

Lithium battery storage, handling, and charging procedures

1. Commonly used items

This section of the document is designed to cover routine everyday domestic type battery usage (eg mobile phones, portable chargers, laptop batteries, e-cigarettes, and vaping items, etc.)

Users of lithium batteries must always ensure they familiarise themselves with the relevant manufacturers guidance and instructions and must follow them at all times.

[The video available here](#) summarises key safety considerations for domestic use of lithium batteries. Some highlights are as follows:

- The size of a lithium battery impacts the risk.
- In the event of a lithium battery fire jets of flame and toxic gases are emitted.
- Batteries charged in close proximity to combustible material (e.g. bedding and clothing) pose a significant fire risk.
- Batteries must never be charged in corridors or fire escape routes.
- Battery charging is safest when done with supervision (i.e. not whilst sleeping).
- Any space where batteries are charged must have a working smoke alarm and door to close in the event of fire.
- Batteries should never be stored or charged in hostile environments (e.g. in direct sunlight, extremely hot environments, damp environments, etc.)

Batteries: Should be stored in line with the manufacturer's instructions for each device. This includes storage in a cool dry environment, away from heat sources such as fires and heaters, and out of the reach of children.

Purchasing: Should only be purchased from reputable retailers. Items should meet British or European standards. You should register your product with the manufacturer to validate any warranties, batteries are usually included in warranties. Registering makes it easier for manufacturers to contact you in the event of a safety concern or if there is a common fault requiring a recall of the battery information.

Batteries should be included in local Portable Appliance Testing requirements along with regular visual inspections (see section 2.3. Receiving and Periodic Inspections).

Users and battery owners are responsible for bringing items for disposal to the attention of the School or Service Safety Adviser who will help to arrange for quarantine and disposal via Sustainability ([see battery disposal procedure here](#)).

Swollen or damaged batteries present an increased fire risk and therefore **must** be highlighted immediately to an appropriate member of Staff: if it is not possible to seek support from Sustainability with regards to external storage individuals must contact Security Services for advice.

Lithium batteries must NEVER be placed in internal battery bins (tubes) or external

battery bins.

Please note this document does **NOT** cover guidance for e-scooters, electric bikes and non-UoB vehicles. For E-bikes and E-scooters please refer to the Safety & Health Services [E-bike fire safety: Guidance for staff and students](#).

2. Specialist use (e.g. UAVs)

This section of the document is not designed to cover routine domestic type battery usage e.g. laptops, mobile phones, e-cigarettes, etc.

This section establishes requirements and best practices for lithium batteries associated with University of Bristol (UoB) operation of Unmanned Aerial Systems (UAS) and other such powered devices, i.e. remote-controlled cars. It also covers power tools such as rechargeable drills. This document supports the information contained within [the University of Bristol UAS Operations Manual](#).

There are currently at least 3 types of Lithium batteries:

- **Lithium-ion:** a lithium-ion or Li-ion battery is a type of rechargeable battery which uses the reversible reduction of lithium ions to store energy. It is the predominant battery type used in portable consumer electronics and electric vehicles. Due to the liquid electrolyte nature of these batteries, they are more vulnerable to risks associated with puncture damage.
- **Lithium-Polymer:** a lithium polymer battery, or more correctly lithium-ion polymer battery, is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid polymers form this electrolyte. Li-polymer batteries are more rigid and lightweight. These batteries also have a lower chance of leaking due to their gel-like characteristic.
- **LiFePO:** the lithium iron phosphate battery is a type of lithium-ion battery using lithium iron phosphate as the cathode material, and a graphitic carbon electrode with a metallic backing as the anode. These batteries have a longer life span, require no maintenance, are extremely safe, lightweight and have improved discharge and charge efficiency.

Users of lithium batteries must always ensure they familiarise themselves with the relevant manufacturers guidance and instructions and must follow them at all times.

Smart batteries or a smart battery pack refer to a rechargeable battery pack with a built-in battery management system (BMS), usually designed for use in a portable computer such as a laptop.

Externally, a smart battery can communicate with a smart battery charger. A smart battery can demand that the charging stop, request charging, or demand that the smart energy user stop using power from this battery.

2.1 Responsibilities

Schools and Services are responsible for the following:

- Management of any battery charging and storage facilities.
- Maintaining a log of all registered battery charging facility users.
- Accurate record keeping of battery charging and battery disposal.
- Registering and labelling of new batteries.
- Regular safety inspections of all laboratories including a review of battery usage,

storage and charging procedures.

- Disposal of damaged batteries or batteries of unknown origin or chemistry, through the hazardous waste procedures established by UoB Sustainability. [See battery disposal procedure here.](#)

Research and user groups are responsible for the following:

- Complying with the UoB Battery Storage, Handling and Charging Procedures.
- Complying with the UoB UAS Operations Manual (where applicable e.g. for UAS batteries).
- Identifying and labelling batteries.
- Instigating disposal of batteries where appropriate (either via Technical teams, School or Service Safety Advisers or Sustainability).
- Procuring batteries **ONLY** via reputable approved suppliers within ERP. Note batteries are expected to be accompanied by a Safety and or Technical Data Sheet.
- Notifying their school or service of any new battery acquisitions/purchases and providing the relevant safety/technical information so the batteries can be registered.
- Ensuring the batteries chosen for use are suitable for the intended application/use.
- Ensuring that batteries are not tampered with or altered in any way.

