

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

November 2024

Contents

Part 1 - General	. 3
Part 2 – Aim of the Course	. 3
Part 3 – Background of the Course	. 4
Part 4 – Health and Safety: Conduct of Training	. 4
Part 5 – Training Structure	. 5
Part 6 – Course Duration	. 6
Part 7 – Entry Requirements	. 6
Part 8 – Staff to Learner Ratio	. 6
Part 9 – Qualifications of Instructors and Assessors	. 6
Part 10 – Facilities and Equipment	. 7
Part 11 – Assessment Requirements	. 8
Part 12 – Certification and Course Outcomes	. 9
Annex A – AEPC1 Equipment List	13
Annex B – AEPC1 Sample Questions	20
Annex C – AEPC1 Course Completion Certificates for Part 1	24
Annex D – Instructors/Assessors Curriculum Vitae Template	26
Annex E - Conditions for MCA approval of Short Courses	28

Part 1 – General

- 1.1 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.
- 1.2 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.
- 1.3 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.
- 1.4 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.
- 1.5 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.
- 1.6 Completion of Parts 1 and 2 of the AEPC 1 course (combined) will be treated as 2 weeks of MCA approved **additional** workshop skills training and therefore candidates who have successfully completed the full 5-day course will be able to use it as 2 weeks of sea service towards their SV EOOW CoC as per MSN 1904 sections 4.3.2, 4.5.1 and 8.5 (approval). Candidates will not be able to complete another MCA approved additional workshop skills training course to gain another 2 weeks of sea service towards their SV EOOW CoC .

Part 2 – Aim of the Course

- 2.1 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.
- 2.2 The aim of the course is to provide learners with the basic theoretical knowledge and some practical hands-on experience. Part 1 will be aimed at all crew members (operationally) and Part 2 will be technical based. Learners must have completed Part 1 of the course in order to move onto Part 2. Some learners may only wish to attend Part 1 which is designed more around the safety and familiarisation, and general understanding.

2.3 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 as defined in MSN 1904.

Part 3 – Background of the Course

- 3.1 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).
- 3.2 The AEPC1 Working Group, MCA, new approved Training Providers, and other agreed stakeholders will meet on a six-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.
- 3.3 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 engineers working in Small Vessels.
- 3.4 MSN 1904 outlines the certification structure and examination and training requirements for engineer officers wanting to work on "Small Vessels" (Fishing Vessels, Yachts, Tugs, Workboats, Standby, Seismic Survey, Oceanographic Research Vessels, and Government Patrol Vessels). It also explains the regulatory requirements regarding the implementation of training elements applicable.
- 3.5 This document includes the criteria for the development of courses to deliver training for service on ships.

Part 4 – Health and Safety: Conduct of Training

- 4.1 At all times, the safety of the 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 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).

- 4.4 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.
- 4.5 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.
- 4.6 Training Providers must draw up their own safe working procedures to meet the statutory Health and Safety obligations.

Part 5 – Training Structure

- 5.1 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.
- 5.2 Learners may undertake Parts 1 and 2 from different MCA Approved AEPC1 Training Providers.
- 5.3 Providers¹ 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).
- 5.4 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.
- 5.5 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.

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.

Part 6 – Course 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 (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.
- 6.3 Part 1 of the course will be covered over 2 days whereas Part 2 will be covered in 3 days.

Part 7 – Entry Requirements

- 7.1 The entry requirements for Part 1 of the course are:
 - Minimum age of 18 years or older.
- 7.2 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

- 8.1 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.
- 8.2 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

9.1 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 instructors and assessors to the MCA where these will be considered on a discretionary basis for MCA approval.

Part 10 – Facilities and Equipment

- 10.1 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.
- 10.2 All facilities must be maintained and, where appropriate, be inspected and assessed in accordance with the applicable regulations, current standards and manufactures recommendations.
- 10.3 The course must be delivered from a suitably heated and ventilated building and should be of a permanent construction.
- 10.4 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).
- 10.5 Case studies should be used to aid the delivery of the learning objectives against the relevant outcomes. *The below list ²is not exhaustive and Training Providers should use other case studies to assist facilitate the required learning:*
 - Fire aboard Tank Vessel S-Trust (ntsb.gov)
 - NSIA-Brim-Repor-2022_07.pdf (safety4sea.com)
 - <u>Protecting battery systems against humid, salty air and seawater intrusion Norwegian</u> Maritime Authority (sdir.no)
 - <u>1st International symposium on fire in electric storage at sea on Vimeo</u>
- 10.6 Sufficient and suitable equipment must be provided to enable practical sessions and assessment of the learning objectives.
- 10.7 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.

