



Australian Government

Department of Education, Employment and Workplace Relations

TDMMB1207B FAULTFIND, DISMANTLE, MAINTAIN AND REPAIR SHIPBOARD PLANT AND EQUIPMENT

Release: 1

TDMMB1207B FAULT-FIND, DISMANTLE, MAINTAIN AND REPAIR SHIPBOARD PLANT AND EQUIPMENT

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required by to fault-find, dismantle, maintain, repair and reassemble shipboard plant and equipment on a commercial vessel of unlimited propulsion power using hand and power tools and appropriate test equipment. This includes working with a senior engineer in fault finding and in the dismantling, maintenance and repair of shipboard plant and equipment.

Application of the Unit

Application of the unit	The unit has application in the qualifications for an Engineer Watchkeeper on a vessel of unlimited propulsion power, i.e. Diploma of Transport&Distribution(Marine Engineering - Engineer Watchkeeper).
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Licensing/Regulatory Information

Licensing/legislative requirements	The unit is consistent with the relevant sections of STCW 95 and Marine Orders under the Australian Navigation Act 1912, describing the role and responsibilities of an Engineer Watchkeeper.
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Pre-Requisites

Not applicable.

Employability Skills Information

Not applicable.

Elements and Performance Criteria Pre-Content

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

ELEMENT	PERFORMANCE CRITERIA
<p>1 Detect, identify and investigate plant and equipment malfunctions and faults</p>	<p>a The operation of shipboard plant and equipment is monitored in accordance with vessel's survey requirements, standard procedures, chief engineer's instructions and manufacturer's instructions</p> <p>b Performance of shipboard plant and equipment is compared with specifications and recommended limits of performance</p> <p>c Out of specification performance and faults are identified in accordance with marine engineering practice and plant and equipment specifications</p> <p>d Out of specification performance and faults are investigated as per marine engineering practice and manufacturer's instructions and appropriate action initiated to rectify the identified problem in consultation with the responsible engineer</p> <p>e Appropriate action is taken to prevent damage in accordance with vessel's planned maintenance system or procedures, established marine engineering practice, safety regulations and manufacturer's instructions</p>

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ELEMENT	PERFORMANCE CRITERIA
<p>1 Detect, identify and investigate plant and equipment malfunctions and faults (continued)</p>	<p>f Faulty equipment and components are identified and reported and action is initiated as required for isolation, tagging and repair or replacement as per company procedures and established marine engineering practice</p> <p>g In consultation with a senior engineer, decisions are made to carry out temporary or permanent repairs depending on the vessel's position and circumstances in accordance with established marine engineering practice</p> <p>h Appropriate consultation is undertaken with classification society and marine administration concerning the nature of the repairs and any action required</p>
<p>2 Disassemble and repair faulty plant and equipment</p>	<p>a Identified faults in shipboard plant and equipment are investigated using established fault finding techniques</p> <p>b In consultation with a senior engineer where necessary, malfunctioning or faulty plant and equipment is correctly isolated and disassembled, if necessary, as per manufacturer's instructions and established marine engineering practice</p> <p>c Appropriate procedures are selected for the repair of plant, equipment or components as per manufacturer's instructions and established practice</p> <p>d In consultation with a senior engineer, damaged or faulty components are repaired or replaced as per planned maintenance system or procedures, manufacturer's instructions and established marine engineering practice</p> <p>e Repaired plant and equipment is reassembled in accordance with manufacturer's instructions and established marine engineering practice</p> <p>f Repaired plant and equipment is tested and adjusted as per vessel's procedures and manufacturer's instructions and in consultation with relevant personnel</p>

ELEMENT	PERFORMANCE CRITERIA
	<p>g Repaired plant and equipment and associated safety devices, control systems and alarms are restarted/reactivated and their performance tested as per manufacturer's manuals and instructions and established engineering practice</p> <p>h Tests are conducted to survey, class and manufacturer's requirements</p> <p>i Performance against recommended performance specifications is confirmed and the plant and equipment is recommissioned in accordance with vessel's procedures and established marine electrical/electronic marine practice</p>
<p>3 Complete maintenance and repair documentation</p>	<p>a In consultation with the senior engineer, correct records are kept concerning plant and equipment malfunctions and fault finding, maintenance and repair operations</p> <p>b All planned maintenance system and repair documentation is completed in accordance with survey and company requirements and regulations</p>

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ELEMENT	PERFORMANCE CRITERIA
<p>4 Follow safety and hazard control procedures</p>	<p>a Fault finding, dismantling and repairs of plant and equipment and associated safety devices, control systems and alarms are conducted in accordance with safety regulations and company procedures</p> <p>b Maintenance and repair hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment</p> <p>c Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during maintenance and repair operations</p> <p>d Procedures and precautions necessary for entry into confined</p>

