



Australian Government

TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH

Revision Number: 1

TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH

Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to maintain a safe engineering watch on a commercial vessel, including the correct conduct, handover and relief of the engineering watch, correct internal communications, monitoring of operation and performance of the main propulsion and auxiliary systems and associated controls, identification and rectification of engine room malfunctions, initiation of correct responses to engine room emergencies and maintenance of records of engineering watch activities and incidents.

Application of the Unit

Application of the unit	The unit has application in the qualifications for an Engineer Watchkeeper on a vessel greater than 750 kW, 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

Elements describe the essential outcomes of a unit of competency.

Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Carry out engineering watchkeeping procedures	- a The conduct, handover and relief of the engineering watch conforms with accepted principles and vessel's procedures - b Watchkeeping principles and procedures are maintained in accordance with established marine engineering practice and regulatory requirements - c Main propulsion and auxiliary systems and associated controls are operated in accordance with bridge commands and operational procedures and requirements - d The frequency and extent of monitoring of performance of main propulsion and auxiliary systems and associated controls conform with vessel's procedures and established engineering practice - e Problems in the performance of main propulsion and auxiliary systems and associated controls are promptly identified and appropriate action is initiated to correct the problems in accordance with established marine engineering practice - f A safe engineering watch is achieved through the implementation of accepted bridge and engine room resource management principles and procedures

ELEMENT	PERFORMANCE CRITERIA
	g Fatigue management strategies are correctly applied within the engine room management team
ELEMENT	PERFORMANCE CRITERIA
2 Respond to malfunctions and emergency situations	a Malfunctions of the main propulsion and auxiliary systems are identified, analysed and appropriate action is taken in ample time and in accordance with regulatory requirements b Correct responses are made to engine room malfunctions, emergencies and situations that pose a danger to the vessel and personnel on board c Emergency situations are recognised and emergency procedures are initiated in accordance with established engineering practice and company and regulatory requirements d Chief engineer is called in the event of an engine room incident or emergency which falls outside the officer's limits of responsibility
3 Maintain watchkeeping records	a A proper and accurate record is maintained of the activities and incidents that have occurred during the keeping of an engineering watch b Appropriate entries pertaining to the engineering watch are recorded in the vessel's log

Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 Sections of the IMO STCW 95 Code and AMSA Marine Orders dealing with the keeping of an engineering watch
- 2 Relevant OH&S pollution control legislation, codes of practice, policies and procedures
- 3 The duties and responsibilities of a watchkeeper engineer on both manned and UMS vessels with respect to safety of personnel and vessel, when taking over, keeping and handing over a watch
- 4 The principles and procedures for the operation and maintenance of a vessel's main and auxiliary systems, including start up, normal running, shut down, and emergency situations
- 5 The layout of a typical engine room and the functions of all systems and components found therein:, including their purposes and relationships with other systems, including:
 - a the main engine systems
 - b the systems of the boiler and waste heat unit
 - c the diesel alternator systems
 - d the turbo-alternator systems
 - e the systems and controls of the engine control room
 - f the ancillary systems of the engine room
 - g common operating parameters of fluids within the engine room, and state correct responses to abnormal values
 - h the location, function, and operation of all safety and protection devices, including all alarms, shut downs and engine room escape routes, including an awareness of the risks associated with defective or bypassed machinery protective devices
 - i the location, function, and operation of main and auxiliary machinery monitoring devices
 - j the types of steering gears commonly employed, their components, the regulations governing their use, and testing procedures

REQUIRED KNOWLEDGE

- k an understanding of single failure criterion and how steering gear systems fulfil this criterion
- l typical transmission systems from the main propulsion engine to the propeller, including typical clutches found along a typical drive line, and explain how emergency operation may be achieved
- 6 Malfunctions and defects in the main and auxiliary systems and components systems, their symptoms and possible consequences, and methods of correcting and/or compensating for them
- 7 Safe working practices for machinery and enclosed spaces, including:
 - a safe practices for isolating main and auxiliary machinery prior to work commencing
 - b hazard minimisation and control during work at sea, in heavy weather, at anchorage in port, or during dry dock

The working principles of fire prevention, detection, and fighting, including:

- 8
 - a actions that should be carried out if a fire is detected and
 - b actions that should be carried out if it is decided to use a fixed installation to combat a major fire, especially if CO₂ is to be used.
- 9 Watchkeeping records that must be maintained on a vessel to meet the requirements of the company and regulatory authorities
- 10 Basic supervisory, teamwork, and communication skills as they relate to the responsibilities of an officer on the engineering watch, including:
 - a communication skills required in simulated and real engine room operations.
 - b the various tools available to communicate between the bridge, engine control room, and main engine room
 - c teamwork in simulated and real engine room operations, including start up, normal running, shut down, and emergency situations
 - d basic supervisory skills required when acting as team leader in simulated and real engine room operations, including start up, normal running, shut down, and emergency situations

- The working principles of fire prevention, detection, and fighting, including:
- 8
- 11 Elementary principles of internal combustion engine cycles, including:
- a the operating principles of two stroke and four stroke internal combustion engines
 - b the Otto, diesel and dual combustion cycles
 - c Methods for calculating mean effective pressure using an indicator diagram
 - d the indicated power formula
 - e specific fuel consumption and thermal efficiency
 - f the ideal cycle and air standard efficiency
 - g the effects of insufficient, minimum and excess air on combustion
- 12 The operating cycle of refrigeration and related problems on refrigeration plant performance, including:
- a the principles of refrigeration
 - b the refrigeration cycle as a pressure/enthalpy diagram
 - c the properties of refrigerants used in refrigeration plants
 - d refrigeration effect and plant capacity
 - e ways of calculating the refrigeration effect and condition of vapour after expansion, using refrigeration tables
- 13 The psychrometric chart and the cycle of operation and working principles of air-conditioning plants, including the meaning of psychrometric terms such as relative humidity dry and wet bulb temperatures
- 14 Procedures for the operation of the main and auxiliary systems and components in warm through, start up, manoeuvring, normal running, emergency, and shut down situations
- The types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used on board vessel, including a basic understanding of the working principles, construction, maintenance and safe operation of centrifuges, filters and other treatment devices
- 15
- 16 Basic principles of operation of boilers and steam systems, including:

- 15 The types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used on board vessel, including a basic understanding of the working principles, construction, maintenance and safe operation of centrifuges, filters and other treatment devices
- a understanding of how combustion occurs in a boiler, and related safety procedures, including the importance of purging a boiler and other safety precautions taken when firing a boiler
 - b principles of boiler operation in normal and emergency situations
 - c typical feed systems for marine boilers, including all components normally found in such systems
 - d a basic understanding of the various fittings mounted on boilers, including:
 - i the common operating routines of local water level indicators, including methods of blowing a gauge glass, clearing blockages, and overhaul of these devices
 - ii the effects of blockages in the water, steam and drain cocks of water level indicators
 - e how a boiler is flashed up from cold and put on line
 - f the purpose of all alarms and shut downs incorporated in a marine boiler
 - g typical configurations of, and describe the operating principles applying to, the various steam distribution systems found aboard vessel
 - h the checks which should be made regularly during routine turbine operation
- 17 Basic principles of operation of turbine systems, including:
- a the methods of turbine control, including safety devices
 - b the symptoms, causes, effects, and actions to be taken of defects of auxiliary steam turbines
 - c the construction and operation of auxiliary steam turbines
 - d procedures for emergency operation of a steam turbine
 - e methods of lubricating the principal components of a marine steam turbine and its associated gearing, and evaluate common faults, including common lubrication faults, symptoms, causes, and actions to be taken with such faults

- 15 The types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used on board vessel, including a basic understanding of the working principles, construction, maintenance and safe operation of centrifuges, filters and other treatment devices
- 18 The causes, symptoms, means of preventing, detecting, and extinguishing fires and the correct procedures to be taken upon their detection, including:
- a scavenge fires
 - b crankcase explosions in both diesel and dual fuel engines
 - c starting air-line explosions
 - d the risks of continued service with an isolated waste heat unit
- 19 Operating precautions for main and auxiliary machinery and associated control systems to ensure operational performance is in compliance with the bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations

- 20 Basic principles of diesel engine operations to a level suitable for an engineer in charge 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

- 20 Basic principles of diesel engine operations to a level suitable for an engineer in charge of an engineering watch, including:
- 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, and appropriate actions
 - d means of pressure charging diesel engines, including common service faults and give appropriate actions to these faults and emergency operation and isolation procedures
 - 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, scavenge and uptake fires
- 21 Basic thermodynamics as it relates to the responsibilities of an engineer watchkeeper, 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 explain 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 the volumetric efficiency
 - j advantages of multistaging and intercooling
 - k meaning of gauge and absolute pressure

- i clearance volume, its effect on volumetric efficiency and methods of calculating the volumetric efficiency
- l temperature and temperature scales
- m SI units and common thermodynamic terms and principles.

REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Read, interpret and apply instructions, procedures and information relevant to the role and responsibilities of an engineer watchkeeper
- 2 Select and use appropriate internal and external communications equipment during watchkeeping duties
- 3 Work as a leader and member of the bridge team during watchkeeping duties
- 4 Take appropriate initiatives related to the protection of the environment during watchkeeping duties
- 5 Interpret and apply practices during watchkeeping duties
- 6 Communicate effectively with others on watchkeeping issues, arrangements and requirements
- 7 Modify activities dependent on differing vessel contingencies, risk situations and environments
- 8 Identify and solve problems that may arise during watchkeeping duties and report problems and issues and take appropriate action based on available information
- 9 Monitor and anticipate hazards and risks that may arise during watchkeeping duties and take appropriate action

Evidence Guide

Evidence Guide

TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH

The Evidence Guide provides advice on assessment and must be read in conjunction

Evidence Guide**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

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 Implement engineering watchkeeping arrangements and procedures - b Fulfil engineering watchkeeping responsibilities - c Take appropriate action in the event of an engine room malfunction arising during a watch - d Communicate effectively with others in the course of watchkeeping duties
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 maintaining a safe engineering watch 2 identifying and evaluating watchkeeping problems and determining appropriate courses of action 3 identifying and implementing improvements to engine room and bridge management procedures 4 applying safety precautions relevant to engineering watchkeeping operations 5 dealing with engine room malfunctions and emergencies arising during an engineering watch - c Shows evidence of application of relevant workplace procedures, including: 1 relevant sections of IMO STCW 95 Code and AMSA Marine Orders 2 OH&S and pollution control regulations and hazard

Evidence Guide**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

- prevention policies and procedures
- 3 job procedures and work instructions
- 4 ISM Code safety management system procedures, quality procedures and work instructions on the keeping of an engineering watch
- 5 environmental protection procedures

Evidence Guide (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

2 Evidence required for demonstration of consistent performance (continued)

- d Action is taken promptly to report and/or rectify engine room malfunctions and emergencies in accordance with manufacturer's instructions, statutory requirements and company procedures
- e Work is completed systematically with required attention to detail
- f Work is managed, controlled and completed systematically with required attention to detail

3 Context of assessment

- a Assessment of competency must comply with the assessment requirements of the relevant maritime regulations
- b Assessment of this unit must be undertaken within relevant marine authority approved and audited arrangements by a registered training organisation:
 - 1 As a minimum, assessment of knowledge must be 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

Evidence Guide (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH****4 Specific resources required for assessment**

Access is required to opportunities to:

- a participate in a range of exercises, case studies and other simulated practical and knowledge assessments that demonstrate the skills and knowledge to maintain the seaworthiness of a vessel in a range of operational situations; and/or
- assist in maintaining the seaworthiness of a vessel in a range of operational situations either:
 - i using a simulator, meeting the requirements of Section A I/12 of the IMO STCW 95 Code, over an appropriate range of simulated loading and operational situations
 - ii in appropriate practical situations on an operational commercial or training vessel possibly during seetime training

Range Statement**Range Statement****TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

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**

Range Statement**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

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 in consultation with a senior engineer, within broad operational requirements, with limited accountability and responsibility for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice to the keeping of a safe engineering watch on a vessel of unlimited propulsion power across a wide and often unpredictable variety of operational contexts. Defined accountability and responsibility for self and others in achieving the watchkeeping outcomes is involved
d. Work requires:	1 some judgement and teamwork in carrying out engineering watchkeeping duties and procedures for vessels of unlimited propulsion power. This includes supervision and control of personnel, hazard minimisation, analysis of performance and operational situations and related decision making and record keeping

