February 2020

Maritime & Coastguard Agency

Maritime & Coastguard Agency (MCA)

APPROVED ENGINE COURSE - 1 (AEC 1)

Guidelines

35 Contact Hours Course.

(recent changes highlighted in yellow)

MCA “APPROVED ENGINE COURSE 1” (AEC 1) - Guidelines - 35 Contract Hours Course.

Additional information about the unit

1. General

1.1 All new AEC 1 Course approvals and re-approvals must be undertaken in accordance with these guidelines. These guidelines confirm a change in the mandatory minimum hours for the AEC course. The total running time of the AEC course must now include the assessment and must be at least 35 hours. Previously minimum course time was set at 30 hours. However, this did not include assessment. Existing courses should now transition to the new requirements within 6 months of this document being published (by 02 September 2020). A desk top submission should be sent for approval to your local Marine Office or in the case of overseas training providers, the Seafarer Training and Certification Branch. This should demonstrate changes in your procedures and course content to meet the new requirements. If you are unable to transition within this period then you should write to the Chief Examiner (stc.courses@mcga.gov.uk) providing a valid explanation and action plan for your transition.

1.2 This training is relevant to wide ranges of personnel that require the knowledge and understanding to build up a career as an Engineer of a Small Vessel.

1.3 The Approved Engine Course 1 (AEC 1) is a Non- STCW certificate. This is issued directly by MCA-approved training providers. The training is a prerequisite to obtaining a Marine Engine Operators License.

While the MCA recognises these qualifications, it cannot guarantee recognition internationally. Holders of these certificates should check the certification requirements of the local Port State Control Administration prior to entering their jurisdiction.

1.3 The AEC 1 basic theoretical learning and relevant practical hands on trainings course, provides base foundation for Small Vessel engineers from the course participants and enable students to carry out regular servicing of onboard machinery/equipment by developing a greater understanding of possible faults before they develop into major problems.

2. Aim of the Course.

2.1 The aim of this course is to provide students with the basic theoretical knowledge and some practical hands on experience of diesel engines and systems to enable them to meet the requirements of the 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.

This course is also aimed to address the following reference areas.

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

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

- Annex 11 of the Safety of Small Workboats & Pilot Boats Code 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.”

Note: 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 before they develop into major problems.

2.2 The course also aims to give the basic training to the engineer officers who want to pursue a career on “Small Vessels” (Fishing Vessels, Yachts, Tugs, Workboats, Standby, Seismic Survey, Oceanographic Research Vessels and Government Patrol Vessels). The necessary training outlines the certification structure, examination and training requirements. It also explains the regulatory requirements regarding the implementation of intended training elements, as may be applicable.

2.3 The overall aim is to provide Small Vessel engineers with the necessary knowledge, understanding and proficiency to carry out safe and effective operations onboard.

3. Background of the Course.

3.1 Article IX of the STCW Convention allows an administration to adopt alternative arrangements of education and training for special types of ships and trades. The MCA has utilised this alternative arrangement to create a certificate structure for this course.

3.2 This document includes the criteria for the development of courses to deliver training for service on ships.

4. Health and Safety: Conduct of Training

4.1 At all times the safety of learners and staff delivering training must be ensured.

4.2 Practical exercises should be designed and delivered solely to meet the course criteria.

4.3 All training centres must adhere to applicable regulations made under the Health and Safety at Work Act 1974, as amended, and take proper account of the advice given in associated guidance documents and ‘Approved Codes of Practice’. Outside the UK, training centres must adhere to relevant national legislation and have a routine inspection

to ensure a safe working environment for students broadly equivalent to the UKs standards (Health and Safety at Work Act 1974).

4.4 Training centres are required to make assessments of any potential risks to the health and safety of staff and learners that may be associated with their activities. They are also required to identify, implement, monitor and review effective measures for minimising and controlling risks.

4.5 Centres are required to make effective arrangements for dealing with any emergency, incident or accident that may occur during the training course. In the UK, the foregoing is required in accordance with the Management of Health and Safety at Work Regulations 1999, as amended.

