

# Car Battery Explained

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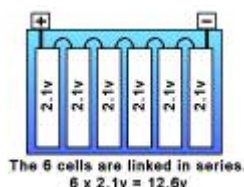


Figure 1

A car battery consists of 6 cells linked in series.

Charge %	Voltage
100%	12.6
75%	12.4
50%	12.2
25%	12.0

As the voltage drops so does the charge.

Figure 2

As the battery voltage drops, so does the charge.

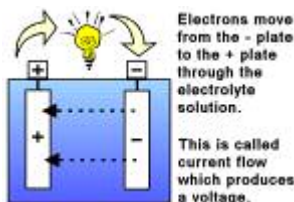


Figure 3

Electrons move from one plate to another creating current.



Figure 4

Sealed batteries usually quote the CCA.

## What is a car battery?

The car battery is a storage device, which stores energy. This supplies a current at a particular voltage (DC) to the conductive parts of the circuit. The standard car battery in today's vehicles are rated at 12 volts. Each battery has six cells which are 2.1 volts each. A car battery is considered fully charged at 12.6 volts. When a battery drops voltage, even by a small amount, it makes a **big** difference.


For instance, when a battery drops from 12.6 to 12.0 volts, its power drops from 100% to 25%! At 12.4 volts, a car battery is only 75% charged. At 12.2 volts, it's 50% charged. A car battery is considered charged at 12.4 volts or higher. It is considered discharged when it's at 12.39 volts or less. The current is heavily dependent on the type of battery and the resistance of the 'load'.

 DC stands for **Direct Current**. Its a term used in electronics to indicate a steady positive constant voltage (i.e. not alternating).

## How does a car battery work?

The voltage and current is produced by a chemical reaction. Inside the battery there are positive and negative lead plates (cells) that sit in a liquid called electrolyte solution (the electrolytic). Electrolyte solution is a mixture of water and sulphuric acid. When this solution interacts with the lead plates, there's a chemical reaction.

The electrons in the atoms jump from one atom to another. In fact they fall off one plate and get attracted to the next one. This electron movement is current flow, electrons move from negative to positive in a circuit. The amount of current can be thought as pressure, which has a name, the voltage. The pressure (voltage) pushes the current out of the battery's negative terminal through the 'load', which is the equipment drawing the power. The current returns through the positive terminal.

 Voltage and current are two different things, but you can't have one without the other. Current travels from - to + (electron flow) this is called 'conventional current'. However when working on electric circuits, its always best to work from + to -, i.e. the voltage always works from the highest potential (+) to ground ( - ).

## Chemical reaction:

To achieve the chemical reaction that creates voltage in an car battery, the electrolyte solution inside the battery must have the correct mix of water and sulphuric acid. As you know, when a car battery is at 12.6 volts, it's charged at 100%. At 12.4 volts, the electrolyte solution is 65% water and 35% sulphuric acid. This is the ideal combination! Sometimes the electrolyte "breaks down" and the acid moves onto the plates (a bit like dandruff). So, there's less acid in the water.

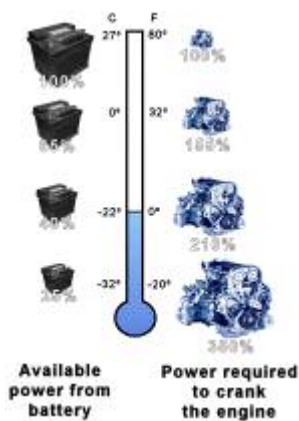


Figure 5  
Relationship between temperature and power required to crank engine.

Whenever the percentage of acid in the solution decreases, the charge drops. Most modern day car batteries are now sealed items (maintenance free) and you can't 'top up' the water any more. But these tend to last longer as the liquid can't evaporate as quickly as non-sealed lead acid batteries.

**i** Temperature matters! Heat kills car batteries and cold reduces the available capacity.

### Cranking power:

As the temperature drops, the cranking power required by the car increases. However, as more cranking power is used, the amount of battery power available decreases. Cold Cranking Amps (CCA) is critical for good cranking ability. It refers to the number of amps a battery can support for 30 seconds at 0 °F until the battery voltage drops to unusable levels. For example, a 12 volt battery with 600 CCAs means the battery will provide 600 amps for 30 seconds at 0 °F before the voltage falls to 7.20 volts (three cells). The higher the CCA, the more powerful the cranking ability.

If you live in a cold climate, you should consider the CCA rating when choosing a battery. If you live in a very hot climate, you don't need as much CCA.

**i** An Amp (or Ampere's) is the standard unit that current is measured at. If there is a 1 volt drop across a 1 ohm resistor, then 1 Amp is drawn. This formula is known as 'Ohm's Law'. However an Amp is a BIG unit, for smaller electronic devices (i.e. computers) it's usually measured as milliamps (mA) which is 100th of an Amp.

### Alternator Charging:

Usually when a car is jump started, it is driven long enough to fully recharge the battery. The length of time to fully recharge the battery depends on the amount of discharge, the amount of surplus current that is diverted to the battery, how long the engine is run, engine speed, and ambient temperature. That is, an alternator is sized by the car manufacturer to carry the maximum accessory load and to maintain a battery and NOT to recharge a dead battery.

For example, if 300 amps were consumed for two seconds to start a car from a fully charged battery, it will take an 80 amp charging system approximately nine seconds to replace the power used. If 25 amps are available to recharge the battery, it will take 12 minutes and 30 seconds at one amp. With a dead 120 minute RC battery, it would take approximately 45 minutes at 80 amps, 2.4 hours at 25 amps, or 60 hours at one amp to obtain a 90% State-of-Charge.

