



Australian Government

MARL027 Demonstrate intermediate knowledge of marine diesel engines and systems

Release: 1

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Modification History

Release 1. New unit of competency.

Application

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.

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).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Not applicable.

Competency Field

L – Marine Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

1 Evaluate diesel fuel systems

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| 1.1 | Why atomisation and penetration of fuel and air turbulence are essential to optimum combustion is explained |
| 1.2 | Typical injection pressures and viscosities for different grades of fuel are documented and compared |
| 1.3 | Design modifications of pumps, camshafts and injectors for fuel types are outlined |

- 1.4 Difference between constant and variable injection fuel pump timing, showing materials, principal parts, method of operation and adjustments of common pump types is compared and explained
- 1.5 Injection requirements for slow speed and high speed diesel engines are compared, including pilot injection and pre-combustion chambers
- 1.6 Common service faults, symptoms and causes of diesel fuel injection problems are identified, specifying appropriate adjustments, including methods of fuel pump timing
- 1.7 Work health and safety/occupational health and safety (WHS/OHS) requirements for handling and testing fuel injection systems are explained
- 1.8 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**
 - 2.1 Importance of maintaining diesel engine thermal efficiency and evaluate thermal loads on engine components is outlined
 - 2.2 Cooling media selection is justified, and advantages and disadvantages of different diesel cooling methods are outlined
 - 2.3 Appropriate action to be taken with common faults in cooling systems is explained and different cooling water treatments are compared
 - 2.4 How cooling systems are commissioned, stored during idle periods and restored after contamination is confirmed
 - 2.5 Methods of load-dependent cooling of diesel alternators on heavy fuels are evaluated
 - 2.6 Normal operation temperatures, pressures, and methods of cooling medium and slow speed diesel engine pistons, exhaust valves, cylinders, turbochargers and cylinder heads are identified
- 3 **Evaluate diesel engine lubrication requirements**
 - 3.1 Principles of engine lubrication are outlined
 - 3.2 Lubricant types, physical and chemical properties and applications are assessed

- 3.3 Sources of diesel lubricant contamination and deterioration are identified
- 3.4 Ways of testing for diesel lubricant contamination and deterioration, interpreting test results and identifying appropriate action to be taken are outlined
- 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
- 3.6 Principles of bearing lubrication are outlined
- 3.7 Materials used in bearing construction are identified
- 3.8 Bearing faults are evaluated and remedies to prevent them from occurring are determined
- 4 **Compare different propulsion, manoeuvring and starting methods**
 - 4.1 Starting procedures of diesel engines for power generation, propulsion, and emergency use are clarified
 - 4.2 Starting and manoeuvring requirements/sequences for direct-coupled reversible and geared propulsion diesels, including CPP applications are explained
 - 4.3 Common faults are analysed and appropriate action to be taken with typical diesel starting and manoeuvring systems is identified
 - 4.4 Manoeuvring and reversing systems of propulsion diesel engines are outlined
 - 4.5 Different methods of achieving reversing capability with direct-coupled propulsion diesels are compared
 - 4.6 Layout of a diesel-electric drive is compared and contrasted with the layout of a turbo electric drive
- 5 **Analyse materials used in constructing diesel engines**
 - 5.1 Common materials used in diesel engine construction are assessed, selection is justified, and typical compositions and physical properties of components are specified
 - 5.2 Dynamic stresses and loads are interpreted, service limitations are identified and different methods of component fabrication are 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 scavenge 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

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| | 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

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

- Methods of component fabrication include one or more of the following:
- ceramics
 - composite
 - forged
 - laser-hardening
 - plasma-spraying
 - welded
- Accessories include one or more of the following:
- accessory gear
 - lube oil:
 - cooler
 - pump
 - filter
 - starting devices

Unit Mapping Information

This unit replaces and is equivalent to MARL6014A Demonstrate intermediate knowledge of marine diesel engines and systems.

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>