4.6 Centres must draw up their own safe working procedures to meet statutory Health and Safety obligations.

5. Training Structure

5.1 Approved Engine Course (AEC) is divided in two parts, AEC I and AEC II. The previous AEC is modified to AEC I. The AEC 2 is an enhanced continuation with the delivery of approximately 50% practical tasks and half (50%) theory. The AEC part I and part II will be termed as the full AEC. The scope of these guidelines is limited to AEC 1 only.

5.2 Centres will need to develop a training programme covering the AEC 1 syllabus requirements and then submit their training plans to commence approval process. **Approvals within the UK should be directed to the local Marine office. Outside of the UK approval requests must come to the Seafarer Training and Certification Branch (STC.Courses@mcga.gov.uk).**

5.3 The training plans must define education and training objectives and related standards of competence to be achieved. The levels of knowledge, understanding and skills appropriate to the assessments required under these criteria are required to be identified.

5.4 The training should be structured around the outcomes although centres should devise their own training schedules and detailed lesson plans to ensure effective and logical delivery of the subject matter and achieve the objectives of the training.

6. Training Day and Training Duration

6.1 A training day is defined as one which has no more than eight contact hours and cannot be in excess of 10 hours, including relevant breaks.

6.2 The training shall be not less than 35 contact hours and will be delivered as a stand-alone module.

7. Entry Requirements

7.1 Minimum 18 years of age.

7.2 There is no entry qualification specified to join this course.

8. Trainer to Learner Ratio.

8.1 The trainer to learner ratio should not exceed 1:24 for non-practical sessions and 1:8 for practical sessions. However, an Approved training provider may raise this to 1:10, if they can complete a risk assessment to ensure that, there is adequate equipment for all candidates to work simultaneously and all training outcomes can be monitored and assessed.

8.2 The training centre, having due regard to health and safety and the objectives of the training, should determine other staffing requirements.

9. Qualifications of Instructors and Assessors

Instructors and assessors are required to be qualified in accordance with the requirements of Regulation I/6 STCW. Guidance on relevant qualifications & experience required to deliver & assess the training is given in Annex C.

10. Facilities and Equipment

10.1 Training centres seeking approval will need to demonstrate availability of suitable facilities for practical, general and theoretical instruction, appropriately equipped with teaching and learning aids and designed to enable each learner to fully engage, in the learning process.

10.2 All facilities must be maintained and where appropriate, inspected and tested in accordance with applicable regulations, current standards and manufacturers recommendations.

10.3 A classroom or equivalent must be provided for general instruction and the theoretical aspects of the course, to include suitable presentation facilities and audio-visual aids (e.g. DVDs, posters, diagrams)

10.4 Sufficient and suitable equipment must be provided to enable practical sessions and assessment of learning objectives.

10.5 A list of recommended equipment is given in Annex B, for guidance. The training centres may to use additional or similar equipment, as considered to be suitable, to deliver their training course.

11. Assessment Requirements

11.1 Assessment must be organised so that learners can, through demonstration and examination, show that they meet the competences stipulated, as identified in the AEC 1 syllabus.

11.2 The assessment system, methods and practice must be valid, reliable and authentic.

11.3 Each learner shall receive an assessment plan at the start of the training.

11.4 The assessment system should support appeals made by learners against assessment decisions.

11.5 A variety of sources of evidence may be used and must include evidence of learners' ability to meet the criteria for evaluating competence.

11.6 A range of direct observation, oral questioning, simulation and role play are considered ideal approaches to generating much of the evidence required.

11.7 All assessment must be formally documented and be made available for verification audits.

11.8 The practical exercises must be conducted, and achievement of competency must be assessed throughout the course under the supervision of trainer. The end of week assessment must be marked by an independent appropriately qualified person (same requirements as set out in Annex C).

12. Certification

On achievement of the desired standard of competence, a certificate will be issued by the centre in the MCA approved specimen certificate format, as given in Annex D.

13. Course Outcomes:

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

There are ten learning outcomes within the course:

Outcome 1 - The learner demonstrates competent knowledge of the general principles of the operation of the compression ignition engine and spark ignition engine.

