Electric aircraft
Difference training programme

IAW RA-AUS operations manual 7.1.1 type training
(with regard to Pipistrel Alpha Electro)
September 2023

Abbreviations

CAS	Crew Alerting System
CBT	Computer Based Training
HMI	Human Machine Interface
IAS	Indicated Air Speed
KIAS	Indicated Air Speed in Knots
LAPL(A)	Light Aircraft Pilot Licence (Aeroplane)
POH	Pilot's Operating Handbook
RPC	Recreational Pilot Certificate
RPL(A)	Recreational Pilot License (Aeroplane)
PPL(A)	Private Pilot Licence (Aeroplane)
CPL(A)	Commercial Pilot Licence (Aeroplane)
PNR	Point of no return
RFT	Remaining flight time
SEP(L)	Single Engine Piston (Land) Rating
SOC	State of charge
SOH	State of health
SPOH	Supplement to Pilot's Operating Handbook
MM	Maintenance manual
IAW	In accordance with
BMS	Battery management system

Useful definition

Training Provider -
The training provider is either the organisation or the individual flight instructor that provides the applicant with difference training.
Candidate - The Candidate is the type converting pilot or student completing the difference training, or the difference training in parallel with the RPC training curriculum.

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Scan the QR code for all downloadable material including current POH, MM and Emergency procedures.

1 Introduction

This document outlines the flight training syllabus for the difference training programme with regard to the Pipistrel Alpha Electro.
The training consists of the following phases:

1. Theoretical training
   The training provider should prepare the training material which must cover, as minimum, the topics listed in section 2.1
2. Aircraft POH content familiarisation
3. Practical training, consisting of at least four missions with a flight instructor of around 40 minutes each, plus at least 15 minutes for both pre-flight briefing and post-flight briefing.
4. A fifth mission is recommended for traffic patterns.

After completion of the training, the candidate should have acquired theoretical knowledge and practical experience in the operation of the aircraft in terms of:

- Electric aircraft function and natural limitations
- Pre-flight checks, flight planning, endurance and range management
- General aircraft handling and performance
- Knowledge of the electric propulsion system and its pilot interfaces
- Charging, storing and battery care procedures
- In-flight range and RFT management
- Management of abnormal situations and emergency procedures

Conditions for the candidate to complete the Difference Training are:

- Holding a RPL(A), PPL(A) or CPL(A) or higher
- Hold a current RA-AUS membership
- Attain a Breezy-log electronic log book membership (Free)
- Meet all relevant medical condition requirements as indicated in Section 2.16 of the RA-AUS Flight Operations manual (Issue 7.1.1)

2. Theoretical course

Electric propulsion systems are a technical innovation most candidates are not familiar with. While the macroscopic function of an electric aircraft is not different from a legacy aircraft, the way the powertrain generates thrust differs significantly from a standard ICE. Becoming familiar with the main powertrain parameters and understanding their function are vital to safe use of the aircraft.

2.1 Minimum content and recommended structure of the theoretical training

The theoretical training aims to provide the candidate with the knowledge of both the functioning of an electric aircraft and the specific design of the Alpha Electro.
Table 2.1 lists the minimum topics that the theoretical training must cover. The list applies to both Pipistrel CBT and training material by the training provider.

Table 2.1: Minimum content of Alpha Electro theoretical training

1. General knowledge	
1.1	Battery management (see supplementary battery management material on page 12)
1.2	Electric Engine
1.3	Pipistrel Alpha Electro Architecture
1.4	Avionics and cockpit arrangement
1.5	EPSI570 and warning LEDs
2. Limitations of the Alpha Electro	
2.1	Weight and Balance

2.2	Airspeed and maneuver limits
2.3	Operational limitations
Flying the Pipistrel Alpha Electro	
3.1	Charging and pre flight inspection
3.2	Taxiing
3.3	Take off and climb
3.4	Cruise and Manoeuvering
3.5	In flight energy management and minimum reserves (SOC and RFT)
3.6	Approach to stall and recovery (stall indicators)
3.7	Descent, Side Slip and Landing
3.8	Traffic pattern training
3.9	Mission planning and effects of battery SOH
4. Emergency procedures	
4.1	On ground emergency and use of aircraft SPOH - On Ground Battery Fire - Smoke - Accident/damages
4.2	Complete power loss in long final and in downwind
4.3	Landing out
4.4	Powertrain failures and EPSI warnings - Single Battery Disconnect - Battery Over Temperature - Drive Over Temperature - Loss of EPSI Display - Low SOC - Coolant pump failure - Power control loss - In flight battery fire

The training provider may support the training with any additional material that will help the students to get familiar with Alpha Electro Type, including the Pipistrel CBT programme.

2.2 Alpha Electro Training challenges

The training should focus on the main challenges a candidate will encounter as well as on the areas that pose new risks the pilot is not yet familiar with. These are described in the following paragraphs.