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.

Part 11 – Assessment Requirements

- 11.1 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.
- 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 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 the learner's ability to meet the criteria for evaluating competence.
- 11.6 A range of direct observation, oral questioning and role play are considered as examples of ideal approaches to generate much of the evidence required in a 1-1 and group setting.
- 11.7 All assessments must be formally documented, and reports 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/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, learners 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.
- 11.9 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.
- 11.10 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**.
- 11.11 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.

11.12 The maximum group size for each desktop exercise is four learners/students.

Part 12 – Certification and Course Outcomes

12.1 Certification

12.2 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**.

12.3 Course Outcomes

12.4 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 Propelled 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 maritime industry
	(Awareness only- no assessment).
Outcome 4	The learner has an awareness of cyber security within the maritime 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 charging systems in relation to
	Electric/Hybrid Vessels. (Theory).

<u>Part 1</u>

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 maritime industry.

Learning Objectives:

- 1. Human behaviours towards achieving decarbonisation and reduction of greenhouse gases.
- 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

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.

<u>Part 2</u>

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
 - Absorb/Absorbent Glass Mat (AGM), Enhanced Flooded Battery (EFB)
 - Gel

³ This must be a brief overview at a high level.

- 2. Inverters, controls (including motor driver), charging systems, motors
- 3. Battery Management Systems including software (BMS)
- 4. Understanding of correct battery charging and battery health
- 5. Understand testing and maintenance of batteries
- 6. Use of multi-meter, clamp meter, battery test equipment
- 7. Understanding of battery fault conditions
- 8. Knowledge of ancillary systems (ventilation, cooling etc)
 - To cover cooling systems, including ship side valves
- 9. Read and interpret basic electrical diagrams and symbols
- 10. Electric motor construction (AC and DC)
 - Single phase and three phase
 - Starting methods
- 11. Energy flows (Power Take Off (PTO), Power Take In (PT)), regeneration
- 12. AC/DC voltage and protection systems including voltages differences within the distribution and switchboard 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
- 3. Fault finding and use of fault diagnosis/test equipment
 - On board diagnostic and fault-finding reporting systems
 - Thermal imaging, gas detection
- 4. 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 charging systems in relation to Electric/Hybrid Vessels *(theory)*.

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.
- 8. Intermittent renewable charging systems

Annex A – AEPC1 Equipment List

Learning Objective	Examples of equipment	Additional Information
Reference	that can be used	
	Part 1	
Outcome 1: The learner demonstrates basic knowledge of the use of batteries on Electric and		
Hybrid Vessels		
Learning Objective 1: Basic	Schematic Drawings	
understanding of		
electrical/hybrid propulsion		
Systems	• Dhotographa	
Identification of basic	 Photographs Batteries of various types 	
components within the	 Batteries of various types (lead acid_lithium-ion) 	
system: batteries, battery	etc)	
management systems,	 Invertors 	
inverters, control modules,	 Management Systems 	
charging systems	 Motors AC/DC – samples 	
	and photos to show	
	types available in the	
	market	
Learning Objective 3:	SOLAS requirements (to	
Management of battery	be reviewed and	
rooms/locations (storage,	included)	
ventilation, inventories etc)	Vessel Class	
	requirements	
	Isolation Mats	
	• Example drawings GA	
	Dampers/Flooding Fire Firebook	
Learning Ohiestive A Detter	Fire Fighting	
fault conditions, identification	Battery Management System	
and appropriate first actions	 Senses-remote readings 	
to take.	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 	
	 Insulated gloves 	
	Breathing apparatus	
Learning Objective 7: Safe	MARPOL Annex 5	
disposal of batteries inline	(Garbage)	
with local and international	Local Port restrictions	
requirements.	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	Emergency Procedure Checklist	
Condition	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 <i>Novec 1230</i> 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 maritime industry (Human		
Learning objective 1:	Desktop Presentations	
Behaviours		
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 maritime industry		
Learning Objective 1:	Case Studies	
Identification and protection	Guidelines	
against malicious cyber-	Book/Recommended	
attacks (active and passive)	reading	
Learning Objective 2: How to	Cyber Security Videos	National Cyber Security Centre -
identify non-malicious cyber	Bibby Horizon Case	NCSC.GOV.UK
attacks such as data storm,	Study	
data corruption	-	

