



Australian Government

MARL6014A Demonstrate intermediate knowledge of marine diesel engines and systems

Release 1

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Modification History

Release 1

This is the first release of this unit.

Unit Descriptor

This unit involves the skills and knowledge required to operate and maintain marine diesel engines and systems on a commercial vessel. This includes evaluating diesel fuel systems, methods of diesel engine cooling, diesel engine lubrication requirements, propulsion methods and faults using combustion diagnostic equipment.

Application of the Unit

This unit applies to the work of a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 issued by the Australian Maritime Safety Authority (AMSA).

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

This unit contains employability skills.

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

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| 1 Evaluate diesel fuel systems | <ul style="list-style-type: none">1.1 Why atomisation and penetration of fuel and air turbulence are essential to optimum combustion is explained1.2 Typical injection pressures and viscosities for different grades of fuel are stated1.3 Design modifications of pumps, camshafts and injectors for fuel types are outlined1.4 Difference between constant and variable injection fuel pump timing, showing materials, principal parts, method of operation and adjustments of common pump types is explained1.5 Injection requirements for slow speed and high speed diesel engines are compared, including pilot injection and pre-combustion chambers1.6 Common service faults, symptoms and causes of diesel fuel injection problems are identified, specifying appropriate adjustments, including methods of fuel pump timing1.7 Work health and safety (WHS)/occupational health and safety (OHS) requirements for handling and testing fuel injection systems are explained1.8 Normal operating pressures and temperatures for fuel valve cooling arrangements, and uni-fuel and dual-fuel systems, including both high/medium viscosity fuel types are explained |
| 2 Evaluate different methods of diesel engine cooling | <ul style="list-style-type: none">2.1 Importance of maintaining diesel engine thermal efficiency and evaluate thermal loads on engine components is outlined2.2 Cooling media selection is justified, and advantages and disadvantages of different diesel cooling methods are outlined2.3 Appropriate action to be taken with common faults in cooling systems is explained and different cooling water treatments are compared2.4 How cooling systems are commissioned, stored during idle periods and restored after contamination is confirmed2.5 Methods of load-dependent cooling of diesel alternators on heavy fuels are evaluated2.6 Normal operation temperatures, pressures, and methods of cooling medium and slow speed diesel engine pistons, exhaust valves, cylinders, turbochargers and cylinder heads are identified |

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| 3 Evaluate diesel engine lubrication requirements | <p>3.1 Principles of engine lubrication are outlined</p> <p>3.2 Lubricant types, physical and chemical properties and applications are assessed</p> <p>3.3 Sources of diesel lubricant contamination and deterioration are identified</p> <p>3.4 Ways of testing for diesel lubricant contamination and deterioration, interpreting test results and identifying appropriate action to be taken are outlined</p> <p>3.5 Distribution of lubricating oil to guides, top-end, bottom-end and main bearings of diesel engines, showing direction of flow, typical clearances and stating normal operating temperatures and pressure is explained</p> <p>3.6 Principles of bearing lubrication are outlined</p> <p>3.7 Materials used in bearing construction are identified</p> <p>3.8 Bearing faults are evaluated and remedies to prevent them from occurring are determined</p> |
| 4 Compare different propulsion, manoeuvring and starting methods | <p>4.1 Starting procedures of diesel engines for power generation, propulsion, and emergency use are clarified</p> <p>4.2 Starting and manoeuvring requirements/sequences for direct-coupled reversible and geared propulsion diesels, including CPP applications are explained</p> <p>4.3 Common faults are analysed and appropriate action to be taken with typical diesel starting and manoeuvring systems is identified</p> <p>4.4 Manoeuvring and reversing systems of propulsion diesel engines are outlined</p> <p>4.5 Different methods of achieving reversing capability with direct-coupled propulsion diesels are compared</p> <p>4.6 Layout of a diesel-electric drive is compared and contrasted with the layout of a turbo electric drive</p> |
| 5 Analyse materials used in constructing diesel engines | <p>5.1 Common materials used in diesel engine construction are assessed, selection is justified, and typical compositions and physical properties of components are specified</p> <p>5.2 Dynamic stresses and loads are interpreted, service limitations are identified and different <i>methods of component fabrication</i> are</p> |

evaluated

- 5.3 Two-stroke and four-stroke operating cycle forces, couples and moments, relating to design principles of crankshafts, bedplates, foundations and crossheads are outlined
- 5.4 Out-of-balance gas and inertia forces, couples and moments are related to flywheels, balance weights and first/second order balancing
- 5.5 Factors contributing to torsional vibration are explained and methods of minimising or eliminating harmful effects of critical speeds are clarified
- 5.6 Pistons, liners, piston rings, bearings and crankshafts are calibrated to identify wear patterns, limits and means of correction
- 5.7 Alignment and adjustment criteria of crankshafts, chain-drives, integral thrust bearings and crossheads are specified
- 5.8 Specified working clearances and limits of all bearings, sliding surfaces and interference fits of typical diesel engines are compiled using engine builder manuals
- 6 Explain uptake and scavenge fires and air line, gearbox and crankcase explosions**
 - 6.1 Design and operational factors that contribute to fires in waste heat units are explained and methods of extinguishing and/or containing soot and hydrogen fires are specified
 - 6.2 Routine cleaning procedures, inspection criteria, symptoms of fire and risks of isolation in service associated with waste heat units are identified
 - 6.3 Operational factors that contribute to scavenge fires are identified, symptoms are outlined, methods of extinguishing are evaluated and routine inspection criteria of scavenge spaces are stated
 - 6.4 Principles of explosive mixtures are clarified and how a starting airline explosion can occur is explained
 - 6.5 How risk of scavenger fires may be minimised in service by protective devices and routine evaluation of starting air systems is clarified
 - 6.6 Causes of gearbox and crankcase explosions in propulsion and auxiliary drives are outlined
 - 6.7 How risks of gearbox and crankcase explosions may be minimised in service are explained and correct procedures to be taken in the event of warning of a hazardous atmosphere in both oil and dual-fuel engines are clarified