2.2 Battery storage and charging facility requirements

The following requirements must be applied for battery storage and charging facilities:

- Charging areas must be constructed of fire-proof material. Where this is not possible, advice must be sought from the School or Service Safety Adviser who will consult the UoB Fire Safety Adviser and local Facilities Manager for guidance.
- Specialist individual battery charging boxes or charging bags must always be used.
- Battery storage and charging areas must be controlled so that only trained and authorised personnel may access and charge batteries.
- Charging and storage areas must be free of combustible material.
- Fire-fighting equipment must be readily available. A suitable container of sand is sufficient with protective fire gloves or a suitable fire blanket, access to vermiculite if available as this is an effective oxygen barrier. It not recommended that you attempt to extinguish a fire, leave by the nearest exit, close the door behind you, and dial 999 for the fire service.
- Charging areas must be isolated from storage areas by either compartmentalisation or distribution.
- Heating, ventilation, and air conditioning must be isolated from adjacent working areas. Emergency ventilation to dump smoke and fumes, in conjunction with fire suppression is desirable.
- A clear exit path from storage and charging station must be established.
- A smoke detection system must be installed and operational.
- Access to a manually operated alarm system must be available (i.e. Red fire alarm activation point).
- Access to fire-retardant bags/ammunition container and battery disposal cabinet.
- Access to welding glove.

2.3 Procurement and periodic inspections

Batteries must be bought from reputable approved suppliers within ERP. Note batteries are expected to be accompanied by a Safety and or Technical Data Sheet. In most cases users can register their batteries with the supplier as part of obtaining warranty coverage and

ensuring they are notified of any future product recalls.

Upon receipt of batteries into any charging and storage facility, the following inspection must be carried out:

- Leakage
- Damaged or corroded wiring and connectors
- Damaged packaging
- Dented corners
- Discolouration/heat damage
- Unusual odours
- Swelling

If batteries show any signs of the damage listed above, the following actions must be carried out:

- Segregate damaged battery and store in a fire-retardant bag.
- Label bag with 'DAMAGED LIPO BATTERY', place in the supplied ammunition container, then place in the battery disposal cabinet.
- Keep battery charge and use log with the bag.
- Report battery to the local technical team and/or School or Service Safety Adviser who will help to arrange disposal via Sustainability.

2.4 Transporting of batteries

Prior to transportation, batteries must be inspected for damage in accordance with section 4 of this document.

Before any transportation occurs, individuals must contact their local technical team and/or School or Service Safety Adviser who will be able to liaise with the UoB Dangerous Goods Safety Adviser for advice. Requirements and regulations vary between modes of transportation and therefore no transport must be carried out without specialist advice.

- Output terminals, pins and connectors must be protected from contact with conductive surfaces to prevent short circuits or electric shocks.
- Battery packs are not to be transported installed in the ground equipment or UAVs.
- Batteries must be individually secured in flame retardant bags and transported in sealed metal containers to prevent damage and mitigate the risk of fire.
- Transport containers must always be appropriately marked with Hazard Class 9 signage, see pictogram below (Lithium batteries are Class 9, M4 items). Vehicles used to transport batteries may also be required to display signage dependent upon the quantity of batteries transported.



(ADR 2017)

- A Material Safety Data Sheet must accompany any batteries being transported.
- Specific transport regulations apply depending upon the mode of transportation and should be consulted prior to any transportation activities.

- Road and rail transport regulations within the UK are contained within Reference B, The Carriage of Dangerous Goods and Use of transportable Pressure Equipment Regulations 2009
- Reference C, Accord européen relatif au transport international des marchandises dangereuses par route (ADR) 2017 contains the main duties referred to in Reference B
- Reference D, the International Air Transport Association (IATA) Dangerous Goods Regulations (DGR) manual is the global reference for shipping dangerous goods by air and the only standard recognised by airlines.
- No deviation from the regulations is permitted and ignorance of the law is not accepted as an excuse for non-compliance.

2.5 Charging requirements

The following requirements are to be applied for battery charging:

- All batteries must be inspected in accordance with section 4 of this document prior to charging. Any damaged or suspect batteries must not be charged and disposed of as described in section 4.
- All batteries must be charged in accordance with the Original Equipment Manufacturer (OEM) instructions.
- Only OEM approved chargers are to be used.
- Chargers must be subjected to an annual Portable Appliance Test (electrical safety check)
- Chargers must be subjected to a visual before-use safety check.
- Chargers featuring safety features such as polarity mismatch, current limiting and cell balancing are preferred.
- Batteries are not to be left unattended during charging. It is permissible to monitor from a distance provided appropriate technical or administration systems are available to monitor charging batteries. Such measures must be documented and controlled in a Safe System of work (SSoW).
- Batteries must be charged in the designated charging area (see section 3).
- Batteries must be charged in designated charging 'boxes or bags' only.
- Batteries are to be charged individually. Do not charge in parallel.
- Prior to long-term storage of batteries their charge level should be managed in line with the OEM' recommended level.