Learning Objective 3: Data Protection whilst using remote diagnostics and	 OEM Instructions Example of/part of a company policy 	International Chamber of Shipping books as reference material <u>https://www.ics-</u>
cloud-based systems		shipping.org/resource/guidelines -on-cyber-security-onboard- ships-version-four/
		Public Resources - The Workboat Association – 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 demon	strates competent knowledge of	Electric or Hybrid systems
onboard vessels		1
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 banks.
Learning Objective 2:	Inverters	
Inverters, control modules	Control Modules/Motors	
(including motor driver),	 Charging systems 	
charging systems, motors	 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	TextbooksPresentations	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 (for example Carbon Pile Load tester, Smart battery 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 cooling systems, including ship side valves	 Endoscope System Schematics (examples of) Battery cooling systems Desktop Presentations with photos of Industry cases Water Testing equipment Understanding/maintena nce 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 demon	strates knowledge of safe electric	cal working practices onboard
Electric and Hybrid vessels incl	uding 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 Gas Detector/s (handheld and fixed) e.g. HF Detectors. 	
Learning Objective 4: Routine Maintenance - Test and inspection battery chargers - Test inspection of batteries (Lead Acid, Lithium Ion)	 Battery chargers capable of trickle charge, fast chargers etc. Different types of battery chargers with Bulk, Absorption, Float and 	Lecturer to consider the different modes of a battery charger

 Routine maintenance of electrical systems (tightness checks, thermal imaging surveys) 	 Repair functionality. Thermal imaging camera Different types of Batteries, manuals and other connection methods and maintenance as per 	
	maintenance as per Learning Objective 5.1.	

Outcome 7: The learner demon	strates competent knowledge o	f charging systems in relation to
Electric/Hybrid Vessels.		
Learning Objective 1: Types	 Desktop Learning 	Lecturer to consider Shore power
of connection and condition	 Images 	mock up.
	 Presentations 	
Learning Objective 2: Correct	Desktop Learning	
shore power connection		
procedures (cold ironing/hot		
docking)		
Learning Objective 3:	 Desktop Learning 	
Earthing arrangements and		
stray currents		
Learning Objective 4: Issues	 Desktop Learning 	
with voltage and frequency		
differences		
Learning Objective 5:	 Desktop Learning 	
Interaction with vessels		
power management system		
Learning Objective 6: Shore	 Desktop Learning 	
Power converters		
Learning Objective 7:	 Desktop Learning 	
Forward Planning for shore		
power request.		
Learning Objective 8:	 Desktop Learning 	Ideally a mock-up solar charging
Intermittent renewable		system but not a mandatory
charging systems		requirement

Annex B – AEPC1 Sample Questions

<u>Part 1</u>

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

2. What is the primary advantage of a hybrid system fitted to a Small Vessel (OC1):

- a. It can reduce emissions compared to a purely combustion powered vessel
- b. Better compliance with the Hong Kong convention on ship recycling and disposal
- c. Simpler system
- d. Reduction in paperwork and administrative costs

3. Which of the following materials are commonly used in battery construction for Hybrid ships (OC1):

- a. Plutonium Phosphate
- b. Nickel Cadmium
- c. Nickel Metal Hydride
- d. Lithium Ferro/Iron Phosphate
- 4. If a ships battery system is rated at 40 MWh, this relates to (OC1):
 - a. Two x 20 Mega Webers Inductive capacity
 - b. The capacity of the battery in Mega Watt hours
 - c. The weight of the battery in Mega weight
 - d. It has 40 Major charge and discharge options

5. With reference to Lithium-Ion Batteries, thermal runaway is best described as (OC2):

- a. An exothermal process or failure resulting in an uncontrollable temperature increase
- b. A temperature differential between cells in series
- c. A heat loss problem in batteries
- d. A short circuit event

6. Which Firefighting media should be used on a small Lithium-Ion battery fire (OC2):

- a. Dry Chemical, CO2, or specialist water type extinguishers
- b. HALON gas
- c. BromoChloroTrifluoromethane (BTM)
- d. Saline Solution

- 7. In a Lithium-Ion Battery which statement accurately describes the charging process (OC1):
 - a. Charge is built up in the electrolyte and stabilises
 - b. The negative electrons empower the Anode and is stored
 - c. A liquid electrolyte transports lons from cathode to the positive terminal
 - d. During charging the Lithium lons move from the anode to the cathode storing energy
- 8. With reference to an Inverter used in ship's propulsion systems, which of these statements is true (OC1):
 - a. It changes the voltage from a high value to a low value
 - b. It changes the voltage from a low value to a high value
 - c. It converts an inductive load into a capacitive load
 - d. It converts direct current electricity (DC) to an alternating current (AC)
- 9. With reference to battery charging, which type of charge is preferred for a Lithium-Ion battery (OC1):
 - a. Constant voltage slow charge rate
 - b. Constant current fast charge rate
 - c. Constant current followed by a constant voltage charge
 - d. Slow charge and discharge at constant impedance