Outcome 2 - The learner demonstrates competent knowledge of the general principles of the cycle of operation and constructional details of diesel engines.

Outcome 3 - The learner demonstrates competent knowledge of the safe operation of the fuel system and management of fuel oil.

Outcome 4 - The learner demonstrates competent knowledge of the general principles and purposes of air in the combustion process.

Outcome 5 - The learner demonstrates competent knowledge of the safe operation of the cooling system, including maintenance of pumping components.

Outcome 6 - The learner demonstrates competent knowledge to maintain the lubrication system and associated equipment.

Outcome 7 - The learner demonstrates competent knowledge of the general principles and operation of the electrical distribution system on-board, including engine electrical systems, batteries, and battery maintenance.

Outcome 8 - The learner demonstrates competent knowledge of the power transmission arrangements, including gearbox, coupling, stern tube and propellers.

Outcome 9 - The learner demonstrates competent knowledge of the hull fittings, ship-side valves, protective coatings and cathodic protection.

Outcome 10 - The learner demonstrates competent knowledge of the legislative requirements of the pollution prevention and management of safe working practices, including principles of, risk assessment, fire prevention, control of entry into enclosed spaces and fire-fighting techniques.

14. Course Learning Outcomes:

Outcome 1 - The learner demonstrates competent knowledge of the general principles of operation of the compression ignition engine and spark ignition engine

Learning Objectives:

1.1. Describe the general principles of the compression ignition engine and spark ignition engine.

Outcome 2 - The learner demonstrates competent knowledge of the general principles of the cycle of Operation and constructional details of diesel engines.

Learning Objectives:

2.1 Explain Four Stroke and Two Stroke engine cycles. Describe the differences between two and four stroke engines
2.2 Identify the essential engine components with the acquisition of basic terminology.
2.3 Explain the meaning of engine terms such as: top dead centre, bottom dead centre, stroke, bore, swept volume, engine capacity, clearance volume, power, Specific Fuel Oil Consumption (SFOC) and compression ratio.
2.4 Describe engine configurations: in line and 'V' engine types, side and overhead camshafts engines.
2.5 Explain engine performance data: interpretation of revs, torque and power curves; specific fuel oil consumption.

Outcome 3 - The learner demonstrates competent knowledge of the safe operation of the Fuel System and management of fuel oil.

Learning Objectives:

3.1 Explain the nature of diesel engine fuels, including different grades of distillate fuels. The importance of fuel cleanliness and the avoidance of water ingress.
Explain the conditions which lead to microbiological contaminations. Identify the risks and consequences of fuel leakage contaminating engine lubricating oil.

3.2 Describe fuel tank filling, venting and isolating arrangements. Explain the importance of weather tight sealing of filling cap and tank vents. Adequacy of mounting and support arrangements and the importance of accurate indication of fuel contents.

3.3 Explain fuel pre-filter and water coalesce/separator operation and maintenance procedures.

3.4 Describe fuel lift pumps of diaphragm and plunger types.

3.5 Explain the purpose of fine paper element filters.

3.6 Describe the operation of the essential components of fuel injection pumps: in line jerk type and distributor pumping action. Fuel metering: helical, groove and metering valve (DPA).

3.7 Describe the operation of the common rail system.

3.8 Describe the operation of fuel injectors and the importance of good atomization to the clean and efficient running of the engine.

3.9 Identify fuel system safety parameters.

3.10 Describe the importance of maintaining an adequate reserve of fuel and the consequences of allowing the level to fall too low.

3.11 Describe the bleeding procedure of the fuel system.

Outcome 4 - The learner demonstrates competent knowledge of the general principles and purposes of air in the combustion process.

Learning Objectives:

4.1 Describe the concept of fuel as an energy source and importance of air to fuel ratios for clean and efficient combustion.

4.2 Describe the purpose of air filters and arrangements of inlet manifold. Explain the importance of adequate engine compartment ventilation.

