Maritime & Coastguard Agency (MCA): Approved Electric Propulsion Course 1 (AEPC1) Guidelines

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# Part 1 - General

1. General
	1. The new Approved Electric Propulsion Course 1 (AEPC1) Course Approvals and Re-approvals must be undertaken in accordance with these guidelines. These guidelines outline the mandatory minimum hours for the AEPC1 Course. The total running time of the AEPC1 course must include written/practical assessment and be a total of 35 hours.
	2. A desktop submission should be sent to the Seafarer Training and Certification (STC) Branch, Southampton HQ. This must outline and demonstrate your ability to run the course and can meet the course content requirements. If you have any issues, you should write to MCA on stc.courses@mcga.gov.uk.
	3. 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 (SV) or higher-class ticket.
	4. The AEPC1 course is a Non-STCW certificate. This is issued directly by the MCA-Approved Training Providers/institutes. At present this is a Non-mandatory course but will feature in future small vessel engineer training. This will also give the MCA an option to place this onto a Safe Manning Document similar to that of the AEC1 and AEC2 courses.
	5. While the MCA recognises this qualification, it cannot be guaranteed that this will be wholly accepted internationally. Holder of this certificate should check the certification requirements of the local Port State Control Administration prior to entering their jurisdiction.
	6. Completion of Parts 1 and 2 of the course (combined) will be considered as an allowance of 2 weeks workshop skills training that can count towards the small vessel CoC as per MSN 1904 sections 4.5.1 and 8.5 (approval).

# Part 2 – Aim of the Course

1. Aim of the Course
	1. The aim of the course is to provide learners with the basic theoretical knowledge and some practical hands-on experience. Part One will be aimed at all crew members (operationally) and Part Two will be technical based. Learners must have completed Part One of the course in order to move onto Part Two. Some learners may only wish to attend Part One which is designed more around the safety and familiarisation, and general understanding.
	2. The course also aims to give the basic training to all crew and further technical training to engineers who want to pursue a career on “Small Vessels” (Fishing Vessels, Yachts, Tugs, Workboats, Standby, Seismic Survey, Oceanographic Research Vessels, and Government Patrol Vessels).
	3. The overall aim is to provide learners with the necessary knowledge, understanding and proficiency to conduct safe and effective operations onboard of vessels already utilising electric drives with battery technologies.

# Part 3 – Background of the Course

1. Background of the course
	1. It was identified that due to the increase in sophistication of battery technology, electronics, and electric drives in the small vessel sector there is a need for further crew training regarding the use of batteries and associated systems. It was therefore decided that a new MCA course criteria would be designed to sit alongside the Approved Engine Course 1 & 2 (AEC1 & AEC2).
	2. The AEPC1 Working Group, MCA, new approved Training Providers, and other agreed stakeholders will meet on a 6 monthly basis following the implementation of the course to review any future technologies that may have emerged, the success of the course, any new questions required to be added to the question bank and any other relevant topics of discussion. The meeting frequency can be subject to change based on Industry developments/requirements as agreed with the Working Group Chair, members, and the MCA Chief Examiner.

# Part 4 – Health and Safety: Conduct of Training

1. Health and Safety: Conduct of Training
	1. At all times, the safety of the learners and staff delivering training must be ensured.
	2. Practical exercises should be designed and delivered solely to meet the course criteria.
	3. All Training Providers 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 of the UK, Training Providers must adhere to relevant national legislation and have a routine inspection to ensure a safe working environment for learners broadly equivalent to the UKs standards (Health and Safety at Work Act 1974 as amended).
	4. Training Providers 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.
	5. Providers 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.
	6. Training Providers must draw up their own safe working procedures to meet the statutory Health and Safety obligations.

# Part 5 – Training Structure

1. Training Structure.
	1. The Approved Electric Propulsion Course (AEPC) 1 is divided into two parts. Part 1 will be aimed at all crew onboard a vessel which has been designed to focus on safety familiarisation and general understanding, whereas Part 2 will look at Electric Propulsion from a more technical perspective. Individuals must complete Part 1 in order to attend Part 2.
	2. Learners may undertake Parts 1 and 2 from different MCA Approved AEPC1 Training Providers.
	3. Providers[[1]](#footnote-2) will need to develop a training programme covering the AEPC1 Learning Outcomes and then submit their training plans to the MCA to commence the approval process. Approvals requests must come to the Seafarer Training and Certification Branch (stc.courses@mcga.gov.uk).
	4. 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. The training should be structured around the outcomes, although providers should devise their own training scheduled and detailed lesson plans to ensure effective and logical delivery of the subject matter and achieve the objectives of the training.

