



Australian Government

Department of Education, Employment and Workplace Relations

**TDMMR807B MANAGE THE START UP
AND SHUT DOWN OF MAIN
PROPULSION AND AUXILIARY
MACHINERY AND ASSOCIATED
SYSTEMS ON VESSELS OF UNLIMITED
PROPULSION POWER**

Release: 1



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Modification History

Not applicable.

Unit Descriptor

UNIT DESCRIPTOR:

This unit involves the skills and knowledge required to start up and shut down main propulsion and auxiliary machinery and associated systems on a commercial vessel powered by main propulsion machinery of unlimited propulsion power. This includes the management and coordination of relevant operational activities and the application of advanced diagnostic and problem solving techniques to operational difficulties.

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. It is usually packaged within the 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>PerformanceCriteria 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
.	<i>PerformanceCriteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.</i>
1 Organise the start up of main propulsion and auxiliary machinery	<p>a Method of preparing the start up of main propulsion and auxiliary machinery is in accordance with manufacturer's specifications and instructions and established engineering practice</p> <p>b Procedures for making available fuels, lubricants, cooling water, steam and air for the start up of main propulsion and auxiliary machinery are in accordance with manufacturer's specifications and instructions and established engineering practice</p> <p>c Required precautions are taken prior to start up of main propulsion and auxiliary machinery to minimise and control hazards and operational risks</p> <p>d Potential problems with the start up of main propulsion and auxiliary machinery are identified and investigated and appropriate action is initiated to rectify any problems that occur</p> <p>e Advanced diagnostic techniques are used to investigate poor performance and faults and appropriate action is initiated to rectify the identified problems in accordance with established procedures</p>

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ELEMENT	PERFORMANCE CRITERIA
<p>2 Start up and warm up main propulsion and auxiliary machinery</p>	<p>a Main propulsion and auxiliary machinery is started up and warmed up in response to bridge orders and in accordance with established procedures</p> <p>b Checks of pressures, temperatures, and revolutions and other relevant parameters during the start up and warm up period of the operation of main propulsion and auxiliary machinery are made in accordance with manufacturer's technical specifications and agreed work plans</p> <p>c Out of specification measures of pressures, temperatures, and revolutions during the start up and warm up period are investigated and appropriate action initiated to rectify any malfunctions or faults</p>
<p>3 Prepare the shut down of main propulsion and auxiliary machinery</p>	<p>a Method of preparing the shut down of main propulsion and auxiliary machinery is in accordance with manufacturer's specifications and instructions and established engineering practice</p> <p>b Required precautions are taken prior to shut down of main propulsion and auxiliary machinery to minimise and control hazards and operational risks</p> <p>c Potential problems with the shut down of main propulsion and auxiliary machinery are identified and investigated and appropriate action is initiated to report and rectify the problems</p>

ELEMENT	PERFORMANCE CRITERIA
4 Supervise the cooling down of the engine	a The cooling down of the engine is supervised in accordance with manufacturer's specifications and instructions and established engineering practice
5 Follow safety and hazard control procedures	a Start up and shut down hazards are identified and action is taken to minimise or eliminate risk to personnel, vessel and the environment b Safety, hazard minimisation and pollution control procedures and national and international regulations are followed at all times during start up and shut down operations c Where relevant, safety management procedures and precautions necessary for entry into a pump-room, fuel tanks or other confined spaces on a vessel are correctly followed d Action is taken in the event of a machinery failure or emergency during start up or shut down of main propulsion and auxiliary machinery to secure the machinery and the vessel and ensure the safety of the vessel and persons involved

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ELEMENT	PERFORMANCE CRITERIA
5 Follow safety and hazard control procedures (continued)	e Shipboard emergency and contingency plans are correctly followed in the event of a machinery failure or emergency during start up or shut down of main propulsion and auxiliary machinery f Vessel's internal communication system is used during warm through and shut down operations in accordance with established procedures

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Required Skills and Knowledge

REQUIRED KNOWLEDGE

This describes the knowledge required for this unit.

