Australian Government

MARL033 Demonstrate advanced knowledge of marine diesel engines and systems

Release: 1

MARL033 Demonstrate advanced knowledge of marine diesel engines and systems

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to analyse the operation and maintenance of marine diesel engines and systems on a commercial vessel. This includes evaluating fuel, cooling and lubrication systems; analysing starting, manoeuvring and reversing systems; analysing causes of vibration, scavenge fires and explosions; and interpreting combustion diagnostic equipment faults.

This unit applies to the work of a Marine Engineer Class 1 on commercial vessels of unlimited propulsion power and forms part of the requirements for the Certificate of Competency Marine Engineer Class 1 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	1.1 Optimum combustion parameters, means of adjustment and legislation requirements limiting exhaust emissions are analysed
	1.2 Design modifications of pumps, camshafts and injectors for standard fuel types are evaluated

	1.3	Variable injection timing and fuel quality adjustments in service are justified, specifying common methods of adjustment
	1.4	Injection requirements for common diesel engine types, including combustion modifications for changes in engine service rating, are compared
	1.5	Faults and symptoms of common diesel fuel injection problems are analysed and appropriate adjustment is explained
	1.6	Work health and safety (WHS)/occupational health and safety (OHS) aspects of testing and handling fuel injection systems are explained
	1.7	Operation and normal operating pressures and temperatures of fuel systems are analysed
2 Analyse cooling systems for main and auxiliary diesel engines	2.1	Thermal efficiency optimisation of diesel engines and causes of thermal loads on engine components are explained
	2.2	Cooling media selection is justified and various diesel-cooling methods are evaluated
	2.3	Requirements of a coolant are identified and recorded
	2.4	Corrosion principles and combustion side corrosion problems are explained
	2.5	Appropriate action to be taken with common cooling system faults is established and evaluated
	2.6	How cooling systems are commissioned, monitored and stored during idle periods is explained
	2.7	Reasons for load-dependant cooling of diesel alternators on heavy fuels is explained
	2.8	Use of additives in cooling water is explained
	2.9	Normal operating temperatures, pressures and flow paths of typical methods of cooling medium and slow speed diesel engine pistons, exhaust valves, cylinders, turbochargers and cylinder heads are specified
3 Evaluate diesel engine lubrication	3.1	Principles of engine lubrication are explained
	3.2	Different lubrication systems and demands each puts on oil

	requirements		are explained
		3.3	Methods for lubricating marine diesel engine components are specified and common faults are interpreted
		3.4	Conventional and synthetic lubricant properties and applications are identified
		3.5	Sources of contamination and deterioration of lubricants are analysed, treatment, monitoring and testing methods are explained, results are evaluated and appropriate action to be taken is outlined
		3.6	Diagrams showing direction of flow, typical clearances and stating normal operating temperatures and pressures are used to explain how lubricating oil is distributed to the guides, top-end, bottom-end and main bearings of diesel engines
		3.7	Methods of crosshead lubrication are outlined and compared
		3.8	Methods of medium and slow speed cylinder lubrication are evaluated
4	**Analyse diesel engine starting and manoeuvring**	4.1	Starting procedures for diesel engines for power generation, propulsion and emergency use are specified
		4.2	Starting and manoeuvring sequences/requirements for direct-coupled reversible and geared propulsion diesels, including CPP applications, are specified
		4.3	Common faults are analysed and appropriate action to be taken with diesel starting and manoeuvring systems is specified
		4.4	Major components of a propulsion diesel engine typical manoeuvring and reversing system are outlined using labelled diagrams, explaining how remote, local and emergency manoeuvring is achieved
		4.5	Methods of achieving reversing capability with direct-coupled propulsion diesels are evaluated
5	**Analyse causes of vibration**	5.1	Common materials used in diesel engine construction are identified, justifying selection and specifying typical compositions and physical properties of components
		5.2	Dynamic loads and stresses are summarised, identifying service limitations, and different methods of component fabrication and reclamation are evaluated