1. **Electric power plant systems and HMI**
   The POH and MM describes all powerplant systems of the Alpha Electro extensively, including construction, installation, functioning and modes of failure. The HMI present in the cockpit is also described in the POH and CBT and will be demonstrated before the first flight by the flight instructor, emphasising the importance of the main power plant parameters that must be monitored in flight.

2. **Energy and Endurance management**
   The limited endurance of the Alpha Electro poses a challenge to the average candidate.
   Experience shows the main difficulty is inferring the available flight time from battery SOC and SOH values, under different atmospheric conditions and flight operations. The correct procedure for using the Remaining Flight Time indication is explained and demonstrated. These two points will be covered by the flight instructor before flight and in flight. Refer to POH section 2-6 for information about energy and endurance.

3. **Emergency procedures**
   The introduction of a new power technology also comes with a new risk profile. The possible failures of the Pipistrel Alpha Electro and related emergency procedures are described in the POH and CBT as well as being outlined in this difference training programme. The familiarisation training should focus on the possible failure conditions, the functions of the aircraft CAS, the way the pilot interacts with the CAS and the corrective actions to take when a failure is detected. Before candidates start the flight activity, they should be familiar with the use of the CAS and the corrective actions following cautions and warnings as indicated in the POH, Emergency procedures supplement and in flight emergency checklist supplement.

4. **The charging process**
   The charging process is described in the POH and explored in depth in the Battery SOC and maintenance supplement. The correct procedure to charge will be demonstrated by the instructor for the pilot including any balancing or battery restart requirements to optimise the charger/aircraft interface and operational state.
   The Pilot will learn the possible risks to the charger and the aircraft or its electrical system when performing the charging process and/or storing the aircraft for extended periods between flights.
   The candidate also has to familiarise with managing possible errors during the charging cycle and consequent procedures.

2.3 The aircraft POH

The Aircraft POH is structured to provide sufficient knowledge about the aircraft operation, the use of the HMI and the management of powertrain failure conditions. The candidate should be familiar with the content of the POH and supplementary material before transitioning to the last stage of the difference training - Flight activity.

3 Flight training syllabus

This section outlines the practical training activity. The training is structured into four mandatory missions, whose elements are specified in the following subsections. However, depending on the new pilot's performance and considering his or her previous experience as PIC on Pistrel or other sport aircraft, the flight instructor can combine the elements of the training into fewer missions, though none of the elements can be skipped.
In addition, one single mission should not be overloaded with excessive workload and thereby negatively impacting the quality and effectiveness of the training.

The candidate who takes part in the difference training will be allowed to advance to the next missions of the training only if the flight instructor deems the proficiency shown in the last mission as satisfactory. The training is complete only when the training goals are reached and proficiency is displayed in all areas.

3.0 Charging

Before performing pre-flight inspection, the instructor will acquaint the candidate with the charging procedure and charger HMI. If the aircraft is already charged to sufficient SOC for flight, the charging procedure can be explained after the flight.

GROUND	
1	Charging procedure
2	Battery balancing and reset procedure (supplementary battery management guide)
3	Charger interface and EPSI charging page
4	Charging errors

3.1 First mission

The first mission will consist of the following training activities:

PRE FLIGHT	
5	Pre-Flight inspection
6	Cockpit familiarisation (standard avionics, EPSI570C, battery warning LED's)
7	Endurance management and missions planning
IN FLIGHT	
8	Taxi and before take-off checks
9	Take Off
10	Establish level flight at a minimum altitude of 3000 ft AGL with general coordination and pitch control
11	Cruise flight at normal performance (22kW), then at lower airspeed (required power moderation)
12	Familiarsation with SOC and RFT
13	Steep turns (80 KIAS), minimum altitude 3000 ft AGL
14	Approach to stall and recognition of pre stall airframe feedback
15	Stalls: clean and full flap, minimum altitude 3000 ft AGL
16	Practice of approach procedure and traffic patterns with remaining energy
17	Charging procedure
18	Post-flight debriefing
19	Discussion of energy management and reserve (refer POH 5-2)
20	Parking and storage

3.2 Second Mission

The second missions will consist of the following training activities:

IN-FLIGHT	
21	Circuit patterns with standard configuration
22	1st circuit - Short field approach
23	2nd circuit - Approach without flaps
24	3rd circuit - Approach with sideslip*
25	4th circuit - Engine failure drill on long final
26	Recovery from a long landing
27	The danger of a 3 point landing and bounce off the runway
28	Debrief and discussion on energy management IAW MOS19.03 and for possible low-state-of-charge go around.

