

HOW TO CHARGE A BATTERY

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There are a number of different methods of charging lead-acid batteries and their variants; namely, constant voltage; constant current; 2 step and 3 (or more) step charging. Each method has advantages and limitations and certain charging protocols are more appropriate in particular applications. Any charger must be completely automatic. It must stop charging when the batteries are fully charged. This dissertation will only compare the 3 (or more) -step charger with the constant voltage or float charger.

All lead acid batteries have a voltage-charge characteristic. That is, they are essentially discharged when the terminal voltage drops to 10.0 volts (for a 12-volt battery) and are fully charged when the terminal voltage rises to 13.25 volts. It is this voltage-charge characteristic that is used by the charger to determine the state of charge of the battery.

Three step chargers essentially charge the battery at constant current until the terminal voltage of the battery reaches a certain level. This voltage, approximately 14.5 to 14.7 volts, is somewhat higher than the battery voltage. This step is called the 'bulk charge step' and during this stage most of the charge is returned to the battery. At the completion of the Bulk Charge step the charger switches from a constant current to a constant voltage mode. This is the Absorption step with a voltage generally in the 13.7 to 13.8 volt ranges. Current continues to flow into the battery at a lower rate. As the terminal voltage of the battery rises, the current will decrease. When sufficiently low, 1 to 3 amperes, depending on the charger size and the battery capacity, the charger switches to a Float mode, the 3rd step. In the float mode the voltage is reduced to 13.25 volts and maintained at this level so as not to overcharge the battery.

Three step charging is an excellent way and sometimes called the 'preferred way' to recharge batteries. It results in the fastest recharge and is particularly useful for forklift truck batteries, electric vehicle batteries or whenever the battery is 'idle' during the recharge cycle.

A problem can arise with 3 step chargers when the battery being charged has a constant and sometimes variable parasitic load. The charger, in addition to the current required for charging, will supply this load current such as an accessory, or even locker/cab lights accidentally left switched on. In many instances the parasitic loads can prevent the charger from switching from the absorption mode to the float mode. When this occurs the terminal voltage of the battery is maintained at the 13.8 volts and overcharging and water boil-off results. If the parasitic load varies, the problem can result in inconsistent overcharging.

Kusssmaul Electronics Co. Inc. makes a wide variety of battery chargers. While 3 step chargers are manufactured for industrial applications, those chargers specifically designed for the fire service and emergency vehicles are

float chargers. These charge the battery at a constant voltage, usually 13.25 volts for a 12-volt system. When the battery is discharged and its terminal voltage low, the output is constant current. During this phase the charging is identical to that of a 3-step charger. As the terminal voltage of the battery rises and the float voltage of 13.25 volts is reached, the charger switches its operation from constant current to constant voltage. Voltage is then constant and the current decreases until the battery is fully charged. This results in a slightly longer time to recharge the battery but has the advantage of being more tolerant of parasitic loads.

Emergency vehicles have a wide variety of parasitic loads, some constant and some varying. These may consist of rechargeable hand lights, radios, computers, medical equipment and more. The charger for any particular application must have an output current sufficient to carry the parasitic loads and still recharge the battery.

Kussmaul float chargers are insensitive to parasitic loads. Even momentary load currents greater than the charger output do not have an effect. When overloaded, the charger switches to a constant current mode and the battery supplies the excess load. After the overload is removed, the battery voltage rises to the float voltage. The output of the charger is reduced to the load current plus the current required to recharge the battery. As the battery becomes charged, the charging current decreases until finally the charger output current is only the current required by the parasitic load.

In summary, for emergency vehicles the float charger, though slower in recharging, is preferred. Float charging ensures that the battery will not be overcharged and the parasitic loads, fixed or variable, will be maintained. For forklifts, electric vehicles, electric shavers, computers and wherever recharge time is critical, the 3-step charger is more suited. With more than 25+ years of experience building emergency vehicle chargers and tens of thousands of successful installations the Auto Charge float charger is a proven product.