

	<b>Standard Modification</b> <b>Issue 5</b>	Mod No. SM 14337
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		Compiled : J Viner
		Approved : J Viner

**TITLE :** Lithium iron phosphate batteries

**APPLICABILITY :** **All aircraft types except factory-built microlights, factory-built gyroplanes and any aircraft with electrically dependent engines (e.g. those fitted with Rotax 914 engines, UL Power engines, or Leburg ignitions)**

**Mod Type :** **At build or retro-fit**

### 1. Introduction

Lithium iron phosphate (LiFePO<sub>4</sub>) batteries have a much greater energy density than traditional lead-acid batteries, offering potential weight savings for the same amount of stored energy. They tend to offer greater cranking ability for their capacity, and for this reason it may be tempting to choose a smaller capacity battery than the one the aircraft might usually be fitted with. This should be done with caution: should the alternator/charging system fail, the smaller capacity battery will provide a shorter electrical endurance for radios, flap motors, etc. You should plan to have an electrical system that allows for a safe flight and landing of at least 30 minutes after discovery of a charging fault – you might include 'load shedding' procedures that switch off non-essential services to extend the endurance.

This Standard Modification only relates to lithium iron phosphate chemistry, and not to lithium polymer, lithium cobalt or any other chemistry. It covers specific makes and models that have been investigated by the LAA. This Standard Modification will be updated as other makes and models are accepted by LAA. If you want to install a lithium battery on an aircraft that is not eligible to use this mod, or a battery model that is not listed below, a separate mod application must be made using form MOD2 in the usual way.

It also only covers a straight swap of an existing battery with a LiFePO<sub>4</sub> battery where no modification is required to the mounting arrangement except for packing/retaining the new battery. Alternative battery mounting positions/arrangements may only be used if these are accepted parts of the aircraft design, e.g. shown on the aircraft build drawings or in the build manual or listed on the TADS for the type, otherwise a separate mod application must be submitted for the new mounting arrangement.

### 2. Parts List

Batteries that have been assessed by the LAA have been grouped in two ways. Where the suppliers of batteries have been able to provide full test reports against the UN38.3 transportation of dangerous goods regulations, or equivalent justifications, these models are listed in Group 1. Where full test reports haven't been available, but sufficient information has been received by LAA to assess the basic design and characteristics of the battery, these models are listed in Group 2.

Group 1: The following battery makes and models have been accepted as being fit for installation either within enclosed occupied areas (e.g. in the cockpit or in baggage/fuselage compartments that are not separated from the cockpit) or outside enclosed occupied areas (e.g. forward of the firewall or in separate fuselage compartments):

Make/manufacturer	Models	Notes
EarthX	ETX12A, ETX18B, ETX18C, ETX18F, ETX24C, ETX24D, ETX36C, ETX36D, ETX36E, ETX680, ETX680C, ETX900	
Racing Batteries	RBA-300	
Shorai	LFX18A1-BS12, LFX18L1-BS12	
Varley	Li-5, Li-16	

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Group 2: The following battery makes and models have been accepted as being fit for installation only outside enclosed occupied areas (e.g. forward of the firewall or in separate fuselage compartments):

Make/manufacturer	Model	Notes
Aerovoltz	AVO2-12	
Antigravity	ATX12-20, ATX12-24	
Ballistic Performance Components	EVO2 12 cell	
Lithium Powerbloc	11AH-S	

For batteries in group 2, at least one of the following measures is required:

- The alternator supply must incorporate an automatic cut-off that isolates the alternator in the event that the alternator output exceeds the maximum permitted battery operating voltage.
- There must be an automatic warning of the alternator supply exceeding the maximum permitted battery operating voltage and a placard requiring the pilot to isolate the alternator supply should the warning occur.

For all installations:

- The battery must be installed in accordance with the manufacturer's instructions, including any system protection that exceeds the minimum requirements in this Standard Modification leaflet.
- A voltmeter must be fitted and visible to the pilot, showing the electrical system voltage and marked or programmed with the limits for the battery.
- There must be a means to independently isolate both the battery and the alternator from the rest of the system and from one another, operable from the pilot position. Note that with some installations, it may be detrimental to operate the electrical system on the alternator without a battery connected and a capacitor or equivalent may be required to damp the system: refer to your engine or alternator installation manual.
- Batteries must be securely and positively mounted: use of fabric straps is not generally satisfactory unless called up on the plans/drawings.
- Positive terminals and permanently live connections must be protected by a rubber boot, or equivalent, to prevent inadvertent short circuits.

### 3. Action

- If changes such as additional/alternative switching or automatic cut-out devices/warnings are required, you must contact [LAA Engineering](#) for advice prior to making the change.
- Isolate the electrical supply by disconnecting all negative (earth) terminals of all batteries.
- Remove the old battery.
- Install any required over-voltage protection or warning, ensuring that any cockpit indicators are clearly visible to the pilot in the normal seated position and labelled appropriately.
- Install any required battery/alternator isolation switches, ensuring that these are labelled as to function and sense of operation ('up' for 'on'), and are suitably rated.
- Ensure that any additional wiring is suitable (PVC insulation should be avoided) and of an appropriate current rating.
- Install new battery ensuring that it is secure, using appropriate padding materials as necessary (shaped wooden or dense foam blocks would be appropriate) and ensuring that any likely deformation of the battery mount/box in the event of a crash is unlikely to result in a short-circuit.
- Take care to check that the system is correctly wired prior to restoring power, to avoid damaging equipment or wiring.
- Ensure permanently live positive terminals and connections are suitable protected against short circuits.
- Update the aircraft's circuit diagram with any changes.

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- Update the Pilot's Operating Handbook, Pilot Notes or equivalent to describe any revised normal or emergency procedures with respect to the electrical system.

#### 4. Weight and Balance

	Weight (kg or lb)	CG (mm or inches)	Moment
Existing A/C			
Weight removed (old battery)			
Weight added (new battery)			
Weight added (new equipment)			
Post Mod A/C			


Amend the aircraft weight and balance schedule accordingly (see form [LAA/WB](#) and [TL 3.16](#)), ensuring that the extreme forward and aft loading cases fall within limits. Send a copy of the aircraft's revised weight and balance schedule to the LAA.

#### 5. Flight Test and Special Instructions

- 1) Flight testing is not required; however, full ground tests of the electrical system with and without the engine running should be done in conjunction with your inspector prior to flight. This should include a minimum of five consecutive engine starts, shutting down the engine within 10 seconds of starting each time (the appropriate starter motor cooling period between cranks must be observed).
- 2) To enable the revised design standard of the aircraft to be recorded, a [MOD1](#) - Standard Modification Incorporation form (available from the LAA web site) must be completed. The form must state the make and model of the battery fitted, any resulting changes to the electrical system, and the results of the ground testing in item 1) above.
- 3) Submit the MOD1 form to LAA Engineering, along with the revised weight and balance report and the revised circuit diagram (if changes have been made).

Before the modified aircraft may be flown:

- 4) An LAA inspector must check that the installation meets the requirements of this Standard Modification.
- 5) With the above found to be satisfactory, a logbook entry must be made, making reference to Standard Modification number 14337 issue 5 and the make and model of battery installed, changes to the electrical system at that time, and the inspector must sign a Permit Maintenance Release (PMR) in the airframe logbook.

Approved:	J Viner Chief Technical Officer	Signed:	
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**Note: please let us have feedback at [engineering@laa.uk.com](mailto:engineering@laa.uk.com) as to how you find your lithium battery to perform over time; whether that be good, bad, reliable, long life, etc.**