2. WORKSITE ENVIRONMENT

a Vessel may include:	1 any Australian or international commercial vessel of unlimited propulsion power
b Watchkeeping arrangements and procedures	1 by day or night in both normal and emergency situations 2 under any possible conditions of weather and loading

Range Statement**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH****may be implemented:**

- 3 while underway
- 4 during berthing and unberthing operations

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

VARIABLE	SCOPE
b Watchkeeping arrangements and procedures may be implemented: (continued)	5 while anchoring or mooring 6 while in port 7 while moored or at anchor
c Watchkeeping principles (as laid out in the AMSA Marine Orders) include:	1 a safe engineering watch must be maintained at all times 2 all necessary precautions must be taken to avoid pollution of the marine environment 3 appropriate assistance must be available to be summoned to the engine room if required by a change in the vessel's operational situation
d 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

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

	6 steam or gas turbine
	7 reduction gears
	8 thrust blocks, detuners and shaft bearings
e Main and auxiliary machinery and associated systems may include:	1 steam turbine, diesel, diesel electric and gas turbine propulsion systems and controls 2 steam boilers 3 steering gear, stabilisers, bow thrusters, rudders 4 fluid power systems and controls 5 pumps and pumping systems 6 auxiliary systems and controls, including - i fresh and salt water cooling systems - ii lubricating oil cooling systems - iii fuel, oil, gas, coal - iv air starting - v lubrication

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

VARIABLE	SCOPE
e Main and auxiliary machinery and associated systems may include: (continued)	- vi on-board air compressors and compressed air and control air systems - vii waste management and pollution control systems - vii sewage plant - i 7 fixed firefighting installations and fire control systems
f Fatigue management strategies may include:	1 recognition of symptoms of fatigue 2 arranging to take a break when symptoms of fatigue are identified 3 maintenance of personal fitness and health and appropriate dietary habits 4 avoidance of excessive consumption of alcohol prior to watchkeeping duties
g Emergencies may include:	1 loss of propulsion or steering 2 flooding of engine room 3 fire or explosion in engine room 4 loss of refrigeration 5 loss of water making ability 6 fuel oil, lubrication oil, steam and gas leaks 7 loss of electrical power

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

	8 pump failure
	9 overheating and overspeed of machinery, governors, emergency trips
h Potential hazards during operation of main and auxiliary systems may include:	1 operating equipment beyond safe working limits 2 moving and rotating machinery 3 working in confined spaces 4 faulty machinery equipment handling equipment and lifting gear 5 non-compliance with safe working procedures 6 hot pipes and valves (steam, fuel oil, lubricating oil) 7 cold pipes and valves (refrigeration and liquefied gas cargoes) 8 flammable liquids, vapours and fuel 9 working at heights and in confined spaces 10 moving heavy loads using unsafe lifting procedures

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

VARIABLE	SCOPE
h Potential hazards during operation of main and auxiliary	11 unsecured machinery, components or equipment 12 slippery deck 13 poor housekeeping procedures

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH**

systems may include: (continued)	14 power tools, and sharp tools or implements 15 dangerous atmosphere 16 overspeed of electrical machinery, emergency trips 17 noxious and dangerous cargoes 18 machinery overload
i Documentation and records may include:	1 operational orders 2 ISM Code safety management system plans, procedures, checklists and instructions 3 vessel's and company's watchkeeping procedures and instructions 4 plant and equipment manufacturer's specifications, instructions and recommended procedures 5 plant and equipment running sheets, operations logs and other operational records, including computer database of running information, where relevant 6 vessel's survey as it relates to shipboard plant and equipment 7 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and classification society rules dealing with the keeping of an engineering watch 8 instructions of relevant maritime authorities and classification societies concerning the keeping of an engineering watch
j Applicable legislation, regulations and codes may	1 IMO STCW 95 Convention and Code related to the keeping of an engineering watch 2 relevant sections of AMSA Marine Orders related to the keeping of an engineering watch

Range Statement (continued)**TDMMF3107B MAINTAIN A SAFE ENGINEERING WATCH****include:**

3	relevant international, Commonwealth, State and Territory OH&S legislation
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Unit Sector(s)

Not applicable.

Field

Field MF Operational Quality and Safety

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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