# Part 6 – Course Duration

1. Course Duration
	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.
	2. The training (Part 1 and Part 2) shall not be less than 35 hours and will be delivered as a stand-alone module, with a 50/50 split of theory and practical elements.
	3. Part 1 of the course will be covered over 2 days whereas Part 2 will be covered in 3 days.

# Part 7 – Entry Requirements

1. Entry Requirements
	1. The entry requirements for Part 1 of the course are:
* Minimum age of 18 years or older.
	1. In order to attend Part 2 of the course, you must be:
* Minimum age of 18 years or older
* Must have completed Part 1 of the course
* Must hold and provide evidence of a Part 1 Completion Certificate (**Annex C**) or are attending a combined Part 1 and Part 2 course.

# Part 8 – Staff to Learner Ratio

1. Staff to Learner Ratio
	1. The Staff to Learner ratio should not exceed 1:24 for non practical sessions, and 1:8 for practical or 1:10 if suitably risk assessed for practical sessions. The latter may only take place if an Approved Training Provider completes a risk assessment to ensure that there is adequate equipment for all learners to work simultaneously and all training outcomes can be monitored and assessed.
	2. The Training Provider, having due regard to health and safety and the objectives of training, should determine other staffing requirements.

# Part 9 – Qualifications of Instructors and Assessors

1. Qualifications of Instructors and Assessors
	1. Instructors and Assessors are required to have demonstrable industry experience in order to be able to deliver this course. Training Providers will need to submit CVs of assessors to the MCA where these will be considered on a discretionary basis for MCA approval.

# Part 10 – Facilities and Equipment

1. Facilities and Equipment
	1. Training Providers seeking approval will need to demonstrate the availability of suitable facilities for practical, general, and theoretical instruction, be appropriately equipped with teaching and learning aids, and designed to enable each learner to fully engage in the learning process.
	2. All facilities must be maintained and, where appropriate, be inspected and assessed in accordance with the applicable regulations, current standards and manufactures recommendations.
	3. The course must be delivered from a suitably heated and ventilated building and should be of a permanent construction.
	4. 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. Video presentations, posters, diagrams, etc).
	5. Case studies should be used to aid the delivery of the learning objectives against the relevant outcomes*. The below list [[2]](#footnote-3)is not exhaustive and Training Providers should use other case studies to assist facilitate the required learning*:
* [Fire aboard Tank Vessel S-Trust (ntsb.gov)](https://www.ntsb.gov/investigations/AccidentReports/Reports/MIR2323.pdf)
* [NSIA-Brim-Repor-2022\_07.pdf (safety4sea.com)](https://safety4sea.com/wp-content/uploads/2022/07/NSIA-Brim-Repor-2022_07.pdf)
* [Protecting battery systems against humid, salty air and seawater intrusion - Norwegian Maritime Authority (sdir.no)](https://www.sdir.no/en/shipping/legislation/directives/protecting-battery-systems-against-humid-salty-air-and-seawater-intrusion/)
* [1st International symposium on fire in electric storage at sea on Vimeo](https://vimeo.com/830182462/aa852b93a7?share=copy)
	1. Sufficient and suitable equipment must be provided to enable practical sessions and assessment of the learning objectives.
	2. A list of the minimum recommended equipment is given in **Annex A**, for guidance. ***To note this list is not exhaustive.*** Training Providers may use additional or similar equipment, as considered to be suitable to deliver the training course.

# Part 11 – Assessment Requirements

1. Assessment Requirements
	1. Assessment must be organised so that the learners can, through demonstration and examination, show that they meet the competencies, learning outcomes and objectives stipulated, as defined, and outlined in Part 12 of this document .
	2. The assessment system, methods and practice must be valid, reliable and authentic.
	3. Each learner shall receive an assessment plan at the start of training.
	4. The assessment system should support appeals made by learners against assessment decisions.
	5. A variety of sources of evidence may be used and must include evidence of the learner’s ability to meet the criteria for evaluating competence.
	6. A range of direct, observation, oral questioning and role play are considered as examples of ideal approaches to generate much of the evidence required.
	7. All assessments must be formally documented and be made available for verification audits.
	8. The practical exercises must be conducted, and achievement of competency must be assessed throughout the course under the supervision of trainer/s.

* Continuous Assessment for Part 1 – this should incorporate elements of the outcomes and include a desktop exercise, e.g. as an example exercise, where high temperature has been identified in one battery cell, leading to thermal runaway and subsequent fire, candidates must demonstrate appropriate first actions and proceed with dealing with the incident.
* Continuous Assessment for Part 2 - this should incorporate elements of the outcomes including practical elements where possible.
	1. All learners are to be assessed on the outcomes and must be give satisfactory answers to pass the course – this should be included in the assessment plan submitted by the Training Provider in their desktop submission.
	2. The Part 1 Written Assessment will be in the form of a multiple-choice exam paper. Examples of the questions that may be asked can be found in **Annex B**.
	3. The Part 2 Written Assessment will be in the form of a written exam paper covering the learning outcomes. This can be split into modules and spread out over the duration of the course. Records must be retained for all parts of the written exams.
	4. The maximum group size for each desktop exercise is 4.

