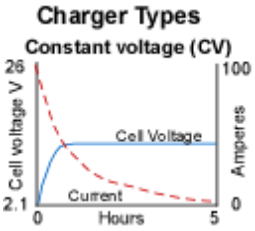
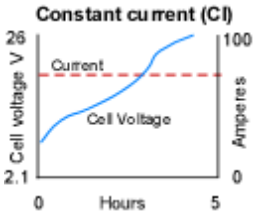
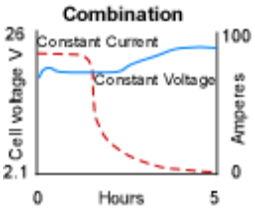
Battery Chargers



A constant voltage is applied and the current flows into the battery (high current when the battery is discharged, low current when the battery is nearly charged.)



A constant current is applied until the battery voltage reaches a set value.



The charge cycle starts with a high constant current until the voltage reaches a set value, then changes to a constant voltage control.

A series of very high current and voltage pulses are applied until the battery voltage reaches a set value.

Battery chargers replenish the energy used by an electric vehicle much like a gasoline pump refills a gas tank. One significant difference is that an electric vehicle operator can fully charge the vehicle overnight, at home, rather than refueling at a gasoline station. The battery charger is a device which converts the alternating current distributed by electric utilities to the direct current needed to recharge the battery. There are a number of different types of battery chargers based on the way they control the charging rate.

Charge Levels

Chargers are also classified by the level of power they can provide to the battery pack:

Level 1 - Common household type of circuit, rated to 120 volts/AC and rated to 15 amps. Level one chargers use the standard household 3-prong connection and they are usually considered portable equipment.

Level 2 - Permanently wired electric vehicle supply equipment used specially for electric vehicle charging and it is rated up to 240 volts/AC, up to 60 amps, and up to 14.4 kilowatts.

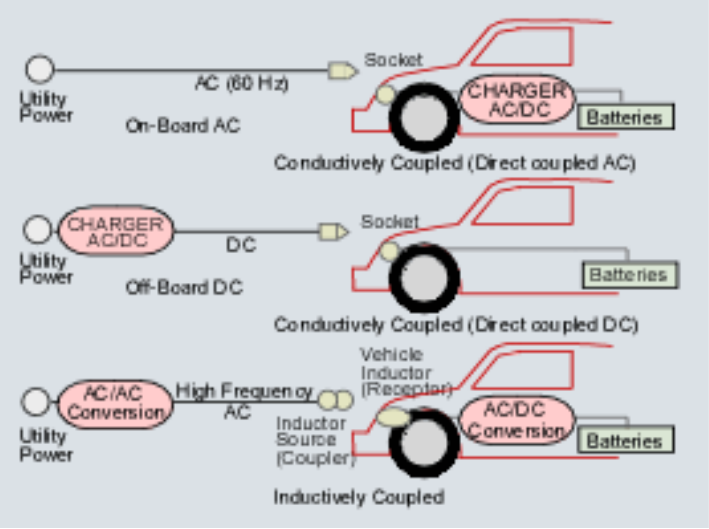
Level 3 - Permanently wired electric vehicle supply equipment used specially for electric vehicle charging and it is rated greater than 14.4 kilowatts. Fast chargers are rated as Level 3 chargers.

However, not all Level 3 chargers are considered as fast chargers. This depends on the size of the battery pack to be charged and how much time is required to charge the battery pack. A charger can be considered a fast charger if it is capable of charging an average electric vehicle battery pack in 30 minutes or less.

Coupling Alternatives

There are two basic coupling methods used to complete the connection between the utility power grid, the battery charger, and the vehicle connector. The first is the traditional plug (called conductive coupling). With this connection, the EV operator plugs his vehicle into the appropriate outlet (i.e. 110 or 220 volts) to begin charging. This type of coupling can be used with the charger in the car (onboard) or out of the car (offboard). The second type of coupling is called inductive coupling. This type of coupling uses a paddle which fits into a socket on the car. Rather than transferring the power by a direct wire connection, power is transferred by induction, which is a magnetic coupling between the windings of two separate coils, one in the paddle, the other mounted in the vehicle.

Charger Location



Electric vehicle battery chargers may be onboard (in the electric vehicle) or offboard (at a fixed location). As with many options, there are advantages and disadvantages with both types. If the battery charger is onboard, the batteries can be recharged anywhere there is an electric outlet. The drawback with onboard chargers is the limitation in their power output because of size and weight restrictions dictated by the vehicle design. Offboard charges are limited in their power output only by the ability of the batteries to accept the charge. While the EV owner can shorten the time it takes to recharge the batteries with a high-power, offboard charger, the flexibility to charge at different locations is restricted.

Summary

With existing electric vehicles and battery chargers, it usually takes from several hours to overnight to recharge an electric vehicle battery pack. The time required to recharge electric vehicle batteries depends on the total amount of energy that can be stored in the battery pack, and the voltage and current (i.e., power) available from the battery charger.

New developments in battery recharging decreases the time required to recharge electric vehicle batteries to as little as 10-15 minutes. Pulse battery chargers have demonstrated that the EV battery pack can be recharged in under 20 minutes without damaging it. When this technology is fully deployed, electric charging stations, similar to gas stations, will allow the electric vehicle operator to quickly recharge the battery pack. This new charger technology, coupled with advanced batteries with a range of 200 miles between recharging, will allow the electric vehicle operator the same freedom of the road currently enjoyed by today‘s operators of gasoline-powered vehicles.