AIRCRAFT BATTERY & HAZARDS

Online Training

Definition

Aircraft batteries are used for many functions (e.g., ground power, emergency power, improving DC bus stability, and fault clearing). Most small private aircraft use lead acid batteries. Most commercial and corporate aircraft use nickel-cadmium (NiCad) batteries. However, other lead acid types of batteries are becoming available, such as the valve-regulated lead-acid (VRLA) batteries. The battery best suited for a particular application depends on the relative importance of several characteristics, such as weight, cost, volume, service or shelf life, discharge rate, maintenance, and charging rate. Any change of battery type may be considered a major alteration.

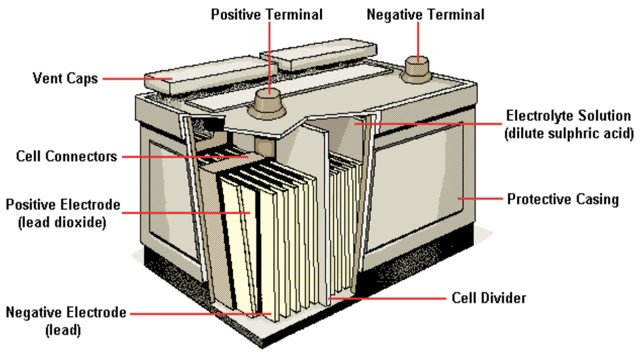
Operational Description Overview

With the exception of the most rudimentary of aircraft types, virtually all aeroplanes incorporate an electrical system. In the vast majority of cases, the primary electrical system incorporates one or more batteries. Batteries are used during pre-flight to power up the electrical system and to start the Auxiliary Power Unit and/or the engines. Once started, the APU or engine(s) drive generators which then power the electrical circuits and recharge the batteries. In the vent of failure or required isolation of all generators as part of a Quick Reference Handbook procedure where they are the source of all normal electrical power when operating, battery power is available as a substitute source for essential use. Some electrically powered fixed equipment such as the Emergency Locator Transmitter (ELT), the CVR, the FDR, will have their own dedicated batteries. Portable equipment routinely carried on board aircraft such as Torches, Megaphones and Automatic External Defibrillators (AED) are also battery powered. In both cases, since batteries are an energy source, their failure due to damage, defect, malfunction or misuse represents a potential risk of hazardous fumes, smoke or fire.

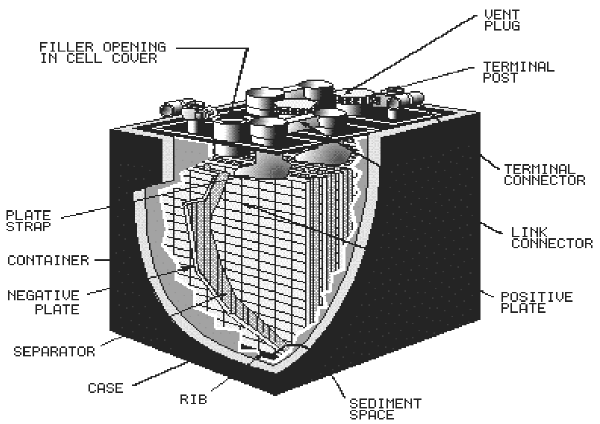
Aircraft Battery Types

Numerous types of batteries have been developed and variants of some of them are used in aviation applications. These include:

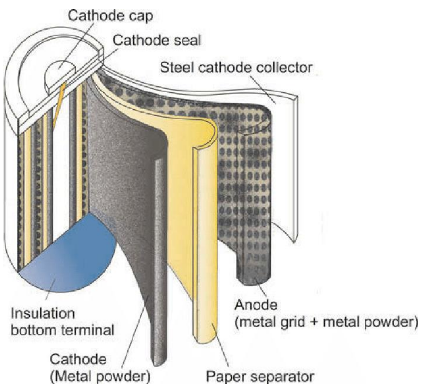
- **Lead Acid.** In some lead acid batteries, the electrolyte is suspended in a silica gel or impregnated into a fiberglass mat to make the battery non-spill able. While lead acid batteries have good energy storage and power provision properties, they are quite heavy and their energy density is relatively low. If overcharged, lead acid batteries can sometimes vent hydrogen gas which can result in an explosion or lead to a fire. Lead acid batteries are often used as the main battery(s) in an aircraft.