4.3 Describe differences between naturally aspirated and turbo charged engines, including power to weight ratios.

4.4 Describe the operating principles of turbo chargers and mechanical blowers:

4.5 Describe the purpose of charge air coolers and its arrangement in the induction system.

4.6 Describe the components of the exhaust system, including, catalytic converters[1], silencers, water injection elbows and syphon breaks.

[1] Catalytic converters which may be fitted for MARPOL annex VI Tier III NOx compliance. Note: The North Sea becomes NOx Tier III emission control area from Jan 21 for new vessels.

Outcome 5 - The learner demonstrates competent knowledge of the safe operation of the cooling system, including maintenance of pumping components.

Learning Objectives:

5.1 Describe the effects of heat generated in the combustion process on engine component materials such as: copper alloy, copper, aluminium alloy, cast iron and steel.
5.2 Describe the cooling water circuit through the engine.
5.3 Describe raw water (sea water) cooling system and explain the corrosion prevention measures by Anodes.
5.4 Describe the fresh-water cooling system including purpose of anodes and corrosion inhibitors and the function of heat exchangers.
5.5 Explain the importance of maintaining the correct cooling water temperature and the operation of the thermostat.
5.6 Describe the purpose of cooling water pumps, identifying the function and operation of the key components: including impeller, seal and volute casing.

Outcome 6 - The learner demonstrates competent knowledge to maintain the lubrication system and associated equipment.

Learning Objectives:

6.1 Describe the principle of friction. Explain the composition of bearing materials and the role of lubricating oil. in minimising the former and dissipating the heat produced.
6.2 Describe 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.
6.3 Describe lubricating oil pumps of gear and lobe types.
6.4 Explain the purpose of lubricating oil filters and the action of the pressure relief valve.

Outcome 7 - The learner demonstrates competent knowledge of the general principles and operation of the electrical distribution system on-board, including Engine Electrical Systems, batteries, and battery maintenance.

Learning Objectives:

7.1 Describe the materials of construction and the electro-chemical processes of different type of batteries, such as Lead Acid, Lithium-ion and Alkaline. Explain the explosive dangers of Hydrogen gas.
7.2 Explain 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.
7.3 Explain basic appreciation of the battery discharge versus recharge relationship. Simple calculations to show the importance of maintaining batteries in an adequate state of charge.
7.4 Explain twin battery installations and split charging arrangements.
7.5 Explain the principle of the A.C. generator (Alternator) and describe basic maintenance routines.
7.6 Explain the reasons for using a pre-engaged starter and describe the operation of a pre engaged starter circuit.

7.7 Demonstrate knowledge of Engine stopping arrangements, manual and solenoid operated. Further describe emergency stopping, by obstructing the air intake or shutting off fuel supply.
7.8 Describe the principle and operation of cold starting aids.
7.9 Describe the basic circuit diagrams and engine instrumentation by identifying the function and operation of the main key components.
7.10 Explain safety features in the electrical distribution system such as fuses and breakers and the importance of bonding/earthing.

Outcome 8 - The learner demonstrates competent knowledge of the power transmission arrangements, including gearbox, coupling, stern tube and propellers.

Learning Objectives:

8.1 Describe reduction/reverse gear boxes and plate clutches. Explain mechanical and hydraulic modes of operation.
8.2 Describe bowden cables and rods with references to control systems. Describe the associated safety considerations.
8.3 Describe propeller shafting and couplings. Explain the importance of accurate alignment and engine mountings - both rigid and flexible.
8.4 Describe stern tube bearings and sealing arrangements - both traditional packed glands and mechanical seals [such as Deep-Sea Seals]
8.5 Describe the reasons for propeller matching: refer to hull speed, engine power output and speed (revolutions).

Outcome 9 - The learner demonstrates competent knowledge of the Hull Fittings, ship-side valves, protective coatings and cathodic protection.

Learning Objectives:

9.1 Describe the maintenance procedures of ship side valves and the importance of annual inspection.
9.2 Describe zinc anodes and Cathodic protection systems and associated bonding circuits.