10. With reference to batteries, what is meant by the classification LiFePO4 (OC1):

- a. Lithium Pressurised Oxygen 4
- b. Lithium Ferro/Iron Phosphate
- c. Lithium Polar 4
- d. Lithium Iron Polonium

11. With reference to batteries, what is meant by the classification Li-NMC (OC1):

- a. Lithium Nickel Manganese Cobalt Oxides
- b. Lithium Negative Matter Charge
- c. Lithium Non-Magnetic Charge
- d. Lithium Ferro/Iron Phosphate
- 12. Which statement below reflects the advantages of Lithium-Ion Batteries compared to Lead Acid Batteries (OC1):
 - a. Increased power output, faster charging, reduced weight, longer life
 - b. Increased voltage, lower temperature, higher resistance
 - c. Faster charging, extended warranty, slow discharge rate
 - d. Longer life, waterproof, low cost, low fire rating

13. What is meant by a battery management system (OC1):

- a. The monitoring and management of temperature, voltage and current and state of health of the battery when a battery is charging or discharging
- b. The automatic monitoring of heat, resistance, capacitance, and resistance of the battery during fast charge
- c. A high level of ships managers always monitoring battery health and conditions
- d. A safe system of work as described in the Code of Safe Working Practices (COSWOP)

14. Which of the following describes the main dangers of a lead acid battery fire (OC2):

- a. Toxic gases, explosive gases, secondary fires, smoke
- b. Loss of power and lighting
- c. Loss of ventilation, cooling and charging of batteries
- d. Thermal runaway

15. From the list below choose Four gases that are released during a Lithium-Ion battery fire (OC2):

- a. Nitrogen
- b. Oxygen
- c. Lithium oxide
- d. Hydrogen cyanide
- e. Hydrogen chloride
- f. Hydrogen fluoride
- g. Sulphur dioxide
- h. Methane

16. From the list below choose Four actions to be taken upon discovery of a battery fire (OC2):

- a. Raise the alarm
- b. Evacuate the space
- c. Change to a secondary power source
- d. Isolate batteries from charging system
- e. Abandon ship
- f. Drop the anchor
- g. Try to put it out with a foam fire extinguisher
- h. Sound the ship's whistle

17. What safety features are fitted to a Lithium-Ion battery to prevent overheating (OC2):

- a. Temperature sensors, thermal cutoffs, pressure relief valves, protective casing
- b. Over current relays, reverse power cutoff, fuses
- c. Smoke sensors, flame sensors, heat detectors
- d. Charge indicators, fusible plugs, vents

18. Select the correct answer below which shows the main reason(s) for battery room ventilation systems (OC2):

- a. Cooling of equipment, removal of toxic and dangerous gases
- b. Comfortable work environment for the crew
- c. HSE requirement
- d. Local port authority regulations

19. What does the abbreviation SDS stand for in relation to documentation (OC2):

- a. Safety Data Sheet
- b. Safety Detail Sheet
- c. Ship Document System
- d. Seafarer Documentation System

- 20. Select the correct answer showing the information that should be found in a Battery Register (OC2):
 - a. Unique identification number, make of battery, location, type, size
 - b. Muster list, fire plan, emergency duty list
 - c. Size, colour, physical dimensions, weight, shape
 - d. Local disposal company details including address and contact numbers

21. From the list below choose the Four most appropriate items of Personal Protective Equipment to work on lead acid batteries (select one answer) (OC2):

- a. Gloves
- b. Eye protection
- c. Apron/overalls
- d. Safety boots
- e. Knee pads
- f. Flash suit
- g. Fall arrestor
- h. 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 infor	mation
Full name:		
Name of Training Provider (TP):		Instructor
Name of the course:		Assessor
Training Providers contact emai	l:	Training Providers contact phone:
Ac	ademic/professional quali	fications*
Title	Name of the organisation	Date awarded
Pr	evious experience at sea a	nd 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.

|--|

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 2 and 3 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



www.gov.uk/mca

Y @MCA_media

f @MCA

in /maritime-and-coastguard-agency