ELEMENT	PERFORMANCE CRITERIA
	<p>spaces on a vessel are correctly followed in consultation with the responsible engineer</p> <p>e Action is taken in the event of a plant and equipment failure or emergency to isolate and secure the plant and equipment and the vessel and maintain the safety of the vessel and persons involved</p> <p>f Shipboard emergency and contingency plans are followed in the event of a plant and equipment failure or emergency</p>

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Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 Knowledge of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders applicable to the management of shipboard plant and equipment maintenance and repair operations on vessels of unlimited propulsion power
- 2 Relevant OH&S legislation, policies and procedures
- 3 Established engineering practice for the fault finding, dismantling, maintenance and repair of marine electrical and equipment
- 4 Operational characteristics and performance specifications for the different types of shipboard plant and equipment usually found on a vessel of unlimited propulsion power
- 5 Planned maintenance systems and procedures for the condition monitoring of plant and equipment, including responsibilities and requirements covered by various forms of vessel survey
- 6 The nature and causes of typical shipboard plant and equipment malfunctions and the available methods for their detection and repair, including established fault finding techniques
- 7 Procedures for carrying out shipboard plant and equipment fault finding and repair as part of routine maintenance procedures to ensure compliance with the company and survey requirements and established safety rules and regulations
- 8 Procedures for the completion of temporary and permanent repair and/or replacement procedures for plant and equipment on board vessels at sea, alongside and in dry dock
- 9 A basic understanding of the plant and equipment typically found on board a vessel of unlimited propulsion power
- 10 Concepts of unmanned machinery spaces (UMS) and automated monitoring and control of machinery

REQUIRED KNOWLEDGE

- 11 Procedures for reading and interpreting plant and equipment performance readings and instrumentation
- 12 Basic principles of mechanics as they relate to forces, pressures, stress and strains in shipboard dynamic machinery
- 13 Basic principles of operation and maintenance of:
 - a fluid power control systems
 - b air-conditioning and refrigeration systems
 - c machinery lubrication systems

REQUIRED KNOWLEDGE

- 14 Purpose and content of material safety data sheets
- 15 Typical vessel and plant and equipment specifications, equipment drawings, operational manuals, and electrical and control circuit diagrams
- 16 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
- 17 Maritime communication techniques needed during maintenance and repair operations

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- 18 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions during maintenance and repair of shipboard plant and equipment
- 19 Safety, environmental and hazard control precautions and procedures relevant to shipboard plant and equipment inspection and maintenance operations
- 20 Safe procedures for handling heavy plant and equipment and component parts during maintenance and repair of shipboard plant and equipment
- 21 Safe procedures for the use of hand and power tools and maintenance equipment
- 22 Basic principles of electrotechnology, marine electrical practice and marine automation and control relevant to detection, fault finding and repair of faults in electrical and electronic equipment, including:
 - a basic electrical circuit theory
 - b basic theory of electromagnetism and electrostatics
 - c electrolytic action and cells
 - d AC and DC theory and plant and equipment
 - e basic cabling, distribution and lighting systems
 - f basic control and switch gear
 - g instruments, calibration and testing

- 18 Maintenance and repair hazards and problems and appropriate preventative and remedial action and solutions during maintenance and repair of shipboard plant and equipment

- 23 Basic principles of diesel engine operation to a level suitable for an officer of an engineering watch, including:
 - a typical starting air and manoeuvring systems of diesel engines, including all components normally found therein
 - i starting methods of marine diesel engines and how propulsion manoeuvring is achieved
 - ii requirements for diesel engines for propulsion, power generation, and emergency use.
 - iii methods of reversing direct reversing engines with their interlocks and other safety arrangements.
 - iv common faults and appropriate action to be taken with starting/manoeuvring systems.
 - b typical diesel engine lubrication systems, including:
 - i all components normally found therein
 - ii normal operational pressures and temperatures which should be expected.
 - iii methods of lubricating the principal components of a marine diesel engine, with its associated gearing and/or chain drives, including common lubrication faults, symptoms, causes, and actions to be taken with such faults
 - c the operating principles and adjustments of diesel engine fuel injection equipment, including common service faults, symptoms, and causes of diesel fuel injection problems, explaining appropriate actions to be taken
 - d means of pressure charging diesel engines, including common service faults, appropriate actions to rectify these faults, and emergency operation and isolation procedures

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- e different methods of cooling marine diesel engines, including common requirements of cooling