Outcome 10 - The learner demonstrates competent knowledge of the legislative requirements of the pollution prevention and management of safe working practices, including principles of, risk assessment, fire prevention, control of entry into enclosed spaces and fire-fighting techniques.

Learning Objectives:

10.1 Describe the role of MARPOL and include Annex I, IV, V and VI regulations.

10.2 Explain the role of the Code of Safe Working Practices for Merchant Seafarers, to include principles of risk assessment including difference between a risk and a hazard. Risk assess at least two practical scenarios one of which must be and entry into dangerous (enclosed) spaces. Discuss safety culture and awareness of potential fire hazards. Explain the principles of basic fire-fighting techniques.

10.3 Describe the use and hazards of fixed fire extinguishing systems:

10.3.1 Carbon Dioxide (CO_2)
10.3.2 Hi Fog
10.3.3 FM 200

10.4 Describe bottled LPG installations and the safety requirements.

10.5 Shows awareness of UK clean maritime plan as part of the government's Maritime 2050 long-term strategy. Including awareness of new technologies relating to hybrid vessels and alternative fuels.

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

Annex A

Conditions for MCA Approval of Short Courses

1. Training centers offering training and assessment leading to the issue of a certificate of proficiency must be approved by the Maritime and Coastguard Agency.

2. MCA approval requirements are for a functional Quality Management System to be in place that ensures:

   a. Continued satisfactory delivery of the programme to the current standards, reflecting changes of technology and best practice;

   b. The training programme entry standards are met;

   c. The agreed assessment process is maintained;

   d. Only those who complete the training programme and meet any other necessary requirements are issued with certificates/documentary evidence;

   e. Certificates are issued in a format that meets the MCA requirements, as per the examples provided for the operational and management levels within sections two and three of this document;

   f. Records of certificates issued are securely maintained until the 70th birthday of the certificate holder or five years from the date of issue whichever is the longer;

   g. The record system enables authenticity of certificates to be verified and replacement certificates issued;

   h. This course cannot be approved for peripatetic delivery,

   i. The approving MCA Office is informed of dates, timing and venues of all courses delivered;

   j. Any changes made to the course content, facilities, equipment, training staff or other matter that may affect the delivery of the programme are reported to the approving Marine Office without delay.

3. Monitoring of the training programme by the MCA proves to be satisfactory.

4. Re-approval by the MCA is carried out within 5 years of the approval or re-approval. Such approval and re-approval will incur costs in line with the fees in force at that time.

5. If, as the result of an audit, or if the MCA otherwise becomes aware that the Training Centre is no longer complying with the conditions of approval, or has serious non-compliance issues as regards health and safety, the MCA reserves the right to suspend or cancel the approval of the course.

6. Should the training establishment cease to trade then all records of certificates issued should be sent to the MCA to enable them to carry out the verification and replacement functions.

Annex B

List of equipment

Outcome 1 - The learner demonstrates competent knowledge of the general principles of the operation of the compression ignition engine and spark ignition engine.

1.1 One or more compression ignition engine in working condition (running).
1.2 One spark ignition engine in working condition (running) or suitable models, posters or video presentations.

Outcome 2 - The learner demonstrates competent knowledge of the general principles of the cycle of Operation and constructional details of diesel engines.

2.1 Large posters / video clips showing 4-Stroke and 2-Stroke engine cycles.
2.2 Actual, model or large posters / video clips of In-line and V- type engines.
2.3 Components of the compression ignition engine for physical inspections, including dismantled Cylinder cover, Piston, connecting rods, bearing shells, crankshaft, fuel pump and few fuel injectors.
2.4 One set of sample sea trial reports of a main propulsion engine recommended additional set for comparison).
2.5 One set of sample engine diagrams showing interpretation of revs, torque and power curves; specific fuel oil consumption, recommended additional set for comparison.
2.6 One set of sample main propulsion engine performance data sheets recommended additional set for comparison.

Outcome 3 - The learner demonstrates competent knowledge of the safe operation of the Fuel System and management of fuel oil.

