uptake fires and starting air-line, crankcase and gearbox explosions
- 22 Safety and environmental management strategies applicable to maintenance and repair operations on a vessel of unlimited propulsion power, including:
 - a requirements specified in material safety data sheets and OH&S regulations
 - b safety, environmental and hazard control precautions and procedures relevant to shipboard machinery inspection and maintenance operations

- 17 The properties, characteristics and application of materials and structures typically used in the construction of a vessel of unlimited 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
 - c safe procedures for handling heavy machinery and component parts during maintenance and repair of shipboard machinery
 - d safe procedures for the use of hand and power tools and maintenance equipment during maintenance and repair of shipboard machinery, structures and equipment
- 25 Principles of fluid power control systems, including:
 - a system function requirements
 - b methods of displaying system functions
 - c elementary programming and program modification for programmable logic controllers (PLCs)
 - d safety requirements
- 26 Principles of air-conditioning and refrigeration systems, including:
 - a principles of operation
 - b performance indicators
 - c characteristics, hazards and handling requirements of CFCs and HCFCs
 - d safety and environmental requirements associated with air-conditioning and refrigeration systems
- 27 Principles of mechanics as they relate to forces, pressures, stress and strains in shipboard dynamic machinery, including:
 - a statics (primarily non-concurrent systems)
 - b friction
 - c dynamics

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- d balancing
 - e simple harmonic motion
 - f radial, circumferential and, longitudinal stress
 - g strain energy
 - h beam deflection
 - i buckling and crippling loads and struts
 - j combined stress, shear stress
 - k fluid mechanics
 - l losses in pipes, fittings and pumps
 - m torsion, hollow and solid shafts
 - n loads due liquid head
 - o structural strength and vibration of vessels
 - p gears, including epicyclic gearing
- 28 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 forces on the rudder and stress in the rudder stock
 - c propellers
 - d structural strength and vibration of vessels
 - e vessel measurement and classification
 - f load-line
 - g stability calculations

- d balancing
 - h free surface effects
 - i dry docks
 - j lifesaving equipment
 - k hull repairs and maintenance
- 29 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

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- 30 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
- 31 Maritime communication techniques needed during maintenance and repair operations
- 32 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

- 30 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
- h combustion with a specific understanding of volumetric analysis
 - i refrigeration and air-conditioning, including the use of entropy charts
- 33 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
 - 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

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- vi instruments, calibration and testing
- vii electronic control, surveillance, measurement and recording systems

- vi instruments, calibration and testing
- viii telemetering devices
- ix alarm systems
- x main and auxiliary machinery control and UMS.

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REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when managing safe maintenance and repair procedures on a vessel
- 2 Interpret and follow safe maintenance and repair procedures on a vessel
- 3 Read and interpret equipment performance readings and instrumentation
- 4 Read and interpret material safety data sheets
- 5 Read and interpret vessel and equipment specifications, equipment drawings, operational manuals, and electrical circuit diagrams
- 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 managing safe maintenance and repair procedures on a vessel, take appropriate remedial action, and initiate appropriate solutions
- 8 Carry out calculations required when managing the safe maintenance and repair procedures on a vessel
- 9 Adapt to differing types of equipment and systems from one vessel to another and when equipment and systems are changed
- 10 Coordinate the selection and use of appropriate equipment during safe maintenance and repair procedures on a vessel

Evidence Guide

Evidence Guide

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

1 Critical aspects of evidence required to demonstrate competency in this unit	Assessment must confirm appropriate knowledge and skills to: - a Manage, plan and manage surveys, maintenance and repairs on a vessel - b Lead and motivate the engine room crew to the achievement of shipboard maintenance and repair goals - c Monitor and inspect maintenance and repair on a vessel of unlimited propulsion power as per vessel survey requirements - d Establish and implement a safety management strategy for maintenance and repair operations on a vessel of unlimited propulsion power - e Identify typical machinery maintenance and repair problems and hazards and establish appropriate hazard control strategies - f Communicate effectively with others during the organisation and management of maintenance and repair operations, including effective use of internal communication systems
2 Evidence required for demonstration of consistent performance	- a Performance is demonstrated consistently over a period of time and in a suitable range of contexts - b Consistently applies underpinning knowledge and skills when: 1 planning and organising survey, maintenance and repair operations 2 assessing operational performance of shipboard machinery and equipment 3 identifying shipboard machinery malfunctions and faulty plant and equipment and initiating action to minimise any damage and pollution 4 monitoring and inspecting shipboard machinery maintenance and repairs

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| | <ol style="list-style-type: none"> 5 identifying and evaluating machinery maintenance and repair problems and determining appropriate courses of action 6 establishing safety management strategies relevant to mechanical and electrical machinery and equipment maintenance and repair operations 7 completing machinery maintenance and repair documentation and records 8 organising and training personnel |
| c | Shows evidence of application of relevant workplace procedures, including: <ol style="list-style-type: none"> 1 relevant sections of IMO Conventions and AMSA Marine Orders |

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)