- 1 Relevant national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders applicable to the start up and shut down of main and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 2 Relevant OH&S legislation and policies
- 3 Established engineering practice for the start up and shut down of main and auxiliary machinery and associated systems
- 4 Operational characteristics and performance specifications for the different types of main and auxiliary machinery and associated systems usually found on a vessel
- 5 Procedures for carrying out the start up and shut down of main and auxiliary machinery and associated systems to ensure compliance with the company and survey requirements and regulations
- 6 The nature and causes of typical start up and shut down malfunctions of main and auxiliary machinery and associated systems and the available methods for their detection and rectification
- 7 Safety, environmental and hazard control precautions and procedures relevant to the start up and shut down of main and auxiliary machinery and associated systems
- 8 Principal features of vessel construction and principles of transverse and longitudinal stability
- 9 A basic understanding of the properties and application of materials and structures typically used in the construction of a vessel of unlimited propulsion power and its associated operational machinery
- 10 Operational records that must be maintained on a vessel to meet the

REQUIRED KNOWLEDGE

requirements of the company, survey requirements and regulatory authorities

- 11 Maritime communication techniques needed during the start up and shut down of main and auxiliary machinery and associated systems
- 12 Purpose and content of material safety data sheets
- 13 Procedures for the testing of boiler water, machinery cooling water and lubricating oil
- 14 Procedures for reading and interpreting machinery performance readings and indications
- 15 Typical vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 16 Principles and operational characteristics of internal combustion engines, including:
 - a two stroke and four stroke cycles
 - b optimum combustion parameters and their control
 - c diesel engine scavenging systems both in normal and emergency operation
 - d atmospheric pollution caused by diesel engine combustion and ways in which it can be minimised
- 17 Principles of engine cooling and lubrication, including:
 - a different methods of diesel engine cooling

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- b need for treatment of engine cooling water and methods used
- c diesel engine lubrication requirements
- d methods of lubricating diesel engine components
- e theory and types of lubrication

- b need for treatment of engine cooling water and methods used
 - f relative characteristics, and applications of mineral and synthetic oils
 - g contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants
 - h common lubrication problems and their solution
- 18 Principles of operation of hydraulic and electronic overspeed governors
- 19 Principles of marine control systems, including
- a common sensors and their associated transmitters
 - b analysis of control loops
 - c temperature and pressure control systems used on board vessel
 - d methods of load-dependent cooling of diesel alternators on heavy fuel oils
 - e analysis of typical level control systems used on board vessel
 - f operation and application of electronic PID controllers
- 20 Principles and functions of machinery space monitoring and alarm systems, including:
- a central cooling and load-dependent cooling control systems
 - b main engine control arrangements for fixed pitch and controllable pitch propeller systems requiring sequential control
 - c alarm and monitoring systems involving data loggers, alarm loggers and trend analysis
- 21 Theory and preventative strategies for scavenge and uptake fires, and starting air-line, crankcase and gearbox explosions, including:
- a plans for hazard reduction
 - b procedures for extinguishment of scavenge fires and dealing with crankcase mist detector alarm
 - c regaining of control after starting air-line, crankcase and gearbox explosions

- b need for treatment of engine cooling water and methods used
- 22 Methods of providing air for combustion
- 23 Principles of operation of key auxiliary systems
- 24 Principles and procedures of machinery lubrication, including:
- a theory and types of lubrication
 - b relative characteristics, and applications of mineral and synthetic oils

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- c contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants
- 25 Principles and operational characteristics of steam turbines, gearing and associated equipment, including:
- a lubrication
 - b gear configurations
 - c thrust blocks
 - d air ejectors
 - e determination of shaft power
 - f irregularities in the performance of machinery and plant
- 26 Principles of fuel systems, including:
- a typical injection pressures and viscosities for different grades of fuel
 - b alterations to fuel pumps, camshafts and injectors for varying fuel types
 - c differences between constant and variable injection timing of fuel
 - d injection requirements for different speeds of diesel engine
 - e common service faults, symptoms and causes of combustion problems and related solutions