3.1 One diaphragm fuel pump and one plunger type fuel pump.
3.2 Few different types of fine paper element filters.
3.3 Fuel injector testing unit to see atomization and set injecting pressure, optional when video and graphic presentations are provided.
3.4 Actual, model or large posters or video of a fuel system safety, double wall piping and fuel leakage alarm system.
3.5 Video clips or physical demonstration of the bleeding procedure of the fuel system.

Outcome 4 - The learner demonstrates competent knowledge of the general principles and purposes of Air in the combustion process.

4.1 One turbocharger unit or suitable model, video presentation or animation.

Outcome 5 - The learner demonstrates competent knowledge of the safe operation of the cooling system, including maintenance of pumping components.

5.1 Anodes used in the Raw water (sea water) cooling system.
5.4 Plate type heat exchanger components, video presentation, animation or model.
5.5 One cooling water pump for dismantling and for identifying the function and operation of the key components.

Outcome 6 - The learner demonstrates competent knowledge to maintain the lubrication system and associated equipment.

6.1 Few used bearing shells for conceptions of bearing materials and the role of lubricating
6.2 One lubricating oil pump for dismantling and for identifying the function and operation of the key components.
6.3 One duplex lubricating oil filter unit with the pressure relief valve, for dismantling and for identifying the function

Outcome 7 - The learner demonstrates competent knowledge of the general principles and operation of the electrical distribution system on-board, including engine electrical systems, batteries, and battery maintenance.

7.1 Different types of batteries. At least couples of each types of lead acid, lithium-ion and alkaline batteries.
7.2 A twin battery installations with split charging arrangements, optional where the Twin arrangement is described in graphic or video presentations.
7.5 One Spare a.c. generator (alternator) unit only for external inspection.
7.6 One electric motor with starter unit, in working condition.
7.7 Spares or dummies of various cold starting aids, for inspection, optional where graphic or video presentations are provided.
7.9 Various electrical safety equipment – such as fuses, MCB and main breakers, optional where graphic or video presentations are provided

Outcome 8 - The learner demonstrates competent knowledge of the power transmission arrangements, including gearbox, coupling, stern tube and propellers.

8.1 Actual, model or large posters of reduction/reverse gear boxes. Mechanical and hydraulic clutches.
8.2 Couple of spare bowden cables and/or rods with references to control systems.
8.3 Model/ Large poster of a propeller shafting and couplings arrangement.
8.4 Model/ Large poster of a stern tube bearings and sealing arrangement.

Outcome 9 - The learner demonstrates competent knowledge of the Hull Fittings, ship-side valves, protective coatings and cathodic protection.

9.1 For inspection, several spare sea cocks or ship side valves. One duplex sea suction filter unit, optional where graphic or video presentations are provided.
9.2 Several samples of zinc anodes
9.3 Large posters/drawings/Power point presentation, of a Cathodic protection system and associated bonding circuits.

Outcome 10 - The learner demonstrates competent knowledge of the legislative requirements of the pollution prevention and management of safe working practices, including principles of, risk assessment, fire prevention, control of entry into enclosed spaces and fire-fighting techniques.

10.1 A copy of Code of Safe Working Practices for Marchant Seafarers including entry into dangerous (enclosed) spaces.

10.3 Large posters and/or Power point presentation, showing layout and details of fixed fire extinguishing systems for followings:

10.3.1 Carbon Dioxide (CO2)
10.3.2 Hi Fog
10.3.3 FM 200

10.4 Graphics/ video presentation for arrangement of LPG bottles installation and safety features.

Instructor/Assessor Awareness Qualification and Experience Requirements

All training and instruction should be given, and assessments carried out, by suitably qualified and experienced personnel. This annex provides guidance regarding the suitability and acceptability of qualifications and experience for personnel designated to carry out training, instruction and assessment in AEC 2 courses. The list is not exhaustive, and suitable equivalent qualifications and experience will be considered.

All trainers and assessors should:

a) Understand the specific objectives of the training:

b) Be familiar with the use, operation and handling of various machineries and equipment commonly found in onboard pleasure or merchant vessels; and

c) Have an understanding of basic fault finding, before breakdown.