# Part 12 – Certification and Course Outcomes

1. Certification and Course Outcomes
	1. **Certification**
	2. On achievement of competing and meeting the desired standard of competence, a certificate will be issued by the Training Provider in the MCA Approved Specimen Certificate format as given in **Annex C**.
	3. **Course Outcomes**
	4. There are a total of 7 Outcomes expected of the course. This has been broken down into the relevant Parts of the course and their respective learning outcomes as noted below:

**Part 1**

**Outcome 1:** The learner demonstrates basic knowledge of the use of batteries on Electric and Hybrid Vessels.

**Outcome 2:** The learner demonstrates competent knowledge of the risks of dealing with battery fires and appropriate first actions in the event of a dangerous fault occurring.

**Outcome 3:** The learner has an awareness of decarbonisation within the marine industry *(Awareness only- no assessment).*

**Outcome 4:** The learner has an awareness of cyber security within the marine industry *(Awareness only- no assessment).*

**Part 2**

**Outcome 5:** The learner demonstrates competent knowledge of Electric and Hybrid systems onboard vessels *(Theory and Practical).*

**Outcome 6:** The learner demonstrates knowledge of safe electrical working practices onboard Electric and Hybrid vessels including basic maintenance *(Theory and Practical).*

**Outcome 7:** The learner demonstrates competent knowledge of shore power charging systems in relation to Electric Battery Systems *(Theory).*

**Part 1**

**Outcome 1:** The learner demonstrates basic knowledge of the use of batteries on Electric and Hybrid Vessels.

**Learning Objectives:**

1. Basic understanding of electrical/hybrid propulsion systems
2. Identification of basic components within the system; batteries, battery management system, inverters, control modules, charging systems
3. Management of battery rooms/locations (storage, ventilation, inventories etc)
4. Battery fault conditions, identification and appropriate first actions to take
5. Basic Safety – Electric Shock (DC)
6. PPE
7. Safe disposal of batteries inline with local and international requirements.

**Outcome 2:** The learner demonstrates competent knowledge of the risk of dealing with battery fires and appropriate first actions in the event of a dangerous fault occurring:

**Learning Objectives:**

1. Actions upon discovering a fault condition
2. Correct operation of ventilation systems
3. Battery fire suppression systems (theory only)
4. Lithium-Ion batteries – Thermal runaway
5. Products of combustion – emphasis on gases that are toxic to humans
6. Use of Safety Data Sheets (SDS), Battery registers, Fire Plans & Emergency checklists

**Outcome 3:** The learner has an awareness of decarbonisation within the marine industry.

**Learning Objectives (Human Element):**

1. Behaviours
2. Voyage Planning inclusive of fuel loads and charging availability, overview of atmospheric pressures/conditions etc
3. Actions, roles, and responsibilities
4. Efficiency
5. IMO Strategy on Reduction of GHG Emissions from Ships
6. MARPOL Annex 6 – basic understanding of air pollution from marine diesel engines included Emission Control Areas and with emphasis on why this relates to battery vessels. [[3]](#footnote-4)

**Outcome 4:** The learner has an awareness of cyber security within the marine industry.

**Learning Objectives:**

1. Identification and protection against malicious cyber-attacks (active and passive)
2. How to identify non-malicious cyber attacks such as data storm, data corruption etc.
3. Data protection whilst using remote diagnostics and cloud-based systems.

*Further reading ICS Cyber Security Guideline Books – Large ships and small vessels.*

**Part 2**

**Outcome 5:** The learner demonstrates competent knowledge of Electric and Hybrid systems onboard vessels.

**Learning Objectives:**

1. Batteries including, but not limited to, the differences between the following:
* Lithium Ion (including the derivatives)
* Lead Acid
* AGM, EFB
* Gel
1. Inverters, controls (including motor driver), charging systems, motors
2. Battery management systems including software (BMS)
3. Understanding of correct battery charging and battery health
4. Understand testing and maintenance of batteries
5. Use of multi-meter, clamp meter, battery test equipment
6. Understanding of battery fault conditions
7. Knowledge of ancillary systems (ventilation, cooling etc)
* To cover SW cooling systems, including ship side valves
1. Read and interpret basic electrical diagrams and symbols
2. Electric motor construction (AC and DC)
* Single phase and three phase AC
* Starting methods
1. Energy flows (PRO’s, PTI’s), regeneration
2. DC voltage and protection systems including voltages differences within the distribution system.

**Outcome 6:** The learner demonstrates knowledge of safe electrical working practices onboard Electric and Hybrid vessels including basic maintenance.

