# Basic Instruments 6 - Batteries

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The thing most likely to cause our instruments to fail is a battery problem. Batteries are messy things. For our instruments to be reliable as much as thinking in terms of good and bad batteries or instruments, we need to think about battery management.

## Batteries And Cells

Technically, a battery is a number of cells connected together but in modern English a cell is often described as a battery.

## Battery Indicators

Checking batteries by switching on the instrument and seeing if it works is not really adequate. Generally battery level indicators on instruments are a good thing. However they seldom give an accurate indication of the amount of useful energy left in the battery. They should give an idea of whether a battery is “fairly full” or “nearly empty” through.

## Temperature

In general, batteries work better when they are warm than when they are cold, and as we climb the air temperature drops about 2°C per thousand feet of climb. It is not inappropriate to put a flight instrument into a freezer at home to test how well it works when very cold. The battery indicator on our instrument may show it to be fairly full at room temparature but nearly empty after 20 minutes in our freezer. It is a particularly good idea to begin a flight with a fully charged battery in cold conditions.

## Battery Failure - A Classic Example

One day, not having flown for a while, our intrepid pilot wakes up to find a forecast of fine flying. In his nice warm home he checks his instrument works OK and goes out. He takes off, climbs a few thousand feet, his instrument stops working and he is soon on the ground. Having packed up his glider and found his way home he checks his instrument which is now working again.

The battery in his instrument was a bit low. Maybe it had self discharged a little after a bit of a layoff. In his house the temperature was a comfy 19C and on the hill it was about 10C. 2000 feet above take off it was only 6C and the battery output fell too low to power the instrument. Back at home it warmed up and worked again.

## Rechargeable Or Non-Rechargeable?

This may be determined by the type of instrument we want to use but may also be influenced by the type of flying we want to do.

Rechargeable batteries are more economic than non-rechargeable ones. This is partly because relatively short flights leave batteries in an unknown state of charge. In this state rechargeable batteries can be recharged whereas non-rechargeable batteries may have to be binned.

If our charging management is good, rechargeable batteries should enable us to start each flight with an adequate level of charge.

As long as our supply is good, each non-rechargeable battery we use is of new quality and full charge.

Non-rechargeable batteries will deteriorate with time and occasionally need to be checked for performance. Some will have a “use by”date.

## Capacity

The amount of charge a battery can hold is usually measured in milliamp hours (mAH). Note, however, that high capacity is not the only quality we are interested in. The highest capacity batteries available may not necessarily provide the most reliable operation of our instruments.

## Self Discharge

All batteries discharge themselves even if there is nothing connected to them. Traditionally, non-rechargeable cells lasted years before significantly self discharging whereas rechargeable cells would self discharge at about 20% per month. In general modern rechargeable batteries are much better, but self discharge worsens with age in all batteries.

## Purchasing Batteries

For any type of battery there are good and poor examples on the market. A lot of batteries are not what they appear to be at first sight so be aware of fake brands and extravagant claims of performance. I tested a number of after-market mobile phone batteries which supposedly had greater capacity than standard Samsung cells. Some had a slightly increased capacity but none had the capacity claimed in their advertisements. There are good batteries out there but they are not always easy to find.

## Alkaline Manganese Cells (Non-Rechargeable)

These are generally they have a good performance at low temperatures. If you use them it is a good idea to try and identify a reliable supply of good quality cells. Many supermarket "own brand" batteries are very good value obtainable from a reliable source.

Nickel Metal Hydride (NiMH) Cells (Rechargeable)

In some instruments these may be interchangeable with non-rechargeable alkaline manganese cells. Check your instrument manual! Their low temperature performance is not naturally as good as for alkaline manganese cells but usually OK if they are of good quality. For the sort of irregular use we give them in PG and HG instruments cells which have a low self discharge rate are a big advantage.

Personally, although I have no reasons to doubt other makes, I prefer Sanyo Eneloop cells because I have used them for a number of years with no problems. They are made to a published specification which is some assurance of quality. The later Eneloop Pro cells have an improved low temperature performance.

NiMH cells should be charged with the correct type of charger.

1) Overcharging is the most common cause of damage to these cells. Choose a charger which automatically detects when the cell is fully charged and switches off. The most common detection system is called "delta V".

2) Avoid fast chargers which put more stress on the cells than normal rate chargers. They may cause them to get very hot and will reduce their service life. A charger which takes about 3 or 4 hours or more for a fully discharged cell is usually OK.

Chargers are available which can automatically test the capacity of the cell and give an indication of some types of faults. If the capacity of a cell has fallen below about 80% of its specification it should be replaced.

Lithium Ion (Li-ion) Cells (Rechargeable)

Mobile phones have pushed the development of Li-ion cells and their charging and discharging systems. In general they have very low self discharge rates and with the correct charger can be recharged without worries of overcharging. As with NiMH cells the correct charger is essential.

Like mobile phones many modern instruments have micro-usb sockets with

the charging control inside them and can be charged from standard usb ports or chargers. On the whole this is good, but the micro-usb sockets can be rather fragile and sensitive to dirt so some care is needed.

As with NiMH cells the capacity of Li-ion cells will fall as they age. There are ways of testing the capacity but as far as I am aware no appropriate testing devices are commercially available cheaply.

Power Banks

Instruments with micro-usb charging have the advantage that their batteries can be boosted or re-charged from a portable "power bank". This can sometimes be set up so the power bank can boost the instrument in flight. However, particular care must be taken to protect vulnerable micro usb plugs and sockets from bending. Similar care must be taken with any arrangement of wiring and connectors on a flight deck.