

Borders Model Boat Club

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About Batteries

A battery consists of one or more cells which produce a voltage. This is a sort of electrical pressure, which ideally stays more or less constant until the battery is discharged. It supplies a current whose magnitude depends what it is connected to. Ideally, the voltage stays the same, regardless of how much current is supplied. The setup is analogous to a water pump which produces a pressure, with a flow rate depending on the size of the connecting pipes.

For real batteries, the voltage falls slightly as they are discharged, and when larger currents are drawn. There will also be a current limit above which mechanical damage can occur.

Selecting a Battery

The four things you need to know when selecting a battery are:

Voltage quoted in Volts, it is a measure of the electrical “pressure” the battery can produce.

Capacity quoted in Ampere-Hours (Ah) or Milli-Ampere-Hours (mAh). This is a nominal number to indicate how long a fully charged battery will last. So ideally a 1Ah battery would deliver a current of 1 Amp for 1 hour, or 0.5 Amp for two hours. In fact, battery efficiency comes into the consideration, so batteries tend to last longer than expected at low currents, and shorter at high currents.

To decide what capacity of battery you need, find out how much current is drawn by the motor in your boat, and multiply it by the amount of time (in hours) you expect to be operating it during a sailing session. (Then add 20%, or so, for luck.)

Type ie Non rechargeable, rechargeable, Lead Acid, Nickel Metal Hydride (NiMH), Lithium-Polymer (Li-Po), etc

Physical Size Dimensions, Weight, Terminal Type

Types of Battery

Dry Cells

These are not rechargeable. The Voltage drops considerably during their life. The voltage produced is nominally 1.5 Volts per cell, but noticeably falls off with use. They are available in AAAA, AAA, AA, C, D, N sizes (see below, “Cell Sizes”)



Nickel Metal Hydride (NiMH) and Nickel Cadmium (NiCad)

These are rechargeable, and produce a nominal 1.2 volts per cell.

The latest recommendation is that they should be stored and kept in a charged condition.

This means they should be given a regular top-up charge if they have not been used.

The cells are available in AAA, AA, C, D, Sub C and several other less common sizes.

NiMH cells have virtually replaced NiCad cells and have many advantages over them.



These types of cell are usually supplied with radio control sets. (If your gear is fitted with these, on no account should they be replaced with LiPo batteries, no matter what battery suppliers may say. The change could seriously damage your transmitter, and in any case would invalidate the warranty and type approval)

These types of battery have a much lower internal impedance than dry cells, and so can source much higher currents. When purchasing them, be aware that not all batteries of the same size have similar characteristics. They can be designed to supply large currents, in which case they will noticeably lose charge while stored, or to supply lower currents, and hold charge much longer.

Standard cells have a fairly high self discharge rate, maybe as high as 40% of their capacity in a month. If a stored pack discharges below, say, 1 volt per cell, there is a danger of permanent damage. These types of cell require regular charging, whether used or not. Recently “Low Self Discharge” cells (such as “Eneloop”) have been introduced, and are recommended for use in transmitters, or as receiver batteries. They hold charge over an extended period (9 months, or more), but have a lower current sourcing capacity.

These types of cell are available in “Tagged” or “Untagged” form. If you are making the cells up into a “Battery Pack”, use tagged cells. These have connector strips spot welded to them, to which wires can be soldered. Never attempt to solder wires to the cell casing as it will cause internal damage. Untagged cells are for use in battery containers.

Charging NiMH or NiCads

NiMH and NiCad batteries should be stored in a charged state and regularly recharged if not used.

A figure often quoted for the charging current is 10% of the capacity. (For example, for a 500mAH battery, the charging current would be 50 mA) This is called the 10 hour rate. It is reckoned that a battery being charged at the 10 hour rate will not suffer noticeable internal damage if it is overcharged.

Two types of charger are available:

Trickle charger:

These are usually supplied with rechargeable radio gear, and will typically take 14 hours or so to completely recharge the battery at the 10 hour rate.

Fast Chargers (Delta Slope Chargers):

These are “intelligent” and will recharge a battery in about half an hour. The way they work is to put a dose of charge into the battery, then measure its output voltage. All the time the battery is adsorbing charge, its voltage will be increasing. When it is fully charged, the voltage stops increasing, so the charger changes to trickle charging.

A fast charger may use either mains supply or 12 volt supply.