**Learning Objectives:**

1. Safety Management systems for hybrid and electric vessels
2. Safe systems of work, processes, equipment selection
* Proving dead
* Lock out tag out systems
* Permits to work
* Intrinsic safety
* Specification and correct use/limitations of equipment
1. Fault finding and use of fault diagnosis/test equipment
* On board diagnostic and fault-finding reporting systems
* Thermal imaging
1. Routine maintenance
* Test and inspection of battery charging systems
* Test and inspection of batteries
* Lead acid
* Lithium Ion (including the different types and variants of)
* Routine maintenance of electrical systems
* Tightness checks
* Purpose of thermal imaging surveys
* Health checks including inspection
* Insulation condition
* Equipotential Bonding and grounding

**Outcome 7:** The learner demonstrates competent knowledge of shore power charging systems in relation to Electric Battery Systems.

**Learning Objectives:**

1. Types of connection and condition
2. Correct shore power connection procedures (Cold ironing/hot docking)
3. Earthing arrangements and stray currents
4. Issues with voltage and frequency differences
5. Interaction with vessels power management system
6. Shore Power converters
7. Forward planning for shore power request.

# Annex A – AEPC1 Equipment List

|  |  |  |
| --- | --- | --- |
| **Learning Objective Reference** | **Examples of equipment that can be used** | **Additional Information** |
| **Part 1** |
| **Outcome 1:** The learner demonstrates basic knowledge of the use of batteries on Electric and Hybrid Vessels |
| **Learning Objective 1:** Basic understanding of electrical/hybrid propulsion systems | * Schematic Drawings
 |  |
| **Learning Objective 2:** Identification of basic components within the system; batteries, battery management systems, inverters, control modules, charging systems | * Photographs
* Batteries
* Invertors
* Management Systems
* Motors AC/DC – samples and photos to show types available in the market
 |  |
| **Learning Objective 3:** Management of battery rooms/locations (storage, ventilation, inventories etc) | * SOLAS requirements (to be reviewed and included)
* Vessel Class requirements
* Isolation Mats
* Example drawings GA
* Dampers/Flooding
* Fire Fighting
 |  |
| **Learning Objective 4:** Battery fault conditions, identification and appropriate first actions to take. | * Battery Management System
* Senses-remote readings
* Checklists
* Fixed voltmeter
* Switchboards – DC
* Engine Control Panels
* Hydrometer
* Electronic Battery Tester
* Drop Tester (if available)
* Batteries in various conditions/states (good/bad condition/part discharged)
* Gas Detector/s (handheld and fixed) e.g. HF Detectors.
 |  |
| **Learning Objective 5:** Basic Safety – Electric Shock (DC) | * Health and Safety Posters
 |  |
| **Learning Objective 6:** PPE | * Suitable goggles depending on task
* Footwear
* Overalls
* Poles
* Insulated gloves
 |  |
| **Learning Objective 7:** Safe disposal of batteries inline with local and international requirements.  | * MARPOL Annex 5 (Garbage)
* Local Port restrictions regarding waste
* MGN 550, MGN 681, MGN 653 Amendment 1
 |  |
|  |
| **Outcome 2:** The learner demonstrates competent knowledge of the risks of dealing with battery fires and appropriate first actions in the event of a dangerous fault occurring |
| **Learning Objective 1:** Actions upon discovering a fault condition | * Emergency Procedure Checklist
* OEM Fault finding diagnosis chart
 |  |
| **Learning Objective 2:** Correct operation of ventilation systems | * SOLAS Requirements
* Photographs
* Batteries
* Invertors
* Management Systems
* Motors AC/DC – samples and photos to show types available in the market
* Ventilation schematics
 |  |
| **Learning Objective 3:** Battery fire suppression systems (theory only) | * Fire Fighting/Emergency response plans
* Videos
* Desktop Presentations of manufacturers
* Battery OEM Supplied Propagation Prevention Systems (PPS) – Desktop presentation
* Line Diagrams
 | Lecturers/Assessors can also refer to *Novec 1230* Case Study |