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| | <ol style="list-style-type: none"> 2 OH&S regulations and hazard prevention policies and procedures 3 ISM Code safety management system (where existing) 4 security procedures and housekeeping processes 5 managing 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 as per statutory requirements, company procedures and the ISM Code |
| e | Work is 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 organization, 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 manage the maintenance and repair of structures, machinery and equipment typically found on a vessel of unlimited propulsion power; and/or - b manage surveys, maintenance and repair operations in a range of operational situations on a commercial or training 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 under broad operational requirements, with accountability for self and others in achieving the prescribed outcomes within the scope of responsibility of an Engineer Class 1
c. Work involves:	1 the application of management principles to the organisation of the maintenance and repair of the hull, structures, machinery and equipment typically found on a vessel of unlimited propulsion power across a wide and often unpredictable variety of operational contexts. 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.

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| d. Work requires: | 1 significant judgement in planning, engineering and leadership functions related to shipboard maintenance and repair operations and procedures. This includes management, training and control of personnel, analysis of the situation, problem solving and decision making |
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2. WORKSITE ENVIRONMENT

a The hull, structures and equipment to be maintained may include:	1 that typically found on any Australian or international commercial vessel of unlimited propulsion power
b Maintenance and repair operations may be carried out on all main, auxiliary and ancillary machinery, including:	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

Range Statement (continued)

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VARIABLE	SCOPE
b Maintenance and repair operations may be carried out on all main,	6 deck machinery, including cranes and winches 7 auxiliary systems and controls, including i fresh and salt water cooling systems

VARIABLE	SCOPE
ancillary machinery, including: (continued)	- ii lubricating oil cooling systems - iii fuel, oil, gas, coal - iv air starting - 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 a - 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 - xviii lifesaving and firefighting appliances - xix hull and vessel side valves - xx anchoring and mooring equipment - xxi plant associated with the carriage of dangerous goods
c Organisation of maintenance and repair	1 by day or night in both normal and emergency situations 2 under any permissible conditions of weather

VARIABLE	SCOPE
be carried out:	3 while underway
	4 during berthing and unberthing operations
	5 while anchored or moored
	6 when bunkering
	7 during cargo operations

Range Statement (continued)

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VARIABLE	SCOPE
d Organisation of maintenance and repair operations may include:	1 development of maintenance and repair plans 2 planning and organisation of statutory and classification society surveys 3 training, leading and motivating engine room staff 4 monitoring and inspection of maintenance work 5 development and implementation of maintenance and repair safety management procedures and hazard minimisation strategies 6 completion of running logs and maintenance reports
e Propulsion plant configurations may include:	1 low speed, medium and high speed diesel propulsion 2 stern tube bearing 3 CPP 4 direct drive shaft 5 diesel electric

VARIABLE	SCOPE
	6 steam 7 gas turbine 8 reduction gears 9 thrust blocks, detuners and shaft bearings
f 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 fuel oil, lubrication oil, steam and gas leaks 9 overheating and overspeed of machinery, governors, emergency trips
g Testing and repair equipment may include:	1 meters, gauges and electronic instrumentation and other test equipment 2 computer displays of performance parameters 3 hand tools, such as spanners, soldering irons, pliers, cutters, hacksaws, etc.

Range Statement (continued)

**TDMMB907B MANAGE SAFE MAINTENANCE AND REPAIR
PROCEDURES ON VESSELS OF UNLIMITED PROPULSION POWER**

VARIABLE	SCOPE
g Testing and repair equipment may include: (continued)	4 greasing and lubrication equipment 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 and portable and manual lifting equipment and jacks 9 protective clothing and equipment such as: - i eye and ear protection - ii safety boots and helmet - iii dust and fume masks - iv boilersuit/overalls
h Maintenance and repair hazards may include:	1 moving heavy loads in an unsafe work environment 2 unsecured machinery, components or repair equipment 3 slippery deck 4 welding equipment 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

VARIABLE	SCOPE
	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 faulty earthing on systems and equipment 15 hot pipes and valves (steam, fuel oil, lubricating oil) 16 cold pipes and valves (refrigeration and liquefied gas cargoes) 17 working at heights and in confined spaces 18 noxious and dangerous cargoes
i Documentation and records may include:	1 ISM Code safety management system plans, procedures, checklists and instructions

Range Statement (continued)

**TDMMB907B MANAGE SAFE MAINTENANCE AND REPAIR
PROCEDURES ON VESSELS OF UNLIMITED PROPULSION POWER**

VARIABLE	SCOPE
i Documentation and records may include: (continued)	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, including computer database of running information and maintenance records where relevant 5 vessel's survey procedures and instructions as they relate to shipboard machinery 6 relevant sections of national and international regulations,

VARIABLE	SCOPE
	IMO Conventions and Codes, including AMSA Marine Orders and classification society rules dealing with shipboard machinery maintenance and repair 7 instructions of relevant maritime authorities and classification societies concerning shipboard machinery maintenance and repair
j 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 maintenance and repair operations and surveys 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.
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