- c contaminants that may affect lubricants, their effect on machinery performance, and action that can be taken to avoid and remedy contamination of lubricants
 - f fuel line pulsation damping devices and leakage protection
 - g fuel valve cooling arrangements
 - h uni-fuel and dual fuel 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
 - 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

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- 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

- l losses in pipes, fittings and pumps
 - 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
 - h free surface effects
 - i dry docks
 - j lifesaving equipment
 - k hull repairs and maintenance
- 29 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 and gas cycles
 - c properties and expansion of steam
 - d steam cycles, including a specific understanding of the use of entropy charts and modifications to the steam cycle
 - e boilers and evaporators
 - f steam turbines, including an understanding of isentropic efficiency
 - g combustion with a specific understanding of volumetric analysis
 - h refrigeration and air-conditioning, including the use of entropy charts

- l losses in pipes, fittings and pumps
- 30 Principles and operational characteristics of main and auxiliary boilers and associated equipment, including:
 - a boiler operation in normal and emergency procedures

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- b feed systems for marine boilers
- c various fittings mounted on boilers and their functions
- d boiler water tests and treatment
- e corrosion
- f superheaters
- g de-aerators
- h open and closed feed systems
- i uptake fires

- b feed systems for marine boilers

REQUIRED SKILLS

This describes the basic skills required for this unit.

- 1 Communicate effectively with other personnel when starting up and shutting down main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 2 Interpret and follow procedures for the starting up and shutting down of main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 3 Read and interpret equipment performance readings and instrumentation
- 4 Read and interpret material safety data sheets
- 5 Read and interpret vessel and machinery specifications, machinery design drawings, machine drawings, operational manuals, specifications and electrical and control circuit diagrams
- 6 Work collaboratively with other shipboard personnel when starting up and shutting down main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 7 Identify problems that can occur during the starting up and shutting down of main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 8 Carry out calculations required when starting up and shutting down main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power
- 9 Adapt to differing types of fuel, bilge and ballast systems from one vessel to another and when equipment and systems are changed
- 10 Select and use tools and equipment required for the starting up and shutting down main propulsion and auxiliary machinery and associated systems on vessels of unlimited propulsion power

Evidence Guide

Evidence Guide

TDMMR807B MANAGE THE START UP AND SHUT DOWN OF MAIN PROPULSION AND AUXILIARY MACHINERY AND ASSOCIATED SYSTEMS ON VESSELS OF UNLIMITED 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.

<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 Organise and control the start up and shut down of the main propulsion and auxiliary machinery and associated systems b Identify problems and hazards with the start up and shut down of the main propulsion and auxiliary machinery and associated and initiate appropriate action for repair or replacement c Exercise all required safety, environmental and hazard control precautions and procedures when starting up and shutting down the main propulsion and auxiliary machinery and associated systems d Communicate effectively with others during start up and shut down operations
<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 managing the starting up and shutting down of the main propulsion and auxiliary machinery and associated systems 2 identifying problems and hazards with the start up and shut down of the main propulsion and auxiliary machinery and associated systems and initiate appropriate action for rectification 3 exercising all required safety, environmental and hazard control precautions and procedures when starting up and shutting down the main propulsion and auxiliary machinery and associated systems

- 4 communicating effectively with others during start up and shut down operations
 - 5 identifying and implementing improvements to start up and shut down procedures
 - 6 applying safety precautions relevant to start up and shut down operations
 - 7 completing operational documentation and records
- c Shows evidence of application of relevant workplace procedures, including:
- 1 relevant sections of maritime regulations
 - 2 OH&S regulations and hazard prevention policies and procedures

Evidence Guide (continued)

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2 Evidence required for demonstration of consistent performance (continued)

- 3 ISM Code safety management system procedures and work instructions on the start up and shut down of the main propulsion and auxiliary machinery and associated systems typically found on a vessel of unlimited propulsion power
 - 4 following on-board housekeeping processes
 - 5 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 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 among 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 and other assessments that demonstrate the skills and knowledge to start up and shut down the main propulsion and auxiliary machinery and associated systems typically found on a vessel of unlimited propulsion power; and/or b start up and shut down the propulsion and auxiliary machinery and associated systems 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