*The difference training candidate may not be familiar with a sideslip approach. Side Slips are a required element of training for a Recreational Pilot Certificate

3.3 Third Mission

The third mission allows the candidate to further familiarise with the emergency procedures. This mission consists of two parts: an on-ground demonstration of powertrain failures and an in flight simulation of the emergency procedures

ON GROUND	
29	Simulated coolant pump failure during ground run ups (open breaker)
30	Observe motor power derating due to over temperature
31	Battery SOC misread in flight (refer supplementary battery management guide)
32	Simulate battery failure in flight (open breaker)
33	Simulate Loss of EPSI display (power screen off)

IN-FLIGHT	
34	Partial loss of power (simulated derated power due to battery disconnect)
35	Emergency landing in case of battery fire
36	Go-around before hold-off height
37	Power level loss simulation (emergency turnback)
38	Circuit patterns with remaining energy
39	Go around with (simulated) 30% SOC IAW MOS 19.03
40	Debrief and discussion on performed emergency procedures

3.4 Fourth Mission

The fourth mission is a flight to a nearby airfield less than 25 NM from the departure airfield with a focus on cross country flying on an aircraft with limited endurance. SOC predictions are calculated in the pre-flight plan and are monitored at waypoints during the flight along with the calculation of the PNR.

IN-FLIGHT	
41	Cross country flight to a nearby airfield
42	Energy management for cross-country flight
43	Approach with go-around
44	Fly back to the base airfield
45	Circuit patterns with remaining energy
46	Debrief and discussion on energy management for possible low SOC go around.

3.5 Fifth mission

A fifth mission is recommended for circuit consolidation and further simulations of emergency procedures and further adherence to usable fuel capabilities IAW CASR Part 91, MOS 19.03

4 Supplementary material

The following supplementary material is used for reference and to support standard operating procedures as set forth in this training guide and the POH.

4.0 Battery management guide

The Pipistrel Alpha Electro has a energy storage system consisting of 2 independent 10.5kW/h Battery boxes in the fuselage of the aircraft.
Unlike internal combustion fuel, batteries may have varying performance and charge characteristics depending on the ambient temperature and/or the cell temperature of the batteries and/or the SOH of the batteries.
Minimum and maximum battery values are outlined in section 1-4 of the POH.
Similarly, to protect the integrity and longevity of the batteries, careful handling and charge cycle practices must be adhered to.

The following battery management practices are taught on the ground IAW with the operational parameters outlined in the POH

ON GROUND	
47	Battery balance analysis (see supplementary material 1A)
48	Battery reset procedure (see supplementary material 1A)
49	Battery SOC misread in flight (see supplementary material 1A)
50	Best battery charging practices
51	Aircraft standby practices

Supplementary material 1A

47- Battery balance analysis

The Pipistrel Alpha Electro batteries must remain within the following parameters

Individual cell voltage differential	
Ideal	< 30mV differential between maximum and minimum cell voltages
Max. allowable	< 150mV differential between maximum and minimum cell voltages

If the batteries present outside of these values the following battery balance procedure must be completed

- Complete a full charge cycle on the slowest charge setting (overnight at 3A setting).
- Power on the Master, Avionics and Battery switches
- Leave the aircraft in this condition to allow the cell voltages to slowly balance (this could take many hours and is best done on a bad weather day so as not to disrupt operations)
- If the battery cell voltages still present in excess of 30mV difference, discharge with run ups or emergency procedure lessons and repeat the above.

Battery state of charge analysis

A full state of charge is completed when the charger is displaying ‘COMPLETE’ with a the ‘charging power’ indicator of the charger HMI reading 0.00kW (see page 18).
The SOC on the EPSI display and battery LCD may not represent this completed charge cycle at the end of the charge until a battery reset procedure is complete (see page 16).
The EPSI cannot correctly analyse the true SOC of the battery in a static state, it requirs time in operation to analyse and accurately represent the SOC values. This will usually occur by the end of the taxi and run up procedure (1-2 minutes of operation).

Supplementary material 1A cont.
Battery state of charge analysis cont.

Individual battery SOC differential	
Max. Allowable	The maximum allowable battery SOC differential is 5%
Battery voltage SOC comparison	
Cell voltage	A cell voltage of over 4100mV represents a 100% SOC
Battery voltage	A battery voltage of over 400V represents a 100% SOC

48 - Battery reset procedure

If the batteries present outside of a 5% difference value at the end of a charge cycle or at the end of a flight, or if the SOC does not display close to 100% despite the battery voltage being close to 400V, the following battery reset procedure must be completed

- Power on the Master, Avionics and Battery switches
- Turn the EPSI control toggle 3 notches to the right (clockwise), 5 notches to the left (counter clockwise) and 6 notches to the right (clockwise). A sub menu will be displayed.
- Using the EPSI control toggle, select the F at 'Battery restart F/R' and press the control toggle, then navigate to the R and press the control toggle. The batteries will each start a reset procedure. At this point you can exit the sub menu by navigating to the 'EXIT' selection and watch the battery reset on the main EPSI display. A low SOC and DC/DC malfunction error will display during the reset. Clear these warnings with a press of the EPSI control toggle.

49 - Battery SOC misread in flight

ANALYSIS
- DUE TO DATA VARIATIONS THE EPSI SOC DISPLAY CAN REACH AN ERROR STATE
During flight and charge cycles, the BMS reports to the EPSI regularly. In this process there is an accumulation of data that can result in a misread of the EPSI SOC/battery balance interface display.