- e different methods of cooling marine diesel engines, including common requirements of cooling
 - f common faults and appropriate action to be taken with cooling of diesel engines
 - g the causes of crankcase and air-line explosions, and scavenge and uptake fires
- 24 Basic thermodynamics as it relates to the responsibilities of an officer in charge of an engineering watch, including:
- a basic thermodynamic properties of common working fluids
 - b methods of heat transfer and related problems
 - c principles of heat transfer by conduction, convection and radiation and their application to marine systems
 - d elementary principles of steam plants
 - e basic steam plant cycles and the function of each component
 - f the combustion process and the calorific value of fuels
 - g air/fuel ratio and the significance of excess air on combustion
 - h the operating cycle of single stage reciprocating air-conditioners, including methods for calculating the mass of air delivered
 - i clearance volume, its effect on volumetric efficiency and methods of calculating volumetric efficiency
 - j advantages of multistaging and intercooling
 - k meaning of gauge and absolute pressure
 - l temperature and temperature scales
 - m SYSTEM INTERNATIONAL (SI) units and common thermodynamic terms and principles

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REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when fault finding, dismantling, maintaining and repairing shipboard plant and equipment
- 2 Communicate with multilingual crew where applicable using established techniques
- 3 Interpret and follow procedures for fault finding, dismantling, maintaining and repairing shipboard plant and equipment
- 4 Interpret and follow all safety management procedures and precautions when fault finding, dismantling, maintaining and repairing shipboard plant and equipment
- 5 Read and interpret material safety data sheets
- 6 Read and interpret vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 7 Work collaboratively with other shipboard personnel when fault finding, dismantling, maintaining and repairing shipboard plant and equipment
- 8 Identify problems that can occur when fault finding, dismantling, maintaining and repairing shipboard plant and equipment and take appropriate action to report and rectify problems identified
- 9 Carry out calculations required when fault finding, dismantling, maintaining and repairing shipboard plant and equipment
- 10 Adapt to differing types of plant and equipment from one vessel to another and when equipment is changed
- 11 Take appropriate precautions to prevent pollution of the marine environment
- 12 Select and use tools and equipment required when fault finding, dismantling, maintaining and repairing shipboard plant and equipment

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.

<p>1 Critical aspects of evidence required to demonstrate competency in this unit</p>	<p>Assessment must confirm appropriate knowledge and skills to:</p> <ul style="list-style-type: none"> a Fault-find, dismantle, maintain and repair shipboard plant and equipment against specifications on a vessel of unlimited propulsion power b Identify malfunctioning and faulty plant and equipment and components and initiate appropriate action for repair or replacement c Exercise all safety, environmental and hazard control procedures d Identify typical plant and equipment maintenance and repair problems and hazards and take appropriate action e Communicate effectively with others during maintenance and repair operations f Ensure adherence to relevant regulations, IMO Conventions and Codes
<p>2 Evidence required for demonstration of consistent performance</p>	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 1 assessing operational performance of shipboard plant and equipment 2 identifying shipboard plant and equipment malfunctions and faulty plant and equipment of a vessel of unlimited propulsion power 3 taking action to minimise any damage and safety risk that

	<p>could be caused by plant and equipment malfunctions</p> <ol style="list-style-type: none">4 fault finding, dismantling, maintaining and repairing shipboard plant and equipment5 identifying plant and equipment maintenance and repair problems and determining appropriate courses of action6 applying safety precautions relevant to plant and equipment maintenance and repair operations7 completing maintenance and repair documentation and records
c	<p>Shows evidence of application of relevant workplace procedures, including:</p> <ol style="list-style-type: none">1 relevant sections of international Conventions and Codes and AMSA Marine Orders2 OH&S regulations and hazard prevention policies and procedures3 ISM Code safety management system procedures, quality procedures and work instructions on the fault finding, dismantling, maintenance and repair of shipboard plant and equipment, including plant and equipment specifications and directions on equipment maintenance

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">4 following on-board housekeeping processes |
| d | Action is taken promptly to report and/or rectify plant and equipment malfunctions, non-conformities, accidents, hazardous occurrences and safety incidents in accordance with statutory requirements, company procedures and the ISM Code |
| e | Work is managed, controlled and completed systematically with required attention to detail |
| f | Recognises and adapts appropriately to cultural differences in the workplace, including modes of behaviour and |

	interactions between crew and others
<p>3 Context of assessment</p>	<p>a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations</p> <p>b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation:</p> <ol style="list-style-type: none"> 1 As a minimum, assessment of knowledge must be conducted through appropriate written/oral examinations, and 2 Appropriate practical assessment must occur: <ol style="list-style-type: none"> i at the registered training organisation; and/or ii on an appropriate working or training vessel
<p>4 Specific resources required for assessment</p>	<p>Access is required to opportunities to:</p> <ol style="list-style-type: none"> a participate in a range of practical and theoretical assignments, exercises, case studies, simulated fault situations and other assessments that demonstrate the skills and knowledge to fault-find, dismantle, maintain and repair plant and equipment typically found on a vessel of unlimited propulsion power; and/or b fault-find, dismantle, maintain and repair shipboard plant and equipment 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