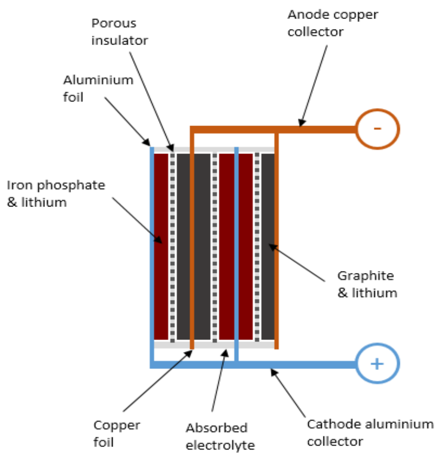
- **Nickel Cadmium (NiCad).** Nickel-cadmium batteries require relatively low maintenance, are liable and have a wide operating temperature range. NiCad batteries are subject to memory effect and may experience thermal runaway if overcharged. Many countries impose strict disposal regulations on NiCad batteries because of the heavy metals used in their manufacture. NiCad batteries are suitable for many aircraft applications inclusive of main aircraft batteries.



- **Nickel-Metal Hydride (Ni-MH).** Small capacity cells of this type of battery are sealed and are maintenance free. Their principal shortcoming is that they require precise charge level monitoring to control gaseous exchanges and to minimize heating while under charge. Ni-MH batteries have a high energy density and are ideal for high-capacity requirements. In aircraft, Ni-MH batteries are often used to power systems such as the emergency door and floor escape path lighting as well as portable entertainment devices and electronic flight bags.



- **Lithium-ion/Lithium-polymer.** Lithium-ion (Li-ion) and Lithium Polymer (Li-poly) batteries, also described as 'lithium secondary batteries' are rechargeable. Their cells have an anode of graphite and a cathode consisting of a combination material which is able to accept and release lithium ions repeatedly (for recharging) and quickly (for high current) such as lithium manganese oxide (Li-Mn2O4). A non-aqueous electrolyte, mainly comprised of a mixture of organic carbonates, is used. Charging or discharging a Li-ion battery involves an exchange of lithium ions between the electrodes. Typical cell output voltage between 3 and 4.2 volts depending primarily on the materials used to construct the cathode.



- **Lithium Metal.** Lithium metal batteries, also described as 'lithium primary batteries' are non-rechargeable. Their electrochemistry is most commonly based on Lithium-Manganese Dioxide (Li-MnO2) cells which have a graphite anode and a Lithium dioxide cathode.

General Aviation Requirements

Batteries used for aviation applications may be either the primary (single use) type or the secondary (rechargeable) type. Any battery intended for use as a power source for equipment installed or routinely carried on aircraft must not only be safe but ideally have a high energy density, lightweight, reliable, require minimal maintenance and be able to operate efficiently over a wide environmental envelope. Battery manufacturers continue to develop new technologies in an attempt to achieve these ideals but in many cases compromises in these non-safety objectives are necessary and in some cases, safety implications of new designs have been overlooked, particularly in respect of the rapidly increasing use of Lithium batteries.

Threats and Hazard

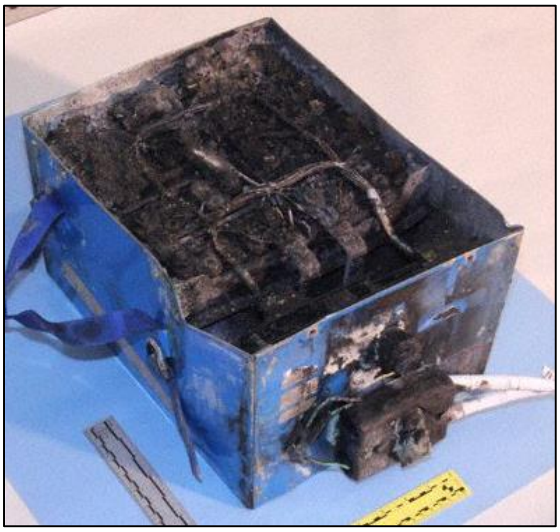
There are number of potential threats that can be associated with aircraft batteries, their distribution networks and their charging and monitoring systems. These threats include:

1. **Battery leakage.** Overfilling a wet cell battery can cause leakage. Likewise, damage to the battery case caused by mishandling, overcharging or freezing can result in leakage.
2. **Battery Internal Failure or Short Circuit.** Manufacturing defects or inappropriate handling can result in internal failures.
3. **Battery Overcharging.** Batteries can be overcharged due to faulty charging equipment or inappropriate maintenance practices.
4. **Excessive Battery Charging Rate.** Some battery types are vulnerable to high rates of charge.
5. **Excessive Battery Discharge Rate.** Some battery types are vulnerable to high rates of discharge.
6. **Battery Bus Fault or Fire.** A Battery Bus Bar is "hot" – it cannot be electrically isolated from the source battery without physically removing the battery.

Effects and Consequence

The effects which could result from the threats, as listed above, range from minor to potentially catastrophic depending upon the circumstances of the occurrence and the type of battery involved. As examples;

1. ***Leakage*** from a spillable lead acid battery could result in corosion, component damage or injury.
2. ***Overcharging*** of a lead acid battery could result in an explosion. Overcharging, excessive charge rate or excessive discharge rate in a lithium-ion battery could result in a thermal runaway leading to battery explosion or fire. This, in turn, could lead to injury or death and collateral damage up to the potential loss of the aircraft.
3. While technically not a battery fault, a problem on an associated ***"hot"*** battery bus bar could result in fumes, smoke or fire.



Other Hazards Associated with Batteries

1. ***Battery Acid*****:** The electrolyte in a battery is corosive and can burn skin or eyes, eat holes in clothing or even etch a concrete floor.
2. ***Flammable Gases*****:** Batteries emit hydrogen gas, which is flammable.it ignites easily and can cause a fire or explosion if allowed to accumulate in small area.
3. ***Electrical Shock*****:** Many of us are aware of this danger because we may have seen sparks fly when jumper cables are attached to a car battery.
4. ***Weight*****:** Batteries, like those used in forklifts, are heavy and require proper material handling equipment to lift them safely.

What to do in Emergency?

1. Have an emergency kit with corosion-resistant plastic tools and materials to absorb acid liquids. Don't forget to use PPE!
2. Baking soda is commonly used to neutralize electrolytes spills.
3. All workers should know how to operate fire extinguishers properly.
4. For contact with a worker's skin or eyes, rinse immediately for at least 10 minutes and then seek medical attention.

Personal Protective Equipment as Protection

1. **Goggles:** Eyes need protection from electrolyte splashes.
2. **Face Shield:** Skin needs acid protection as well.
3. **Rubber Gloves:** Provide both acid protection and electrical resistance to prevent shock.
4. **Rubber Apron:** Worker's clothes and bodies need the same protection.

Follow These Safety Procedure for Safe Battery Charging

1. Be sure the proper charger is being used for the particular kind of battery.
2. Check the vent caps are in place to prevent oveflow and spilling of electrolyte.
3. Shut off the charger when connecting or disconnecting the battery.
4. Before charging a battery while it is stil in a forklift, open the battery compartment and allow it to cool down following lift truck operation.
5. After charging, again allow the battery to cool down – it prolongs battery life.
6. Never overcharge a battery – that's another way to prolong battery life.

Conducive Location for Recharging Purposes

1. Adequate ventilation to disperse fumes given off during charging.
2. "***No Smoking***" area.
3. Elimination of open flames, sparks, welding and electric arcs.
4. Fire protection equipment, such as fire extinguishers, nearby.
5. Equipment and materials for absorbing spilled electrolyte.
6. Emergency shower and eyewash stations in case of an electrolyte splash.