- 6.8 Operating principles of an oil-mist detector, crankcase breather and explosion relief doors are explained
- 6.9 Function of a piston rod scraper box is outlined, and causes of wear and appropriate adjustments are identified
- 7 **Explain correct working practices associated with diesel engine operation, maintenance and repair**
 - 7.1 Safe working practices associated with isolating main and propulsion diesels under all emergency and routine situations are explained, including use of protective devices, interlocks and evaluation of their status
 - 7.2 Safe working practices associated with working in crankcases and other enclosed spaces are explained
 - 7.3 Safe working practices associated with safe handling of hydraulic tools and dangers of lifting/isolating heavy components both unaided and with lifting gear are explained
 - 7.4 Hazards of working with flammable liquids under pressure, chemicals, acids and hydrocarbons as well as selection criteria for appropriate protective clothing are explained
 - 7.5 Safe working strategies for diesel engine maintenance are planned using engine manufacturer instruction manuals and product data safety sheets
- 8 **Analyse faults using combustion diagnostic equipment**
 - 8.1 Two-stroke and four-stroke theoretical cycle diagrams are compared with results recorded using diagnostic tools
 - 8.2 Combustion faults from typical diagrams are evaluated and corrective adjustments are specified
 - 8.3 Service combustion values are compared with trials or test bed figures
 - 8.4 Common faults associated with pressure charging and fuel injection systems are outlined
 - 8.5 Methods of pressure charging diesel engines are compared, and materials of construction, design features, operational maintenance and emergency procedures are correctly identified
 - 8.6 Causes of efficiency loss and surge are explained
 - 8.7 Scavenging systems and gas/air flow paths through a turbocharger, under normal and emergency operation modes are explained using relevant diagrams

9 Analyse construction and operation of marine gas turbines

- 9.1 Flow of air and gas through a simple cycle marine gas turbine is analysed
- 9.2 Materials and construction of compressor, combustion system and turbine in single and two shaft designs are outlined
- 9.3 Controls required for control and protection of marine gas turbines are detailed
- 9.4 Function of **accessories** necessary for safe operation of marine gas turbines are explained

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required Skills:

- Access diagnostic information related to marine diesel engines and systems
- Assess own work outcomes and maintain knowledge of current codes, standards, regulations and industry practices
- Explain operation of marine diesel engines and systems
- Identify and apply relevant solutions for addressing problems associated with marine diesel engines and systems
- Identify and interpret diagnostic information, and perform mathematical calculations related to operating, maintaining and repairing marine diesel engines and systems
- Identify methods, procedures and materials needed for operating, maintaining and repairing marine diesel engines and systems
- Impart knowledge and ideas through verbal, written and visual means
- Read and interpret manuals, technical specifications, safety data sheets/material safety data sheets and manufacturer guides related to operating, maintaining and repairing marine diesel engines and systems

Required Knowledge:

- Chemical and physical properties of fuels and lubricants
- Components of diesel engines
- Crankcase and air-line explosions, scavenge and uptake fires
- Diesel engine lubrication systems
- Diesel engine propulsion and power generation
- Manoeuvring systems of diesel engines
- Pressure charging diesel engines, including common service faults, actions to rectify faults, emergency operation and isolation procedures
- Principles of diesel engine operation
- Properties and characteristics of fires
- Safe working practices associated with diesel engines during operation, repair and maintenance
- Starting methods of diesel engines
- WHS/OHS legislation, policies and procedures

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, the required skills and knowledge, the range statement and the Assessment Guidelines for the Training Package.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the Elements, Performance Criteria, Required Skills, Required Knowledge and include:

- providing accurate and reliable information
- providing appropriate level of detail in responses.

Context of and specific resources for assessment

Performance is demonstrated consistently over time and in a suitable range of contexts.

Resources for assessment include access to:

- industry-approved marine operations site where intermediate knowledge of marine diesel engines and systems can be demonstrated
- diagrams, specifications and other information required for performing basic calculations related to marine diesel engines and systems
- technical reference library with current publications on marine diesel engines and systems
- tools, equipment and personal protective equipment currently used in industry
- relevant regulatory and equipment documentation that impacts on work activities
- range of relevant exercises, case studies and/or other simulated practical and knowledge assessments
- appropriate range of relevant operational situations in the workplace.

In both real and simulated environments, access is required to:

- relevant and appropriate materials and equipment
- applicable documentation including workplace procedures, regulations, codes of practice and operation manuals.

Method of assessment

Practical assessment must occur in an:

- appropriately simulated workplace environment and/or
- appropriate range of situations in the workplace.

A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate to this unit:

- direct observation of the candidate demonstrating

intermediate knowledge of marine diesel engines and systems

- direct observation of the candidate applying relevant WHS/OHS requirements and work practices.

Guidance information for assessment

Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

In all cases where practical assessment is used it should be combined with targeted questioning to assess Required Knowledge.

Assessment processes and techniques must be appropriate to the language and literacy requirements of the work being performed and the capacity of the candidate.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below.

Methods of component fabrication may include:

- Ceramics
- Composite
- Forged
- Laser-hardening
- Plasma-spraying
- Welded

Accessories may include:

- Accessory gear
- Lube oil:
 - cooler
 - pump
 - filter
- Starting devices

Unit Sector(s)

Not applicable.

Competency Field

Marine Engineering