RISK
- THE BATTERY SOC DISPLAY ON THE EPSI CAN RAPIDLY CHANGE
During operation of the aircraft, there is a risk that this accumulation or single sensor approaching limitation thresholds can force a pessimistic adjustment on the SOC display, indicating the battery has had a rapid SOC reduction. This information is designed to alert the pilot to turn their attention to an increased awareness of the SOC.
Supplementary material 1A cont.

MANAGEMENT (IN FLIGHT)

- IF YOU EXPERIENCE A BATTERY SOC READ ERROR IN FLIGHT
Do not panic. Switch the EPSI display to the secondary aircraft information page to assess the battery SOC.
Reduce the power setting to Zero and pitch for a glide to assess the batteries with no load.

First - Assess the **Batt V:** display voltage for each battery.
Each battery **Batt V:** value should be similar, not less than 5% difference.
A **Batt V:** voltage display of **340V** represents approximately **30% SOC**
THE MINIMUM BATT U: VOLTAGE VALUE IS 300V - This represents approx. 10% SOC

Second - Assess the **MIN V:** display voltage for the lowest individual cell voltage
Each battery **MIN V:** value should be similar, not less than 5% difference.
THE MINIMUM SAFE FLIGHT MIN V: VOLTAGE VALUE IS 3200mV
THE MIN V: FAILURE VOLTAGE IS APPROX. 2800mV

If the battery voltage values present above these minimum thresholds, the aircraft is safe to continue flying. HOWEVER, if there is a battery balance or battery value read error on the main user interface display YOU MUST immediately route to the closest practical airstrip for a safe landing, flying as efficiently as possible.

Slowly reapply power for straight and level flight and adjust your flight plan to return to the closest practical aerodrome or airport.

50 - Best Battery charging practices

The rule of thumb for the best battery charging practices is RUN IT LOW, CHARGE IT SLOW. Using only the top 20-30% of the batteries and fast charging them back to full will rapidly damage the individual cells and cell balance in the batteries, as not all cells will charge and discharge at the exact same rates.
It's best to complete a deeper cycle and use the batteries down to sub 40% where safe and at every practical opportunity, charge the batteries on the very slowest charge cycle overnight at the 3A charger input current selection setting on the charger HMI.
This will not only ensure the best charge for the batteries, but also allow a more even cell balance as well as keeping the batteries slightly warm, an important factor when operating in sub 10 degree weather conditions.
Toward the end of the charge cycle, the charger will roll back the current capacity to as low as 0.1kW and will display 'COMPLETE', but may still be completing the last 1-2% of the charge cycle or more importantly, balancing the battery cells. The charger should be left connected and running for as long as it takes for the 'Charging Power' value to present 0.0kW.
Failing to do this every 2-3 charge cycles will drastically reduce the operational life of the batteries and cause permanent damage.
The fast charge should only be used when it is operationally required for the next lesson or recreational flight.

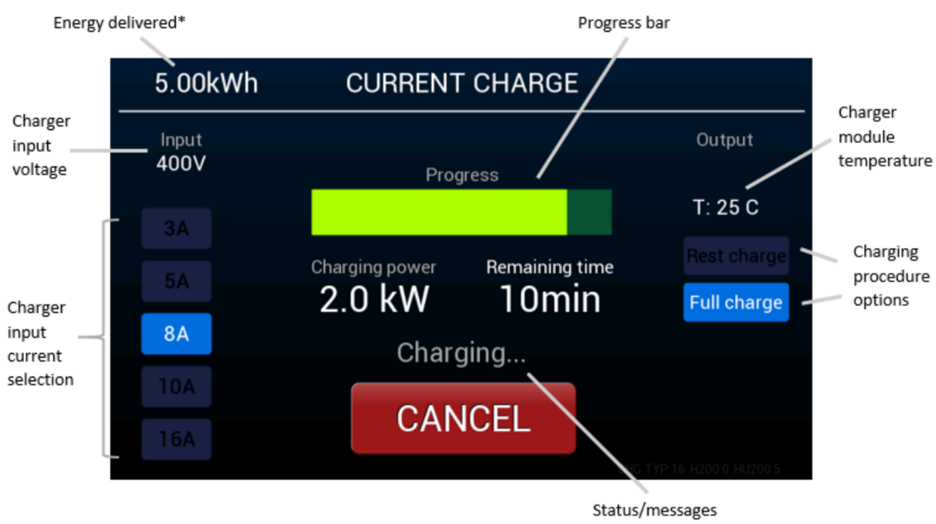

Figure 003
HMI - Digital display

51 - Aircraft standby practices

Main Battery storage levels.
If the aircraft is not to be flown for a period of 5 days or more, it is important to keep the batteries within 355V-365V.
A full (slow) charge should be completed 24 hours before flying again.