2.6 Storage requirements

The following requirements are to be applied for battery storage:

- When not in use, batteries are not to be stored in UAVs, ground control systems or associated equipment.
- Batteries are only to be stored in the designated battery storage facility.
- Batteries are to be stored in a safe state i.e., end caps fitted where supplied and leads secured.
- Batteries are to be numbered/labelled and stored with the appropriate battery charge and use log.
- Batteries are to be stored in a temperature-controlled environment in-line with OEM instructions.
- Batteries are to be segregated by type and manufacturer. **Smart batteries (e.g. DJI batteries) in particular must be stored separately to other battery types due to the heat generated during the auto-discharge phase.**
- Damaged batteries must be segregated from serviceable batteries and disposed of as soon as possible (see section 4).
- Batteries must **not** be stacked or packed tightly together.

- Batteries must be stored in an approved flammable storage locker and/or bag in the designated storage facility (see section3)
- Batteries must not rest directly on metal surfaces – use ceramic tiles or place inside a fire-retardant bag within the flammable storage container.
- Storage containers are limited to an aggregate energy capacity of 2,000 Watt- hours.
- Storage containers must be appropriately marked with Hazard, Explosive and Flammable signage (see pictograms below).



Classification, Labelling and Packaging Regulation ((EC) 1272/2008)

2.7 Operational use

The requirements for operational use are covered in the UoB UAS Operations Manual.

Inventory control and history

All batteries shall be designated with a unique identifier and dated with the original purchase date. Where applicable (eg batteries associated for use with UAVs) a battery log shall be kept of the pack's history in accordance with UoB UAS Operations Manual which includes at a minimum:

- Battery owner
- Date of each cycle
- Start voltage.
- End voltage
- Charged voltage.
- Documentation of events i.e. crashes, charging anomalies.

No repairs or modifications are permitted be made to batteries or battery packs. Refer to OEM specifications for battery lifecycle recommendations.

Periodic checks (6 monthly) must be conducted by users to identify if any of their batteries have developed issues or safety concerns. Users must report any such batteries to their local Technical team and/or School or Service Safety Adviser.

2.8 Disposal

If the user is suspicious of the damaged battery and believes it is unstable use a welding glove to move the battery to one of the ammunition containers filled with Vermiculite, extra Vermiculite will be available to then cover the battery. Close the lid of the container, leave the area, and contact a member of the local Technical team and/or School or Service Safety Adviser as **soon as possible**.

Disposal of end-of-life, damaged batteries, or batteries of unknown origin or chemistry must be disposed of through the hazardous waste procedures established by UoB Sustainability. Sustainability will individually collect Li Batteries upon request. Staff arranging a battery collection should e-mail sustainability-estates@bristol.ac.uk.

Users and battery owners are responsible for bringing items for disposal to the attention of the local Technical team and/or School or Service Safety Adviser who will help to arrange for quarantine and disposal via Sustainability.

Items must be provided to an appropriate member of Technical Services Staff and never left unattended for a later pick-up.

Lithium batteries must NEVER be placed in internal battery bins (tubes) or external battery bins.

References

- [UoB UAS Operations Manual](#)
- [The Carriage of Dangerous Goods and Use of transportable Pressure Equipment Regulations 2009](#)
- [European Agreement concerning the International Carriage of Dangerous Goods by Road \(ADR\) 2019](#)
- IATA Dangerous Goods Regulations Manual (where available)

[Need to Know Guide RE2 Lithium-ion Battery Use and Storage](#)

The Faculty of Engineering have also produced:

- Specific student facing documentation.
- Risk assessments (which may be useful for reference).
- High level complex specialist use battery guidance.

To access please contact their safety mailbox: engf-safety@bristol.ac.uk

Induction checklist

Example induction checklist. This should be amended by schools and services before use. It is designed to record that battery users have read, understood, and will comply with both UoB guidance and local controls and arrangements.

	User has read the UoB Lithium Battery Storage, Handling and Charging Procedures guidance
	User will comply with the UoB Lithium Battery Storage, Handling and Charging Procedures guidance
	User has been provided with suitable instruction regarding local arrangements (to enable compliance with the UoB Lithium Battery Storage, Handling and Charging Procedures guidance)
	User will comply with local arrangements for battery storage, handling, and charging
	User will only purchase lithium batteries from approved suppliers
	User knows how to inspect lithium batteries as part of routine use and to look for signs of damage or failure
	User understands how to dispose of batteries safely (both at end of life and if damaged)

Full name:	
Signed:	
Supervisor or line Manager:	
Induction provided by:	
Staff Signature:	
Date/Time of Induction:	