	5.3	Two- and four-stroke operating cycle forces, couples and moments, relating to design principles of crankshafts, bedplates, foundations and crossheads are analysed
	5.4	Out-of-balance gas and inertia forces, couples and moments, and their relationship with flywheels, balance weights, first/second order balancing and hull vibration are explained
	5.5	Factors contributing to torsional vibration are specified and methods of minimising or eliminating harmful effects of critical speeds are outlined
	5.6	Torsional vibration dampers/detuners are explained using labelled diagrams, indicating construction features and operating principles
	5.7	Calibration is applied to identify wear patterns, limits and means of restoring working clearances and limits of pistons, liners, piston rings, bearings and crankshafts, sliding surfaces and interference fits of typical diesel engines
	5.8	Alignment and adjustment criteria of crankshafts, chain-drives, integral thrust bearings and crossheads are specified
	5.9	Crankshaft deflection measurements are prepared and evaluated, alignment diagrams are constructed, and realignment procedures including restoration of crankshaft shrink-fit slippage, are proposed
6 Analyse scavenge and uptake fires, air-line, crankcase and gearbox explosions	6.1	Operational and design factors contributing to waste heat unit fires are assessed
	6.2	Appropriate strategies for extinguishing/containing soot and hydrogen fires are selected
	6.3	Hazard reduction, inspection and isolation in service procedures are established
	6.4	Operational factors that may contribute to scavenge fires are identified and hazard reduction is planned
	6.5	Factors contributing to explosive mixtures are analysed and hazard reduction procedures for starting airlines are proposed and evaluated
	6.6	Inspection and test intervals are specified
	6.7	Causes of gearbox and crankcase explosions in propulsion

		and auxiliary drives are revised
	6.8	How risks may be minimised in service by hazard reduction is specified
	6.9	Procedures to be implemented for hazardous atmosphere warning in oil and dual-fuel engines are evaluated
	6.10	Relevant diagrams are used to identify operating principles of oil-mist detectors, crankcase breathers and explosion relief doors
	6.11	Maintenance strategies are developed and criteria for piston rod scraper box inspection and maintenance intervals are specified
7 Plan safe working practices associated with diesel engine maintenance, operation and repair	7.1	Safe working practices for isolating main and propulsion diesels under all operational contingencies are planned
	7.2	Safe working practices for machinery in enclosed spaces are planned
	7.3	Hazard reduction procedures for safe working with flammable liquids under pressure, chemicals, acids and hydrocarbons associated with engine overhaul and maintenance are planned
	7.4	Safe working strategies for diesel engine maintenance are planned according to manufacturer instruction manuals and product data safety sheets
8 Interpret combustion diagnostic equipment faults and relate to fuel injection and pressure charging systems	8.1	Two- and four-stroke theoretical cycle diagrams are produced and discrepancies with results recorded by diagnostic tools are accounted for
	8.2	Combustion faults related to fuel injection and pressure charging systems are diagnosed, corrective action is specified and service values with trials or test bed figures are analysed
	8.3	Methods of pressure charging diesel engines are evaluated, efficiencies are determined from records, efficiency losses are accounted for and means of correction are identified
	8.4	Maintenance and emergency procedures for turbochargers and charge air coolers are planned
	8.5	Design features of turbochargers and charge air coolers are evaluated
	8.6	Relevant diagrams are applied to evaluate diesel scavenging

systems, under normal and emergency operation modes

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.

Fuel systems include one or more of the following:	• conventional, low-inertia and dual-fuel (oil fuel/gas) injectors • fuel line pulsation damping devices • leakage protection • uni-fuel and dual-fuel systems (high/medium viscosity fuel types)
Appropriate action to be taken with common cooling includes one or more of the following:	• contamination • different cooling water treatments
Normal operating temperatures, pressures and flow paths include one or more of the following:	• bore cooling techniques • honeycomb techniques • strong-back techniques
Sources of contamination must include:	• bacterial infection
Methods of medium and slow speed cylinder lubrication include one or more of the following:	• optimisation • running-in requirements • speed and load-dependant lubrication
Methods of component fabrication and reclamation include one or more of the following:	• ceramics • composite • forged • laser-hardening • plasma-spraying • welded

Hazards include one or more of the following:	• acids • chemicals • defective or bypassed machinery protective devices • defective or inappropriately adjusted exhaust systems • enclosed spaces • flammable liquids under pressure • hydrocarbons • leaking oil and fuel • lifting heavy components both unaided and with lifting gear
Safe working practices for isolating main and propulsion diesels must include:	• identifying hazards • minimising hazards
Safe working practices for machinery in enclosed spaces must include:	• handling heavy components • using hydraulic tools
Design features of turbochargers and charge air coolers must include:	• bearing types • materials
Relevant diagrams must include:	• light spring diagrams

Unit Mapping Information

This unit replaces and is equivalent to MARL6020A Demonstrate advanced 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