12V AUX battery storage levels
If the aircraft is not to be flown for a period of 72 hours or more, it is recommended to pull both the PWR CTRL and MAIN SYS circuit breakers for this period. This will isolate the AUX battery from any potential phantom draw.
If the AUX battery does run low, the main switches will not engage due to low voltage.
In this case, the AUX battery can be ‘Jump started’ with a 12V charger or battery jumper to engage the MASTER, AVIONICS and BATTERY switches, at which point the main batteries will begin charging the AUX battery.
The AUX battery is low voltage protected and will not run flat to ZERO volts.

4.1 Emergency procedures

Emergency procedures are outlined in detail in section 3 of the POH. To assist with quick reference for the candidate during training and in the event of an in-flight emergency procedure, FlyOnE has created the following document, which can be downloaded in high resolution on the Alpha Electro page of the FlyOnE website - LINK

ALPHA ELECTRO

Stall recovery

1. Reduce the angle of attack by easing-off on the control stick.
2. If the motor is running, add full power.
3. Resume horizontal flight.

Spin recovery

1. If the motor is running, set power to “cut off “(lever in full back position).
2. Apply full rudder deflection in the direction opposite to spin direction.
3. Lower the nose towards the ground to build up speed (release stick force to neutral).
4. As the aircraft stops spinning neutralise rudder deflection.
5. Slowly pull up and regain horizontal flight (do not exceed airspeed and g-load limits).

Motor failure during takeoff or under 100ft

Ensure proper airspeed by lowering the nose and land the aircraft in runway heading, avoiding eventual obstacles in your way. Set master switch to the OFF position. Land straight ahead.

Motor failure in climb under 500 ft

First ensure proper airspeed by lowering the nose, then start scanning the terrain underneath and choose the most appropriate site for landing out.

Motor restart in flight

1. Set the POWER LEVER to CUT OFF
2. Set PWR EN SWITCH to OFF
3. Set MASTER SWITCH to OFF
4. DISENGAGE the PWR CTRL Circuit breaker After 3 seconds:
5. ENGAGE the PWR CTRL Circuit breaker
6. Set MASTER SWITCH to ON
7. Set PWR EN SWITCH to ON
8. SLOWLY INCREASE the POWER LEVER If restart is not successful, perform an emergency landing.

Emergency procedures checklist

EMERGENCY LANDING

1. Master switch OFF.
2. Fasten your seat harness tightly.
3. Approach and land with extreme caution with +10 km/h (+5 kts) airspeed reserve if the chosen landing terrain length permits.
4. Leave the aircraft immediately after landing.

FIRE

POWERTRAIN FIRE ON GROUND

1. Come to a complete standstill, master switch OFF and disengage PWR CTRL circuit breaker. 2. Abandon the aircraft and start extinguishing the fire with a waterless agent. WARNING! After the fire has been extinguished DO NOT attempt to restart the motor.

POWERTRAIN FIRE IN FLIGHT

1. Set master switch to OFF and disengage PWR CTRL circuit breaker. 2. Open all cabin vents. 3. Perform side-slip (crab) maneuver in direction opposite the fire. 4. Perform emergency landing procedure and leave the aircraft immediately.

BATTERY SYSTEM FIRE

Indication of battery fire is dense smoke and a distinctive chemical smell. Disengage both battery circuit breakers, land immediately and leave the aircraft as soon as possible. **WARNING! Be aware that lithium battery fires are extremely dangerous because they are self-sustaining! They are a result of chemical reactions and are impossible to extinguish. You can only prevent or delay fire propagation by continually cooling down the batteries and surrounding items with a copious amount of water.**

EPSI 570 failure

While on the ground:
During taxi: Do not takeoff!
During takeoff run: If possible and safe, abort the takeoff procedure!
While in flight:
With power to the motor: Do not switch the motor off. Attempt to fly to the next airfield and land as practical.
Without power to the motor: Look for a spot to carry out a safe outlanding. If practical check the circuit breakers, disengage the system’s four main switches, power lever to cut-off, and attempt a re-start.

Battery failure

With two battery packs on board the battery system is automatically redundant. A failure of one battery pack will be displayed on EPSI570 as a warning and the system will automatically switch to a single-battery mode, enabling continuation of flight. Land as soon as practical and have the battery system verified by authorised personnel. **WARNING! Single battery operation is considered an emergency situation in which the maximum power output must be kept below 35 kW! Plan actions and maneuvers accordingly.**

Powertrain over temperature

Continuous monitoring and a careful management (power setting) of powertrain components temperature is essential for flight safety. Motor, power controller and battery temperatures are displayed on the EPSI570 screen in the form of vertical bar-type indicators. Temperature ranges (normal, caution, warning) are indicated beside each vertical bar. If temperature warning is incurred, reduce power to minimum straight and level setting to reduce temterature and land as required.

Emergency procedures cont.