| **Learning Objective 4:** Lithium-Ion batteries – thermal runaway | * Video Presentation
 |  |
| **Learning Objective 5:** Products of combustion – emphasis on gases that are toxic to humans | * Desktop Presentation
* BS 62620 (MSDS Templates)
 | Link to gas detectors,Battery rooms/Eclosed spaces |
| **Learning Objective 6:** Use of Safety Data Sheets (SDS), battery registers, fire plans and emergency checklists | * Battery Register
* Use of MSDS
* Fire Plans
* Emergency Checklists
 |  |
|  |
| **Outcome 3:** The learner has an awareness of decarbonisation within the marine industry (Human Element) |
| **Learning objective 1:** Behaviours | * Desktop Presentations
 |  |
| **Learning objective 2:** Voyage Planning inclusive of fuel loads and charging availability, overview of atmospheric pressures/conditions etc | * Textbook/Understanding of voyage planning/fuel loads
 |  |
| **Learning objective 3:** Actions, roles, and responsibilities | N/A |  |
| **Learning objective 4:** Efficiency | N/A |  |
| **Learning objective 5:** IMO Strategy on Reduction of GHG Emissions from Ships | * IMO Circulars
 |  |
| **Learning objective 6:** MARPOL Annex 6 – Basic understanding of air pollution from marine diesel engines including Emission Control Areas and with emphasis on why this relates to battery vessels | * MARPOL Annex 6
 |  |
|  |
| **Outcome 4:** The learner has an awareness of cyber security within the marine industry |
| **Learning Objective 1:** Identification and protection against malicious cyber-attacks (active and passive)  | * Case Studies
* Guidelines Book/Recommended reading
 |  |
| **Learning Objective 2:** How to identify non-malicious cyber attacks such as data storm, data corruption  | * Cyber Security Videos
* Bibby Horizon Case Study
 | [National Cyber Security Centre - NCSC.GOV.UK](https://www.ncsc.gov.uk/) |
| **Learning Objective 3:** Data Protection whilst using remote diagnostics and cloud-based systems | * OEM Instructions
* Example of/part of a company policy
 | Chamber of Shipping books as reference material <https://www.ics-shipping.org/resource/guidelines-on-cyber-security-onboard-ships-version-four/> [Public Resources - The Workboat Association](https://www.workboatassociation.org/public-resources/) – The Guidelines on Cyber Security onboard small commercial vessels – Risk assessment Flow Chart page 61 (**Image 1 following this table**)Section 31.3 in Workboat Edition 3 covers the cybersecurity requirements. |
|  |
| **Part 2** |
| **Outcome 5:** The learner demonstrates competent knowledge of Electric or Hybrid systems onboard vessels |
| **Learning Objective 1:** Batteries including difference between the following: * Lithium Ion (including the derivatives)
* Lead Acid
* AGM/EFB
* GEL
 | * Simulated battery and electric propulsion system which must include:
* Lithium Ion (including the derivatives)
* Lead Acid
* AGM/EFB
* GEL
 | Demonstration of battery and electric propulsion system which must include: * Batteries
* Inverter
* Motor Controller
* Electric Motor
* Must be able to simulate operation and be able to show fault conditions and dangerous trends.
* Functional use of battery management systems either physically or by App.
* Electrical drawings of the simulator system above.
* Videos and diagrams showing ventilation and cooling systems for battery compartments and battery banks.
 |
| **Learning Objective 2:** Inverters, control modules (including motor driver), charging systems, motors | * Inverters
* Control Modules/Motors
* Charging systems
* DC Propulsion motors
 |  |
| **Learning Objective 3:** Battery management systems including software (BMS) | * Battery Management systems
 | Remote screen and app operation |
| **Learning Objective 4:** Understanding of correct battery charging and battery health | * Textbooks
* Presentations
 | Consider the health range of a battery depending on battery types. |
| **Learning Objective 5:** Understand testing and maintenance of batteries | * Test Equipment
* Volt meters
* Condition Testing equipment
* Carbon Pile Load tester
* Torque Wrench
* Insulated Tools