Lead/Acid or “Gel” Cells

These contain lead and lead oxide plates immersed in a bath of sulphuric acid, so should be treated carefully. They are perfectly safe if used correctly, but if damaged so that leakage occurs, the spillage should be rinsed down with copious quantities of water. Do not allow the liquid to come into contact with skin or clothing.



They produce a nominal 2.2 volts per cell. and are available packaged in nominal 2, 6, 12 Volt sizes and in a variety of capacities.

Heavy Duty batteries have more substantial plates to handle higher discharge currents.

They should be stored and kept in a charged condition. This means they should be given a regular top-up charge if they have not been used.

Lead Acid cells are similar to car batteries, and require regular level checks, topping up with distilled water if needed. They must be installed upright, so that acid is not spilled.

Gel cells are sealed. They may be installed in any configuration as spillage cannot occur. They are maintenance free (other than charging).

Charging Lead Acid Batteries

Lead Acid batteries should be stored in a charged state.

A figure often quoted for the charging current is 10% of the capacity. This is called the 10 hour rate. It is reckoned that a battery being charged at the 10 hour rate will not suffer noticeable internal damage if it is overcharged.

Two types of charger are available:

Trickle charger:

These are usually supplied with rechargeable radio gear, and will typically take 14 hours or so to completely recharge the battery at the 10 hour rate.

Fast Chargers (Automatic Chargers):

These are “intelligent” and will recharge a battery somewhat faster. The way they work is to put a dose of charge into the battery, then measure its output voltage. All the time the battery is adsorbing charge, its voltage will be increasing. When it is fully charged, the voltage stops increasing, so the charger changes to trickle charging.

LIPO batteries

Lithium Polymer batteries offer a much better power/weight ratio and so are much used in electrically powered model aircraft.



However they must be used with care

In use, the most significant difference to other types of battery is the danger which can occur by overcharging, over discharging, or using a damaged cell. (They can burst into flames.)

The individual cells are nominally 3.6 volts, with a maximum fully charged rating of 4.2 volts, and a maximum safe discharged rating of 3 volts. If the discharged limit is exceeded, the battery will almost certainly be permanently damaged. If you charge the battery above the 4.2 volt level you have the possibility of thermal runaway, and a resulting fire.

Note that special LiPo speed controllers which prevent over discharge should be used to prevent over discharge.

LiPo batteries should not be left in models when not being used. They must not be charged while installed in models. They should not be transported in a model; use a fireproof container for transport. They should not be allowed to get wet.

Cell Configuration

LiPo batteries are designated by a code such as “3s1p” or “4s2p”. The first two characters tell you how many cells the battery contains, and the second two how many packs are connected in parallel within the battery pack. For example, 3s means 3 cells with a nominal voltage of $3 \times 3.6 = 10.2$ volts, and 2p means two sets of cells in parallel within the battery pack.

The “C” rating indicates the ability to source current, for example, a 10C battery of 700 mAh capacity is rated at $10 \times 700 = 7000\text{mA}$ or (7 Amps).

Charging LiPo batteries

LiPo batteries are best charged outdoors, because of the fire risk.

It is essential to use a dedicated LiPo charger with a cell balancing facility. If it is not automatic, it is essential that the number of cells is entered correctly. Inspect cells before charging, and reject any that show any sign of ballooning.

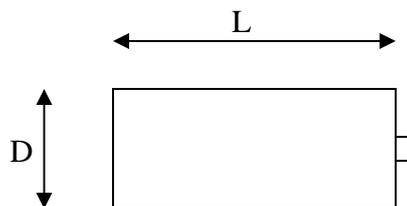
The maximum charging rate for a LiPo battery is 1C, for example a 700mAh battery should be charged at below 700mA. This should be taken only as a guide. If the battery becomes more than just warm while charging, then reduce the charging rate to extend the life of the battery pack.

Do not attempt to recharge damaged or potentially damaged cells. Always charge LiPo cells on a fireproof surface, and preferably inside a LiPo charging bag to contain any possible fire.

Always follow the Battery Manufacturers instructions, and the Charger Manufacturers instructions.

Any LiPo cells you wish to dispose of must first be made safe. Damaged cells should be immersed in salt water for at least 12 hours before disposal. Search the internet for the latest advice on disposal.

Standard Battery Cell Sizes



Dimensions in mm

Size	AAAA	AAA	AA	C	D	Sub C	N
L	42	44.5	50.5	50.0	61.5	42.9	29.4
D	8	10.5	14.5	26.2	34.2	23.0	12

The information given in this data sheet is given in good faith and is believed to be correct. However no liability can be accepted for any damage caused by following any advice given in the sheet.

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