ALPHA ELECTRO
EPSI User action guide

CAUTION:

BATTERY 1/2 OVERTEMPERATURE (at battery temp. 45°C)
- Reduce power - Monitor battery temperature - Land as soon as practical if the problem persists

SOC < 10%
- **Power lever cut off - Land as soon as practical -** monitor the residual %SOC (battery will disconnect by itself, depends on the cell voltage)

BATTERY 1/2 SOC ADJUSTED
Reset the message by pressing the knob.
- Change the flight plan according to the updated SOC value.

WARNING:

ONLY ONE BATTERY PACK IS ACTIVE
- if appears while on the ground: do not takeoff
- if appears during flight: reduce power to 35 kW or less. Land as soon as practical

BATTERY 1/2 NOT PRESENT
- If this occurs on the ground do not take-off and check battery installation
- If this occurs in flight reduce power to 35 kW or less, land as soon as practical

DRIVE OVERTEMPERATURE
- Reduce power immediately (to minimum possible) - Monitor motor/power controller temperature - Land as soon as practical if the problem persists but power is still available (possible power reduction) - Land as soon as possible (emergency) if power is cut off by the system

WARNING:

BATTERY 1/2 DISCONNECTED DUE TO [DISC CURRENT, CHG CURRENT, OVERTEMP, INTERLOCK, UNDERVOLTAGE, OVERVOLTAGE]
- Reduce power immediately to 35 kW or less (battery will disconnect by itself) and land as soon as practical

BATTERY 1/2 DISBALANCED REDUCE POWER
- Reduce power
- Reset message and monitor system status

BATTERY 1/2 STARTUP FAILED EC: [X]
Do not take-off - NOTE the number

DRIVE TEMPERATURE SENSOR FAILURE
WARNING! The power controller may reduce power to 0 if and when sensor failure happens.
- Land as soon as possible

DRIVE COMMUNICATION FAILURE
In flight - Perform MOTOR RESTART IN FLIGHT
On the ground - perform restart procedure

COOLANT PUMP/SENSOR FAILURE
- Reduce power - Monitor temperatures - Land as soon as practical

DC/DC COMMUNICATION FAILURE/MALFUNCTION/NOT WORKING
- If this occurs on the ground do not take-off - If this occurs in flight land as soon as practical

POWER LEVER COMMUNICATION FAILURE
If power to the motor remains - Land at the nearest airfield.
If power to the motor is cut, perform glide back to the airfield or emergency off-field landing

Battery management checklist

Before Flight..

Individual cell balancing
If the individual cells in each battery pack are reading GREATER than 30mV difference, perform battery balance procedure.

Battery stack balancing
If the front or rear battery are displaying a difference of greater than 5% on the main page of the EPSI, perform a battery reset procedure.

In Flight..

Battery balance misread in flight
If the EPSI display makes a rapid SOC % adjustment in flight, reduce power to glide setting, switch to the system page and check the following...
1. Make sure the battery BATT voltage of the F and R battery are within 5% of each other.
A BATT V of 350V represents approx. 50% SOC
A BATT V of 320V represents approx. 20% SOC
Minimum Cell voltage should be above 3200mV
2. If the batteries present within or above these values, slowly re apply power and adjust your flight plan to immediately return to your closest electric-enabled airport using the system page as your primary SOC reference. Continue flying as normal for an efficient return to the closest airfield and disregard the SOC % estimation error on the main display.

Charging

Battery stack balancing
If the batteries presented a misread in the prior flight, perform a battery reset prior to charging. Always charge the batteries at the lowest possible setting on the charger to still accommodate the next scheduled flight.
Eg. Overnight at 3A if it is the last flight of the day.

4.2 Reserve energy requirements

The minimum reserve energy requirements for safe landing operations is 30% SOC as indicated in the POH (Section 5-2).
All relevant airspace requirements in the region you are flying in must be considered when making your return energy calculations for safe operation and approach to your intended airport.
For instance, if you are approaching a busy controlled airspace with an extended approach vector/height and are at, or close to MTOW, the candidate will need to keep greater reserve energy in your mission plan for a safe approach as indicated in the MOS 19.03 general requirements (See appendix A).
For detailed reserve energy calculations and mission planning, see section 5-2 of the POH.

In terms of legal minimum energy requirements as set forth by the Civil Aviation Safety Authority, it is indicated in the General requirements (MOS 19.03) of the plain english guide that **when determining the amount of useable fuel (energy), to use the aircraft manufacturers data in the flight manual** or POH.

By specific definition, the flat rule of 30 minute reserve excludes electric aircraft (See appendix. A), however, in keeping with the above minimum 30% SOC reserve on landing as per section 5-2 of the POH with additional considerations for the airspace you are integrating with, your indicated remaining flight time on the EPSI display will exceed 30 minutes flight time if the aircraft is configured for best glide speed and minimal power settings on approach to the airfield.
Thus remaining in-line with standard operating procedures for ICE light sport aircraft.

