

Approved Engine Course (AEC) - 30 Hour Diesel Engine Course

The objectives of the course defined:

1. Introduction

1.1 The objective of this course is to provide students with the basic theoretical knowledge and some practical hands on experience of diesel engines to enable them to meet the requirements of the Maritime and Coastguard Agency (MCA) Codes of Practice for the Safety of Large Commercial Sailing & Motor Vessels, the Safety of Small Commercial Motor Vessels and the Safety of Small Workboats & Pilot Boats.

Annex 5 of the Safety of Large Commercial Sailing & Motor Vessels defines the Engineering Competencies required for these vessels.

Annex 7 of the Safety of Small Commercial Motor Vessels defines the Engineering Competencies required for these vessels.

Annex 11 of the Safety of Small Workboats & Pilot Boats defines the Engineering Competencies required for these vessels.

Certain defined circumstances require that: *“One of the persons(employed aboard).....should be familiar with the operation and maintenance of the main propulsion and associated machinery of the vessel and should have attended a suitable course.”*

1.2 This short course does not attempt to make diesel engineers from the course participants but should enable students to carry out regular servicing and be more aware of possible faults developing before they become major problems.

2. COURSE CONTENTS

2.1 Compression Ignition Engine

(a) The general principles of the compression ignition engine c.f. spark ignition.

2.2 Cycle of Operation and Constructional Details

- (a) Engine cycles explained: Four Stroke and Two Stroke.
- (b) The essential engine components identified and the acquisition of basic terminology.
- (c) The meaning of engine terms such as: top dead centre, bottom dead centre, stroke, bore, swept volume, engine capacity, clearance volume and compression ratio.
- (d) Engine configurations: in line and vee engine types; side and overhead valve arrangements and side and overhead camshafts.
- (e) Engine performance data: interpretation of revs, torque and power curves; specific fuel oil consumption.

2.3 The Fuel System

- (a) The nature of diesel engine fuels; gas oils and DERV and their related origins. The importance of fuel cleanliness and the avoidance of water ingress. Explanation of the conditions which lead to microbiological contaminations. Risks and consequences of fuel leakage contaminating the lubricating oil.
- (b) The fuel tank: filling, venting and isolating arrangements; the importance of weather tight sealing of filling cap. Adequacy of mounting and support arrangements and the importance of accurate indication of fuel contents.
- (c) Fuel pre-filter and water coalescer/separator.
- (d) Fuel lift pumps of diaphragm and plunger types.
- (e) Fine paper element filters.
- (f) Fuel injection pumps: in line jerk type and distributor pumping action. Fuel metering: helical, groove and metering valve (DPA).
- (g) Fuel injectors and the importance of good atomization to the clean and efficient running of the engine.
- (h) The importance of maintaining an adequate reserve of fuel and the consequences of allowing the level to fall too low. Basic fuel calculations using engine revs, power curves and SFOC with modifications for sea state.
- (i) Bleeding the fuel system.

2.4 The Role of Air in the Combustion Process

- (a) Concepts of fuel as an energy source and the essential air to fuel ratios for clean and efficient combustion.
- (b) Air filters wet and dry types and inlet manifold: the importance of adequate engine compartment ventilation.
- (c) The comparison between naturally aspirated and turbo charged engines against the background of volumetric efficiency. Engine power to weight ratios.
- (d) Turbo chargers: operating principles and “get you home” measures in the event of turbo charger failure.
- (e) Charge air coolers: intercooling / aftercooling.
- (f) The exhaust system: silencers, water injection elbows and syphon breaks.

2.5 The Cooling System

- (a) Outline of the temperatures involved in the combustion process and its effect on engine component materials: alloy, aluminium, cast iron and steel.
- (b) The cooling water circuit through the engine.
- (c) Raw water (sea water) cooling.
- (d) Fresh water cooling and heat exchangers.
- (e) The importance of maintaining the correct cooling water temperature and the functioning of the thermostat.
- (f) Cooling water pumps: rubber impeller and centrifugal.

2.6 The Lubrication System

- (a) The nature of friction, the composition of bearing materials and the role of lubricating oil in minimising the former and dissipating the heat produced.
- (b) The route of lubricating oil through the engine and the importance of maintaining oil at the correct level and in an adequate state of cleanliness.
- (c) Lubricating oil pumps of gear and lobe types.
- (d) Lubricating oil filters and the action of the pressure relief valve.

2.7 Engine Electrical Systems

- (a) Batteries: Lead Acid and Alkaline, their materials of construction, the electro-chemical processes and the explosive dangers of Hydrogen gas.
- (b) The rating of batteries: Ampere-hour and cold cranking capacity for engine starting duties and deep cycling requirements for ancillary loads such as navigation lights and domestic requirements.
- (c) Basic appreciation of the battery discharge versus recharge relationship. Simple calculations to show the importance of maintaining batteries in an adequate state of charge.
- (d) Twin battery installations and split charging arrangements. Risks posed by diodes due to voltage surge from open circuit conditions.
- (e) The a.c. generator (Alternator) and its drive belt.
- (f) Pre-engaged starter motors.
- (g) Engine stopping arrangements - manual and solenoid operated. Emergency stopping by obstructing the air intake.
- (h) Cold starting aids.
- (i) basic circuit diagrams and engine instrumentation - sender units and their locations.
- (j) Safety features in the electrical distribution system such as fuses and breakers and the importance of bonding/earthing.

2.8 Power Transmission

- (a) Reduction/reverse gear boxes and cone and plate clutches. Mechanical and hydraulic modes of operation.
- (b) Control systems: Bowden cables and rods. Safety considerations.
- (c) Propeller shafting and couplings. The importance of accurate alignment and engine mountings - both rigid and flexible.
- (d) Stern tube bearings and sealing arrangements - both traditional packed glands and seals such as Deep Sea Seals.
- (e) Introduction to the basics of propeller matching to hull speed and engine power and revolutions.

2.9 Hull Fittings

- (a) The maintenance of sea cocks and the importance of annual inspection.
- (b) Cathodic protection systems and associated bonding circuits.

2.10 General

- (a) Marine pollution legislation in both MARPOL - Annex I covering oil and MARPOL - Annex V covering garbage.
- (b) Code of Safe Working Practices, safety consciousness and awareness of potential fire hazards. Basic fire-fighting techniques.
- (c) The use and hazards of fixed fire extinguishing systems
 - Carbon Dioxide (CO₂)
 - Halon
 - "FM 200"
 - "[Pyrogen Aerosol](#)"
- (d) Bottled LPG installations - safety requirements to ISO10239.

NOTE: Fault finding and rectification will be covered within each part of the syllabus as the individual topics are covered.