Batteries and battery chargers

Application Sheet

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Batteries

When we talk about batteries in regards to diesel or gas generating sets then we talk about battery used for cranking the engine, a lead-acid battery. It is the same battery you have in your car but usually bigger.

There are many kinds of lead acid batteries. They differ by internal structure, type of electrolyte and by intended purpose of use, but their chemistry is always common - acid as an electrolyte, lead plates as electrodes.

Lead electrodes are mainly:

- thick or tubular = used as a storage of energy , intended for frequent cycling (discharge and charge) - electric vehicles, telecom applications, UPS, stationary batteries
- thin = deliver high current for short time - cranking batteries

Electrolyte is mostly:

- liquid (flooded batteries) = typically cranking batteries
- absorbed in glass mat (AGM batteries) = typically energy storage
- in form of gel (GEL batteries) = typically energy storage (frequent cycling)

Battery chargers

Lead-acid batteries should be charged in three stages:

BULK CHARGE = constant-current charge

In this stage is the battery charged at a constant current (voltage rises) which is usually up to 10-20% of its capacity. For 100Ah battery the current is up to 10-20A. As a higher current is used as the battery is charged faster but if too high current is used, the battery suffers from overheating and gas recombination inside is not fast enough, so sealed batteries (maintenance free batteries) may blow out and get damaged.

This phase takes up about half of the required charge time.

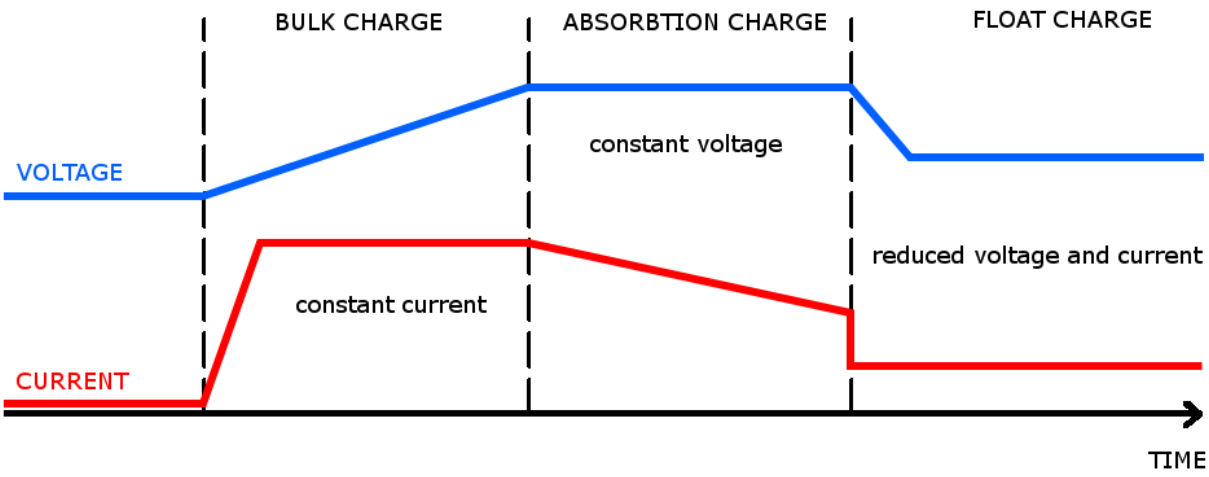
ABSORBTION CHARGE = topping charge

In this stage is the battery charged at a constant voltage (14.0-14.5V for a 12V battery) until the current drops to a predefined level, usually about 3% of the rated current.
No current drop will appear when the battery is damaged so the time limitation for this phase is necessary to avoid evaporating of the electrolyte.

FLOAT CHARGE = reduced current and voltage

This stage is used to compensate the capacity losses caused by self-discharge. It is also called “trickle charge”. Floating voltage is usually about 13.8V. The battery may be connected to this voltage all the time without any risk of overcharging.
All three charging stages are shown at the diagram below.

LEAD ACID BATTERY CHARGING STAGES



Some chargers also offer so called **RECOVERY STAGE** where short pulses are applied to the battery to rejuvenate slightly sulfated electrodes. This stage precedes the bulk charge.

.. a few more tips:

A battery should never be discharged below 12V without being charged within a few hours without a load connected to avoid sulfating of the negative electrode (which decreases battery performance). If the load is connected, the voltage should never drop below 10,5V.

The following table may help to determine the current condition of the battery, based on its terminal voltage (measured when battery is “rested” = few hours disconnected from load or charger).

State of charge	Voltage (12V battery)	Voltage (24V battery)
100%	12,70 V	25,40 V
90%	12,50 V	25,00 V
80%	12,42 V	24,84 V
70%	12,32 V	24,64 V
60%	12,20 V	24,40 V
50%	12,06 V	24,12 V
40%	11,90 V	23,80 V
30%	11,75 V	23,50 V
20%	11,58 V	23,16 V
10%	11,31 V	22,62 V
0%	10,50 V	21,00 V

Fully charged and rested battery has voltage about 12,7V.
After voltage drop below 12V, sulfation of the negative electrode starts quickly as the voltage is low.
The battery is fully discharged when the voltage is below 10,5V.