As an additional guide for Electric LSA Aviators to make safe and informed decisions regarding emergency energy requirements, we recommend being familiar with the EASA LSA emergency reserve requirements document **Annex VII to ED Decision 2022/005/R**
Available at https://www.easa.europa.eu/en/downloads/136242/en
Which stipulates *The final reserve fuel (FRF)/energy should be no less than the required fuel/energy to fly: for 10 minutes at maximum continuous cruise power at 1 500 ft (450 m) above the destination under VFR by day, taking off and landing at the same aerodrome/landing site, and always remaining within sight of that aerodrome/landing site; for 30 minutes at holding speed at 1 500 ft (450 m) above the destination under VFR by day;*

Appendix A - Extract from the CASA Part 91 plain english guide

9. Fuel

Fuel requirements (91.455)

You must comply with the fuel requirements set out in the MOS including (but not limited to):

- matters that must be considered when determining whether the aircraft has enough fuel to complete the flight safely
- determining the quantity of fuel you must carry
- monitoring fuel quantity
- what to do when fuel reaches a specified quantity.

Definitions of final reserve fuel and contingency fuel (MOS 19.02)

You must carry the final reserve and contingency fuel amounts set out in the following table.

Table 16: Final reserve fuel and contingency fuel requirements

Aircraft category	Flight rules	Final reserve	Contingency
Aeroplane with a MTOW equal to and less than, 5,700 kg (piston engine or turbo-prop)	VFR	30 minutes	N/A
Aeroplane with a MTOW, equal to and less than 5,700 kg (piston engine or turbo-prop)	Night VFR	45 minutes	N/A
Aeroplane with a MTOW, equal to and less than 5,700 kg (piston engine or turbo-prop)	IFR	45 minutes	N/A
Turbojet aeroplane with MTOW greater than 5,700 kg	IFR or VFR	30 minutes	5% of trip fuel
Piston engine aeroplane with MTOW greater than 5,700 kg	IFR or VFR	45 minutes	5% of trip fuel
Rotorcraft	VFR	20 minutes	N/A
Rotorcraft	Night VFR	30 minutes	N/A
Rotorcraft	IFR	30 minutes	N/A

Specifically not relevant to an electric aircraft

General requirements (MOS 19.03)

Fuel consumption data
When determining the amount of usable fuel required you must use one of the following fuel consumption data sources:

- the most recent aircraft specific fuel consumption data derived from the fuel consumption monitoring system used by the operator of the aircraft (if available)
- the aircraft manufacturer's data for the aircraft.

Note: The aircraft manufacturer's data includes electronic flight planning data. The manufacturer's data may be in the AFM, cruise performance manuals or other publications.

Operational requirements
When determining the amount of usable fuel required you must also consider the effect of the following:

- the operating conditions for the proposed flight, including the:
  - actual weight (if known or available), or the anticipated weight of the aircraft
  - relevant NOTAMs
  - relevant authorised weather forecasts and authorised weather reports
  - relevant ATS procedures, restrictions and anticipated delays
  - effects of deferred maintenance items and configuration deviations
- the potential for deviations from the planned flight because of unforeseen factors.

General fuel requirements relevant to all fixed-wing powered flight aircraft

Pre Flight Checklist and In-flight emergency procedures supplement
(available for download from www.flyone.com.au)

PRE TAKE OFF

BREIFING____CONFIRMED
FLAPS____STAGE 1
NAV LIGHTS____ON
LANDING LIGHT____ON
FLIGHT CONTROLS____TEST
CABIN____READY

TAKE OFF/UPWIND

POWER____APPLY 55KW
CHECK SYSTEM FOR WARNINGS
CLIMB SPEED____70KIAS
FLAPS____RETRACT
POWER____REDUCE TO 44KW
LANDING LIGHT____OFF

DOWNWIND

CABIN____OK
TEMPS____OK
UNDERCARRIAGE____FIXED
BRAKES____CHECKED
BATTERY____OK
SPEED____80KIAS

APPROACH-FINAL

BREIFING____CONFIRMED
LANDING LIGHTS____ON
SPEED____<60KIAS
FLAPS____STAGE 2
TRIM____NUETRAL
CABIN____READY

MOTOR RESTART IN FLIGHT

POWER LEVER____FULL BACK
SWITCHES RIGHT TO LEFT__OFF
PWR CTRL BREAKER____PULL
COUNT TO 3
SWITCHES LEFT TO RIGHT___ON
POWER____SLOWLY RE-APPLY

EPSI FAILURE IN FLIGHT

WITH POWER TO MOTOR
DO NOT SWITCH THE MOTOR OFF, FLY TO THE CLOSEST AIRFIELD AND LAND
WITHOUT POWER TO MOTOR
ATTEMPT RESTART AND IF NESCESSARY, COMPLETE EMERGENCY LANDING