 | Consider the health range of a battery specific to each battery type.Note: all equipment used should be sufficiency insulated. |
| **Learning Objective 6:** Use of multi-meter, clamp meter, battery test equipment | * Multi Meters
* Clamp meters
* Battery test equipment
* Battery Logs
* Battery Instruction Manuals
 |  |
| **Learning Objective 7:** Understanding of battery fault conditions | * Battery Instruction Manuals
 |  |
| **Learning Objective 8:** Knowledge of ancillary systems (ventilation, cooling)* To cover SW colling systems, including ship side valves
 | * Endoscope
* System Schematics (examples of)
* Battery cooling systems
* Desktop Presentations with photos of Industry cases
* Water Testing equipment
* Understanding/maintenance of the fluids included within cooling systems
 | Refer to case studies |
| **Learning Objective 9:** Read and interpret basic electrical diagrams and symbols | * Electric drawings and symbols
* Electric Schematics
 |  |
| **Learning Objective 10:** Electric motor construction (AC and DC)* Single Phase and three phase AC
* Starting methods
 | * Photos of types of motors
* Textbooks
* Diagrams
* Videos
 | System overview- interactive sessions |
| **Learning Objective 11:** Energy flows (PTO’s, PTI’s), regeneration  | * Textbooks
* Diagrams
* Videos
* Desktop Presentations
 |  |
| **Learning Objective 12:** DC voltage and protection systems including voltages differences within the distribution system | * DC Voltage and Protection systems
 |  |
|  |
| **Outcome 6:** The learner demonstrates knowledge of safe electrical working practices onboard Electric and Hybrid vessels including basic maintenance. |
| **Learning Objective 1:** Safety management systems for hybrid and electric vessels | * Appropriate extracts from Safety Management System including relevant checklists, planned/unplanned maintenance
* Example Procedures – Shipboard, emergency, onboard practices
 | Lecturer to use a range of simple to complex SMS. |
| **Learning Objective 2:** Safe systems of work, processes, equipment selection* Proving dead
* Lock out tag out systems
* Permits to work
* Intrinsic safety
 | * Live Line Testers (Non HV) and means of proving operational
* Lock out Tag Out equipment
* Permit to work examples
* Desktop examples
* A copy of COSWOP (hardcopy/PDF)
 | Class and flag requirements for hazardous areas.COSWOP- Section 20.18 |
| **Learning Objective 3:** Fault finding and use of fault diagnosis/test equipment:* Onboard diagnostic and fault-finding reporting systems
* Thermal imaging
 | * Thermal imaging camera
* Electronic diagnostic test equipment
* Examples of software available
* Videos
* Desktop learning
 |  |
| **Learning Objective 4:** Routine Maintenance* Test and inspection battery chargers
* Test inspection of batteries (Lead Acid, Lithium Ion)
* Routine maintenance of electrical systems (tightness checks, thermal imaging surveys)
 | * Battery chargers capable of trickle charge, fast chargers etc.
* Different types of battery chargers with Bulk, Absorption, Float and Repair functionality.
* Thermal imaging camera
* Different types of Batteries, manuals and other connection methods and maintenance as per Learning Objective 5.1.
 | Lecturer to consider the different modes of a battery charger |
|  |
| **Outcome 7:** The learner demonstrates competent knowledge of shore power charging systems in relation to Electric Battery Systems |
| **Learning Objective 1:** Types of connection and condition | * Desktop Learning
* Images
* Presentations
 | Lecturer to consider Shore power mock up. |
| **Learning Objective 2:** Correct shore power connection procedures (cold ironing/hot docking) | * Desktop Learning
 |  |
| **Learning Objective 3:** Earthing arrangements and stray currents | * Desktop Learning
 |  |
| **Learning Objective 4:** Issues with voltage and frequency differences | * Desktop Learning
 |  |
| **Learning Objective 5:** Interaction with vessels power management system | * Desktop Learning
 |  |
| **Learning Objective 6:** Shore Power converters | * Desktop Learning
 |  |
| **Learning Objective 7:** Forward Planning for shore power request. | * Desktop Learning
 |  |