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 to ensure 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 within an established maintenance plan and in consultation with a senior engineer, with accountability and responsibility for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice to the repair of plant and control equipment typically found on vessels of unlimited propulsion power across a wide and often unpredictable variety of equipment malfunctions or faults. Following of an established plan or strategy for the maintenance and repair of shipboard plant and control equipment 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 some judgement in engineering functions related to plant and equipment maintenance and repair operations and procedures. This includes working with a senior engineer in fault finding and in the dismantling, maintenance and repair of shipboard plant and equipment |
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2. WORKSITE ENVIRONMENT

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| a Shipboard plant and control equipment may include: | 1 that typically found on any Australian or international commercial vessels of unlimited propulsion power |
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Range Statement (continued)

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VARIABLE	SCOPE
b Performance monitoring and repair of shipboard plant and control equipment 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 7 when bunkering 8 during cargo operations

VARIABLE	SCOPE
c Types of plant and equipment may include:	<ol style="list-style-type: none"> 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, including cranes and winches 7 pumps and pumping systems 8 emergency supply systems, including emergency generators and battery banks 9 auxiliary systems and controls, including <ol style="list-style-type: none"> 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 x evaporators xi inert gas generator xii cargo pumps, tank washing machines and associated systems xiii purifiers and clarifiers

Range Statement (continued)

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VARIABLE	SCOPE
<p>c Types of plant and equipment may include: (continued)</p>	<ul style="list-style-type: none"> xiv heaters xv sewage plant xvi fixed firefighting installations and fire control systems xvii auxiliary boilers and waste heat generators xix lifesaving appliances xx maintenance to hull and vessel side valves
<p>d Testing and repair equipment may include:</p>	<ul style="list-style-type: none"> 1 electronic instrumentation, meters and gauges 2 computer displays of performance parameters 3 hand tools, such as spanners, wrenches, screwdrivers, hacksaws, soldering irons, pliers, cutters, wire strippers, 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. 8 welding equipment 9 block and tackle 10 portable and manual lifting equipment and hydraulic jacks 11 material safety data sheets 12 protective clothing and equipment such as: <ul style="list-style-type: none"> i eye and ear protection ii safety boots

VARIABLE	SCOPE
	iii dust and fume masks
e Maintenance and repair hazards may include:	1 moving heavy loads in an unsafe work environment 2 unsecured plant and equipment, components or repair equipment 3 sharp tools and implements 4 power tools 5 moving and rotating plant and equipment 6 faulty equipment, handling equipment and lifting gear 7 using equipment beyond safe working limits 8 poor housekeeping procedures

Range Statement (continued)

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VARIABLE	SCOPE
e Maintenance and repair hazards may include: (continued)	9 non-compliance with safe working procedures 10 electrical wiring and systems 11 exposed live circuits 12 faulty earth connections 13 hot pipes and valves (steam, fuel oil, lubricating oil) 14 cold pipes and valves (refrigeration and liquefied gas cargoes) 15 working at heights 16 exposed live circuits

VARIABLE	SCOPE
	17 faulty earth connections
f Emergencies may include:	1 loss of propulsion 2 loss of electrical power 3 loss of steering 4 flooding, fire or explosion in engine room 5 loss of refrigeration 6 loss of water making ability 7 fuel oil, lubrication oil, steam and gas leaks 8 overheating and overspeed of machinery, governors, emergency trips
g Documentation and records may include	1 safety management system plans, procedures, checklists and instructions 2 planned maintenance system, repair procedures and instructions 3 plant and equipment and vessel manufacturer's specifications, instructions and recommended procedures 4 plant and equipment maintenance log, running sheets and records, including computer databases of running information and maintenance records 5 vessel's survey as it relates to shipboard plant and equipment 6 sections of relevant maritime regulations 7 instructions of relevant maritime authorities

Range Statement (continued)

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VARIABLE	SCOPE
<p>h Applicable legislation, regulations and codes may include:</p>	<ol style="list-style-type: none"> 1 sections of relevant maritime regulations, IMO Conventions and Codes 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 must be assessed in conjunction with other units that relate to the functions of the occupation(s) concerned.
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