POWERTRAIN FIRE IN FLIGHT

POWER LEVER____FULL BACK
MASTER SWITCH____OFF
PWR CTRL BREAKER____PULL
PERFORM EMERG. LANDING

EMERGENCY LANDING

SET BEST GLIDE SPEED__66KAIS
WIND DIRECTION___DETERMINE
FIELD SELECTION__DETERMINE
SURROUNDINGS____CHECK
SIZE____SURFACE____SLOPE
ASSESS FOR BPRS or LAND OUT
IF APPROPRIATE LAND OUT AREA IS IDENTIFIED
IDENTIFY LOW KEY POINT
HIGH KEY____2500FT
MAYDAY MAYDAY MAYDAY
SQUAWK____7700
STATUS_ANNOUNCE ON RADIO
LOW KEY____1500FT
POWER LEVER____FULL BACK
MASTER SWITCH____OFF
HARNESSES____SECURE
LAND OUT

BPRS DEPLOYMENT

IDENTIFY BEST AREA/DIRECTION
POWER LEVER____FULL BACK
MASTER SWITCH____OFF
HARNESSES____SECURE
PROTECT HEAD____**DEPLOY**

PI-AE
Pipistrel Alpha Electro Standard procedures

TABLE 1. BATTERY SOC ESTIMATION BY VOLTAGE

MIN CELL V	4.2V	4.0V	3.90V	3.85V	3.75V	3.64V	3.54V	3.40V
APPROX. SOC%	100%	90%	80%	65%	50%	38%	30%	20%

DAILY/PRE FLIGHT INSPECTION/POWER UP	
CIRCUIT BREAKERS	CLOSE ALL OPEN BREAKERS
MASTER, AVIONICS SWITCH	ON: - EPSI570 IS ENABLED, INSTRUMENTS ON, ALL INSTRUMENTS CLEAR OF OBSTRUCTION/DAMAGE
BATTERY RESET	RESET BATTERIES (FIRST FLIGHT OF THE DAY AND ON CONDITION, REFER TABLE 1 ON REVERSE)
MOTOR/MOTOR COVER	CHECK FOR COOLANT LEAKAGE, FASTENERS AND SCREWS TIGHTENED, MOTOR COVER UNDAMAGED
BATTERIES	CHECK FASTENERS, CONNECTORS AND COOLING INLET/OUTLET CLEAR OF OBSTRUCTIONS
SPINNER/PROPELLER	CHECK UNDAMAGED AND FASTENED
CONTROL SURFACES	INSPECT ALL EDGES, WING TIPS, FLAPERONS, ELEVATOR, RUDDER FOR AIRWORTHINESS
UNDERCARRIAGE	CHECK TYRE PRESSURES, TYRES, BRAKES AND UNDERCARRIAGE FOR DAMAGE/WEAR
PITOT STATIC TUBE	REMOVE COVER, CHECK FOR INSECT INGRESS AND GENERAL AIRWORTHINESS
MAIN WING SPARS AND CONNECTORS	- VISUAL INSPECTION, BOLTS TIGHT + IN POSITION
PITOT STATIC LINES/ NAV LIGHT CABLES	- CONNECTED PROPERLY AND IN POSITION
FLIGHT LOG	**ACKNOWLEDGE MAINTENANCE RELEASE AND START FLIGHT IN BREEZYLOG**
SET ALL INSTRUMENTS TO INITIAL SETTING	QNH, TRANSPONDER, COMM FREQUENCY, AH CALIBRATION
RADIO	CHECK, (REQUEST START/TAXI CLEARANCE)
ELEVATOR TRIM	- VERIFY TRAVEL, SET TO NUETRAL
FLAP HANDLE	LOCKING MECH FIRM, SMOOTH MOVEMENT
PARKING BRAKE	APPLIED
CONTROLS	FREE OF ALL/ANY OBSTRUCTIONS
DOORS SAFETY BELTS	CLOSED, SECURED/FASTENED
BPRS SAFETY PIN	REMOVE AND STOW
BATT EN, PWR EN SWITCH	ON - CHECK BATTERY %SOC, CHECK VALUES/ CHECK TEMP, NO WARNINGS, TEST BATT OVERHEAT WARNING
POWER AND BRAKES	CLEAR PROP, APPLY POWER, TEST BRAKES
COOLANT TEMP M/I	CHECK DURING TAXI FOR PROGRESSIVE CHANGE
TURN OVER FOR AIR SIDE PROCEDURES	TURN OVER FOR AIR SIDE PROCEDURES
SHUT DOWN PROCEDURE	
PWR EN, BATT EN SWITCH	OFF
FLIGHT LOG	**CLOSE FLIGHT IN BREEZYLOG, NOTE BATTERY SOC% IN THE LOG ENTRY**
AVIONICS, MASTER SWITCH	OFF
BPRS SAFETY PIN	RETURN TO SAFE (LOCKED) POSITION ON BPRS LEVER
PITOT STATIC TUBE	REFIT COVER
CIRCUIT BREAKERS	IF CHARGING, ISOLOATE PWR CTRL BREAKER, IF NOT CHARGING, ISOLATE BOTH PWR CTRL AND MAIN SYS