# Annex B – AEPC1 Sample Questions

**Part 1**

1. **With reference to a Small Vessel marine propulsion system, which of the following describes a typical *Electric Hybrid* arrangement (OC 1).**
2. An internal combustion engine linked to a gearbox and propellor
3. A rechargeable battery bank powering an electric propulsion motor
4. An internal combustion engine linked to a gearbox with power take off device and propellor.
5. An internal combustion engine linked to a gearbox with power take in/out device linked to a rechargeable battery bank and propellor.

1. **What is the primary advantage of a hybrid system fitted to a Small Vessel (OC1):**
2. It can reduce emissions compared to a purely combustion powered vessel
3. Better compliance with the Hong Kong convention on ship recycling and disposal
4. Simpler system
5. Reduction in paperwork and administrative costs
6. **Which of the following materials are commonly used in battery construction for Hybrid ships (OC1):**
7. Plutonium Phosphate
8. Nickel Cadmium
9. Nickel Metal Hydride
10. Lithium – Ferro/Iron – Phosphate
11. **If a ships battery system is rated at 40 MWh, this relates to (OC1):**
12. Two x 20 Mega Webers Inductive capacity
13. The capacity of the battery in Mega Watt hours
14. The weight of the battery in Mega weight
15. It has 40 Major charge and discharge options
16. **With reference to Lithium-Ion Batteries, *thermal runaway* is best described as (OC2):**
17. An exothermal process or failure resulting in an uncontrollable temperature increase
18. A temperature differential between cells in series
19. A heat loss problem in batteries
20. A short circuit event
21. **Which Firefighting media should be used on a small Lithium-Ion battery fire (OC2):**
22. Dry Chemical, CO2, or specialist water type extinguishers
23. HALON gas
24. BromoChloroTrifluoromethane (BTM)
25. Saline Solution
26. **In a Lithium-Ion Battery which statement accurately describes the charging process (OC1):**
27. Charge is built up in the electrolyte and stabilises
28. The negative electrons empower the Anode and is stored
29. A liquid electrolyte transports Ions from cathode to the positive terminal
30. During charging the Lithium Ions move from the anode to the cathode storing energy
31. **With reference to an Inverter used in ship’s propulsion systems, which of these statements is true (OC1):**
32. It changes the voltage from a high value to a low value
33. It changes the voltage from a low value to a high value
34. It converts an inductive load into a capacitive load
35. It converts direct current electricity (DC) to an alternating current (AC)
36. **With reference to battery charging, which type of charge is preferred for a Lithium-Ion battery (OC1):**
37. Constant voltage slow charge rate
38. Constant current fast charge rate
39. Constant current followed by a constant voltage charge
40. Slow charge and discharge at constant impedance
41. **With reference to batteries, what is meant by the classification LiFePO4 (OC1):**
42. Lithium Pressurised Oxygen 4
43. Lithium Ferro/Iron Phosphate
44. Lithium Polar 4
45. Lithium Iron Polonium
46. **With reference to batteries, what is meant by the classification Li-NMC (OC1):**
47. Lithium Nickel Manganese Cobalt Oxides
48. Lithium Negative Matter Charge
49. Lithium Non-Magnetic Charge
50. Lithium Ferro/Iron Phosphate
51. **Which statement below reflects the advantages of Lithium-Ion Batteries compared to Lead Acid Batteries (OC1):**
52. Increased power output, faster charging, reduced weight, longer life
53. Increased voltage, lower temperature, higher resistance
54. Faster charging, extended warranty, slow discharge rate
55. Longer life, waterproof, low cost, low fire rating
56. **What is meant by a battery management system (OC1):**
57. The monitoring and management of temperature, voltage and current and state of health of the battery when a battery is charging or discharging
58. The automatic monitoring of heat, resistance, capacitance, and resistance of the battery during fast charge
59. A high level of ships managers always monitoring battery health and conditions
60. A safe system of work as described in the Code of Safe Working Practices (COSWOP)
61. **Which of the following describes the main dangers of a lead acid battery fire (OC2):**
62. Toxic gases, explosive gases, secondary fires, smoke
63. Loss of power and lighting
64. Loss of ventilation, cooling and charging of batteries
65. Thermal runaway
66. **From the list below choose Four gases that are released during a Lithium-Ion battery fire (OC2):**
67. Nitrogen
68. Oxygen
69. Lithium oxide
70. Hydrogen cyanide
71. Hydrogen chloride
72. Hydrogen fluoride
73. Sulphur dioxide
74. Methane
75. **From the list below choose Four actions to be taken upon discovery of a battery fire (OC2):**
76. Raise the alarm
77. Evacuate the space
78. Change to a secondary power source
79. Isolate batteries from charging system
80. Abandon ship
81. Drop the anchor
82. Try to put it out with a foam fire extinguisher
83. Sound the ship’s whistle
84. **What safety features are fitted to a Lithium-Ion battery to prevent overheating (OC2):**
85. Temperature sensors, thermal cutoffs, pressure relief valves, protective casing
86. Over current relays, reverse power cutoff, fuses
87. Smoke sensors, flame sensors, heat detectors
88. Charge indicators, fusible plugs, vents
89. **Select the correct answer below which shows the main reason(s) for battery room ventilation systems (OC2):**
90. Cooling of equipment, removal of toxic and dangerous gases
91. Comfortable work environment for the crew
92. HSE requirement
93. Local port authority regulations
94. **What does the abbreviation SDS stand for in relation to documentation (OC2):**
95. Safety Data Sheet
96. Safety Detail Sheet
97. Ship Document System
98. Seafarer Documentation System
99. **Select the correct answer showing the information that should be found in a Battery Register (OC2):**
100. Unique identification number, make of battery, location, type, size
101. Muster list, fire plan, emergency duty list
102. Size, colour, physical dimensions, weight, shape
103. Local disposal company details including address and contact numbers
104. **From the list below choose the Four most appropriate items of Personal Protective Equipment to work on lead acid batteries (select one answer) (OC2):**
105. Gloves
106. Eye protection
107. Apron/overalls
108. Safety boots
109. Knee pads
110. Flash suit
111. Fall arrestor
112. Arc eye protection

**Examples of practical assessments (but not limited to):**

* Basic Fault finding on DC Hybrid Electric Propulsion system
* Removal or replacement of one battery/cell
* Recommissioning of system
* Making the system safe for shore contractors – providing safe system of work
* Use of Test equipment

# Annex C – AEPC1 Course Completion Certificates for Part 1

Certificate of completion of MCA Approved Electric Propulsion Course 1 (AEPC1) - to be produced and registered locally by the issuing authority.