Instructors qualifications and experience

All instructors and assessors should have:

a. A minimum Yacht 4, Small Vessel Second Engineer, Merchant vessel EOOW, or higher Certificate of Competency. Other equivalent qualifications and experience may also be considered by the MCA, on a case for case basis only – you must email stc.course@mcga.gov.uk for equivalency approval (e.g. other commercial sectors tugs, fishing etc). The MCA may consider the use of shore based maritime engineers with the relevant marine based experience (e.g. ship building, ship repair, ship maintenance etc) – Shore based engineers must be approved by the Seafarer Training and Certification Branch on a case by case basis: email stc.courses@mcga.gov.uk.

b. A knowledge of instructional techniques, training methods and training practice at least to the level of IMO Training for Instructors;

c. An understanding of assessment methods and practice;

d. Practical instructional and assessment experience;

e. The practical exercises must be conducted, and achievement of competency must be assessed throughout the course under the supervision of trainer. The end of week assessment must be marked by an independent appropriately qualified person (same requirements as set out in Annex C).

Requirements for Training Centres

Training centres should have procedures in place to enable staff to update their profession knowledge of onboard machinery and equipment, plus their knowledge of instruction and assessment techniques, in accordance with Continuous Professional Development practices.

Requirements for the final Written Assessment

To ensure a robust final written assessment, centres should have a question bank that will allow them to develop a minimum of 4 written papers. The paper must be independently marked by appropriately qualified person (see point a. of "**Instructional qualifications and experience section"** from this Annex). The marking can take place onsite or from a remote location. This process must be detailed in the centres QMS. Due to the descriptive nature of the answers the questions raised the marking process cannot be completed by an automated computer.

Annex D

Specimen Certificate

Certificate of completion of MCA Approved Engine Course 1, training, covered within the AEC1 syllabus (to be produced and registered locally by the issuing authority).

Certificate No: (Unique identifier number allocated by the training centre)

MCA Approval Certificate Number: (issued by MCA)

Address and contact details including telephone and email of the issuing Authority (Approved Training Centre)

Approved Engine Course 1 (AEC 1) Course Completion Certificate

This is to certify that (Full name)

Date of birth (MM/DD/YYYY)

Has successfully completed a programme of theoretical and practical training sessions that delivers the knowledge requirements, set out in the Maritime and Coastguard Agency, AEC 1 course syllabus.

This certificate is issued under the authority Maritime and Coastguard Agency, of the United Kingdom of Great Britain and Northern Ireland, an executive agency of the department for transport.

Name and signature of Principal or
Authorised Representative of the
Approved Training Centre

Issuing Authority
Stamp and Date

Deep emboss OR Hologram

Signature of the person to whom this certificate was issued

Annex E

MCA "Approved Engine Course 1 (AEC 1)"- Syllabus.

1. Compression Ignition Engine

1.1. The general principles of the compression ignition engine and spark ignition engine

2. Cycle of Operation and Constructional Details

2.1 Engine cycles explained: Two Strokes and Four Strokes.
2.2 The essential engine components identified and the acquisition of basic terminology.
2.3 The meaning of engine terms such as: top dead centre, bottom dead centre, stroke, bore, swept volume, engine capacity, clearance volume, power, specific Fuel Oil Consumption (SFOC) and compression ratio.
2.4 Engine configurations: in line and 'V' engine types, side and overhead camshafts engines.
2.5 Engine performance data: interpretation of revs, torque and power curves; specific fuel oil consumption.

3. The Fuel System

3.1 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.
3.2 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.
3.3 Fuel pre-filter and water coalesce/separator.
3.4 Fuel lift pumps of diaphragm and plunger types.
3.5 Fine paper element filters.
3.6 Fuel injection pumps: in line jerk type and distributor pumping action. Fuel metering: helical, groove and metering valve (DPA).
3.7 Common rail system.
3.8 Fuel injectors and the importance of good atomization to the clean and efficient running of the engine.
3.9 Fuel system safety,
3.10 The importance of maintaining an adequate reserve of fuel and the consequences of allowing the level to fall too low.
3.11 Bleeding the fuel system.