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. Applicable codes, guidelines and standards recommended by IMO, the classification societies and maritime industry organisations must be taken into account
b. Work is performed:	1 independently under broad operational requirements, with accountability for self and others in achieving the prescribed outcomes
c. Work involves:	1 the application of marine engineering practice to the start up and shut down of the main propulsion and auxiliary machinery and associated systems 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 procedures for start up and shut down operations 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 the start up and shut down of the main propulsion and auxiliary machinery and associated systems. This includes management, training and control of personnel, analysis of operational requirements, problem solving and decision making |
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2. WORKSITE ENVIRONMENT

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| a The main propulsion and associated systems may include: | 1 those typically found on an Australian or international commercial vessel of unlimited propulsion power |
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Range Statement (continued)

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VARIABLE	SCOPE
b The main propulsion and auxiliary machinery and associated systems may be started up and shut down:	1 by day or night in both normal and emergency situations 2 under any permissible conditions of weather 3 during berthing and unberthing operations 4 while anchored or moored 5 in dry dock 6 during cargo operations 7 when bunkering 8 during cargo operations

VARIABLE	SCOPE
c Propulsion plant configurations may include:	<ol style="list-style-type: none"> 1 low speed, medium and high speed diesel propulsion 2 stern tube bearing 3 CPP 4 direct drive shaft 5 diesel electric 6 steam turbine plant and boiler 7 gas turbine 8 reduction gears 9 thrust blocks, detuners and shaft bearings
d Auxiliary machinery and associated systems may include:	<ol style="list-style-type: none"> 1 fresh and salt water cooling systems 2 lubricating oil cooling systems 3 fuel, oil, gas, coal systems and centrifuges 4 air compressor and air starting systems 5 lubrication 6 bilge and ballast system, oily water separator 7 refrigeration and air-conditioning plant and equipment 8 on-board air compressors and compressed air and control air systems 9 waste management and pollution control systems as per the MARPOL Convention 10 fresh water evaporators reverse osmosis systems

Range Statement (continued)

TDMMR807B MANAGE THE START UP AND SHUT DOWN OF MAIN PROPULSION AND AUXILIARY MACHINERY AND ASSOCIATED SYSTEMS ON VESSELS OF UNLIMITED PROPULSION POWER

VARIABLE	SCOPE
<p>d Auxiliary machinery and associated systems may include: (continued)</p>	<ul style="list-style-type: none"> 11 inert gas generator 12 cargo pumps, tank washing machines and associated systems 13 purifiers and clarifiers 14 heaters 15 sewage plant 16 fixed firefighting installations and fire control systems 17 auxiliary boilers and waste heat generators
<p>e Emergencies may include:</p>	<ul style="list-style-type: none"> 1 loss of propulsion 2 loss of electrical power 3 loss of steering 4 flooding 5 fire or explosion 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

VARIABLE	SCOPE
f Documentation and records may include:	<ol style="list-style-type: none"> 1 ISM Code safety management system plans, procedures, checklists and instructions 2 vessel 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 as it relates to shipboard machinery 6 relevant sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and class society rules dealing with shipboard machinery maintenance and repair

Range Statement (continued)

<p>TDMMR807B MANAGE THE START UP AND SHUT DOWN OF MAIN PROPULSION AND AUXILIARY MACHINERY AND ASSOCIATED SYSTEMS ON VESSELS OF UNLIMITED PROPULSION POWER</p>
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VARIABLE	SCOPE
f Documentation /records may include: (continued)	<ol style="list-style-type: none"> 7 instructions of relevant maritime authorities and class societies concerning shipboard machinery maintenance and repair
g Applicable procedures and codes may include:	<ol style="list-style-type: none"> 1 sections of national and international regulations, IMO Conventions and Codes, including AMSA Marine Orders and class 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

VARIABLE	SCOPE
	3 relevant international, Commonwealth, State and Territory engineering practice standards

Unit Sector(s)

Not applicable.

Field

Field R Carry Out Operations on Equipment and Systems

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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