|  |
| --- |
| Certificate No: (Unique identifier number allocated by the Training Provider) |
|  |  |  |
| MCA Approval Certificate Number: (issued by MCA) |  |
|  |  |  |
| Address and contact details including telephone and email of the issuing Authority (Approved Training Provider) |
| **Approved Electric Propulsion Course 1 (AEPC 1) Course Completion Certificate – PART 1** |
|  |  |  |
| This is to certify that (Full name) |  |
|  |  |  |
| Date of birth (DD/MM/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, AEPC1 course.** |
|  |  |  |
| 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 Provider |  |
|  |  |  |
| Issuing Authority Stamp and Date |   Deep emboss OR Hologram  |
| Signature of the person to whom this certificate was issued |  |

AEPC1 Course Completion Certificates for Part 2

|  |
| --- |
| Certificate No: (Unique identifier number allocated by the Training Provider) |
|  |  |  |
| MCA Approval Certificate Number: (issued by MCA) |  |
|  |  |  |
| Address and contact details including telephone and email of the issuing Authority (Approved Training Provider) |
| **Approved Electric Propulsion Course 1 (AEPC 1) Course Completion Certificate – Part 2** |
|  |  |  |
| This is to certify that (Full name) |  |
|  |  |  |
| Date of birth (DD/MM/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, AEPC1 course.** |
|  |  |  |
| 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 Provider |  |
|  |  |  |
| Issuing Authority Stamp and Date |   Deep emboss OR Hologram   |
| Signature of the person to whom this certificate was issued |  |
|  |  |

# Annex D – Instructors/Assessors Curriculum Vitae Template

**Instructor/Assessor information**

|  |  |
| --- | --- |
| Full name:  |  |
| Name of Training Provider (TP): Name of the course: |  |  | Instructor ⬜Assessor ⬜ |

Training Providers contact email: Training Providers contact phone:

**Academic/professional qualifications\***

|  |  |  |
| --- | --- | --- |
| Title | Name of the organisation | Date awarded |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Previous experience at sea and ashore**

|  |  |  |
| --- | --- | --- |
| Job title | Company/vessel | Dates from / to |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Teaching experience**

|  |  |
| --- | --- |
| Name of the organisation (College/University) | Dates from / to |
|  |  |
|  |  |
|  |  |
|  |  |

\*Evidence will be verified during on-site audit

**Disclaimer and signature**

*I certify that my answers are true and complete to the best of my knowledge.*

|  |  |  |  |
| --- | --- | --- | --- |
| Signature: |  | Date: |  |

**Privacy notice:**

Personal information which you supply to us will be used to assess your suitability to act as an instructor or assessor delivering an MCA approved training course or programme. but may also be used for other related purposes and shared with other statutory bodies/organisations to enable them to fulfil their statutory obligations. We will not disclose any financial details you provide to us.

We may use your information to investigate complaints, legal claims, or important incidents. We may use your information for crime prevention and prosecution of offenders.

For more information on how we use your information, and your rights to access information we hold on you, please see our full privacy policy available on our website:

<https://www.gov.uk/government/organisations/maritime-and-coastguard-agency>

**UK Seafarer Services**

UK Maritime Services

Maritime and Coastguard Agency

Spring Place, 105 Commercial Road

Southampton

SO15 1EG

UK

stc.courses@mcga.gov.uk

# Annex E - Conditions for MCA approval of Short Courses

The below guidance is to assist Training Providers with MCA Short Course Approvals. For further information on this topic, please refer to MSN 1865 Amendment 1, Annex F.

1. Training Providers offering training and assessment leading to the issue of a certificate of proficiency must be approved by the MCA.
2. MCA approval requirements are for a functional Quality Management System to be in place that ensures:
	1. Continued satisfactory delivery of the programme to the current standards, reflecting changes of technology and best practice;
	2. The training programme entry standards are met;
	3. The agreed assessment process is maintained;
	4. Only those who complete the training programme and meet any other necessary requirements are issued with certificates/documentary evidence;
	5. 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;
	6. 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;
	7. The record system enables authenticity of certificates to be verified and replacement certificates issued;
	8. This course cannot be approved for peripatetic delivery;
	9. The approving MCA Office is informed of dates, timing and venues of all courses delivered;
	10. 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.
	11. A feedback mechanism is in place and captured properly for audit purposes.
3. Monitoring of the training programme by the MCA proves to be satisfactory.
4. Re-approval by the MCA is carried out within five 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 Provider 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

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1. Training Providers will only be approved for delivering AEPC1 course in its entirety and not broken down into separate approvals for Parts 1 and 2. [↑](#footnote-ref-2)
2. Please note that these links are not created by the MCA nor does the MCA have an opinion on these. The case studies are just examples of the types of learning Training Providers can use to assist staff with the delivery of the course. Training Providers should provide other examples to aid with meeting the deliverables outlined in section 12 of this guide. [↑](#footnote-ref-3)
3. This must be a brief overview at a high level. [↑](#footnote-ref-4)