4. The Role of Air in the Combustion Process

4.1 Concepts of fuel as an energy source and importance of air to fuel ratios for clean and efficient combustion.
4.2 Air filters and inlet manifold: the importance of adequate engine compartment ventilation.

4.3 The comparison between naturally aspirated and turbo charged engines. Engine power to weight ratios.
4.4 Turbo chargers: operating principles.
4.5 Charge air coolers.
4.6 The exhaust system, including, catalytic converters[2], silencers, water injection elbows and syphon breaks.

5. The Cooling System

5.1 Outline of the temperatures involved in the combustion process and its effect on engine component materials: alloy, aluminium, cast iron and steel.
5.2 The cooling water circuit through the engine.
5.3 Raw water (sea water) cooling and corrosion prevention measures by Anodes.
5.4 Fresh-water cooling system including purpose of anodes and corrosion inhibitors and the function of heat exchangers.
5.5 The importance of maintaining the correct cooling water temperature and the functioning of the thermostat.
5.6 Cooling water pumps: rubber impeller and centrifugal.

6. The Lubrication System

6.1 The nature of friction, the composition of bearing materials and the role of lubricating oil in minimising the former and dissipating the heat produced.
6.2 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.
6.3 Lubricating oil pumps of gear and lobe types.
6.4 Lubricating oil filters and the action of the pressure relief valve.

7 Engine Electrical Systems

7.1 Batteries: Lead Acid, Lithium-ion and Alkaline, their materials of construction, the electro-chemical processes and the explosive dangers of Hydrogen gas.
7.2 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.
7.3 Basic appreciation of the battery discharge versus recharge relationship. Simple calculations to show the importance of maintaining batteries in an adequate state of charge.
7.4 Twin battery installations and split charging arrangements.
7.5 The a.c. generator (Alternator) and its drive belt checks and maintenance
7.6 Pre-engaged starter motors.
7.7 Engine stopping arrangements - manual and solenoid operated. Emergency stopping by obstructing the air intake or shutting off fuel supply.
7.8 Cold starting aids.
7.9 basic circuit diagrams and engine instrumentation - sender units and their locations.

[2] Catalytic converters which may be fitted for MARPOL annex VI Tier III NOx compliance. Note: The North Sea becomes NOx Tier III emission control area from Jan 21 for new vessels.

7.10 Safety features in the electrical distribution system such as fuses and breakers and the importance of bonding/earthing.

8 Power Transmission

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

9 Hull Fittings

9.1 The maintenance of sea cocks and the importance of annual inspection.
9.2 Zinc anodes and Cathodic protection systems and associated bonding circuits.

10 General

10.1 Marine pollution, MARPOL - Annex I, IV, V and VI regulations.
10.2 Explain the role of the Code of Safe Working Practices for Merchant Seafarers, to include principles of risk assessment including difference between a risk and a hazard. Risk assess at least two practical scenarios one of which must be and entry into dangerous (enclosed) spaces. Discuss safety culture and awareness of potential fire hazards. Explain the principles of basic fire-fighting techniques.
10.3 Describe the use and hazards of fixed fire extinguishing systems
10.3.1 Carbon Dioxide (CO_2)
10.3.2 Hi Fog
10.3.3 FM 200

10.4 Describe how bottled LPG installations - safety requirements.

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

Additional information about the unit

Unit aim(s)	To provide the learner with the knowledge and practical skills required to undertake duties as the engineer on board Small Vessels.
Details of the relationship between the unit and other standards or curricula (if appropriate).	This unit satisfies the requirements of the MCA AEC 1 training course.
Assessment requirements specified by a sector or regulatory body (if appropriate)	MCA
Endorsement of the unit by a sector or other appropriate body (if required)	MCA
Location of the unit within the subject/sector classification system	Transportation
Required Minimum Learning Hours (including assessment)	35 Condition hours. (40 hrs with 1-hour break period every day).
Relevant M Notices	MSN 1859 and MIN 524