If you have added lights, audio amplifiers, two-way radios or other high powered accessories to your vehicle and engage in stop-and-go driving, the alternator might not produce enough current to keep your battery fully charged. You might need to increase the capacity of the charging system. Ideally the combined load of all the accessories should be less than 75-80% of the charging system's maximum output, so that at least 20-25% is available to recharge the battery.

### Why do batteries die over time?

In cold climates the active positive plate material sheds (or flakes off like dandruff) due to the expansion and contraction that occurs during the discharge and recharge cycles. Brown sediment, called sludge or "mud," builds up in the bottom of the case and can (electronically) short the cell out.

However in hot climates causes of failure are positive grid growth, positive grid metal corrosion in the electrolyte, negative grid shrinkage, buckling of plates, or even loss of water. Deep discharges, heat, vibration, over charging, under charging or non-use accelerate this "ageing" process.

Another major cause of battery failure is lead sulphating. Using tap water to refill batteries can produce calcium sulphate that also will coat the plates and fill the pores. Recharging a sulphate battery is like trying to wash your hands with gloves on. When the active material in the plates can no longer sustain a discharge current, the battery "dies". However this won't be case as most modern day batteries are now sealed (maintenance free).

In a hot climate, the harshest environment for a battery revealed that the average life of a good quality car battery was 37 months. If your car battery is more than three years old, then it is living on borrowed time. Abnormally slow cranking, especially on a cold day, is another good indication that your battery is going bad; it should be externally recharged and load tested (i.e. don't let your alternator charge it up - its not good enough). Dead batteries almost always occur at the most inopportune times, for example, after you have jump-started your car, in the airport after returning home from a long trip, during bad weather, late at night in a dark car parking, or when you are late for an appointment. You can easily spend the cost of a new battery or more for an emergency jump start, a tow, or a taxi.

## FAQ:



### **How does a car battery work?**

A battery stores energy in chemical form that can be released on demand as electricity. This electrical power is used by the cars ignition system for cranking the engine. The car's battery also may power the lights and other accessories. Should the alternator belt fail, the battery might also need to power the vehicle's entire electrical system for a short period of time.

### **What should I consider when buying a battery?**

SIZE: What are the dimensions of your original battery? Will it fit into my battery tray?

POWER: What are the Cold Cranking Amps (CCA) required to power your vehicle?

WARRANTY: Automotive batteries are backed by a warranty package. Chose what is right for your vehicle's needs.

### **When I am replacing my battery or cleaning the terminals, why is it important to remove the ground wire first?**

Before you start, always check the type of grounding system the vehicle has. If you remove the positive connector first in a negative ground system, you risk the chance of creating a spark. That could happen if the metal tool you're using to remove the positive terminal connector comes in contact with any piece of metal on the car. If you are working near the battery when this occurs, it might create an ignition source that could cause the battery to explode. It's extremely important to remove the ground source first.

### **What does CCA mean?**

Cold Cranking Amps is a rating used in battery industry to define a battery's ability to start an engine in cold temperatures. The rating is the number of amps a new, fully charged battery can deliver at 0 ° Fahrenheit for 30 seconds, while maintaining a voltage of at least 7.2 volts, for a 12 volt battery. The higher the CCA rating, the greater the starting power of the battery.

### **What are MCA or CA rates?**

This is a rating used to describe the discharge load in amperes which a new, fully charged battery at 32 degrees F (0C), can continuously deliver for 30 seconds and maintain a terminal voltage equal or greater than 1.2 volts per cell. It is sometimes referred to as Marine Cranking Amps or Cranking Amps.

### **What is Reserve Capacity?**

Reserve Capacity, (RC) is a battery industry rating, defining a battery's ability to power a vehicle with an inoperative alternator or fan belt. The rating is the number of minutes a battery at 80 F can be discharged at 25 amps and maintain a voltage of 10.5 volts for a 12 volt battery. The higher the reserve rating, the longer your vehicle can operate should your alternator or fan belt fail.

### **What can excessive heat do to a battery?**

Hot temperatures will deteriorate a battery's life quicker by evaporating the water from the electrolyte, and corroding and weakening the positive grids.

### **When my car won't start, how do I know for sure if my battery really needs to be replaced?**

Many other problems can keep a car from starting, so you need to do some troubleshooting. Stores that sell batteries will often do battery testing free of charge, so that is a good first step.

### **How do I safely jump start my battery?**

There is a particular sequence which should be followed. This reduces the risk of short circuiting the battery and damaging your alternator etc. The sequence is as follows.

- Switch off the dead car and ensure all other electric devices (i.e. head unit) are switched off. Position the dead car and the good car close to each other, but NOT touching each other (could cause a short circuit when jump starting).
- Connect one end of the red jump lead to the positive (+) terminal on the dead battery.
- Connect the other end of the red jump lead to the positive (+) terminal on the good battery.
- Connect one end of the black jump lead to the negative (-) terminal on the good battery.
- Connect the other end of the black jump lead to the chassis or large bolt/nut/bracket on the engine. Anywhere away from the negative terminal of the dead battery. Do NOT connect it to the negative terminal (-) of the dead battery (explained why latter).
- Ensure that none of the jump leads will come in contact with any rotating or moving parts in the engine bay. Switch on the good car and let it idle for a few minutes. This will allow the two batteries voltages to 'settle' and the alternator to do its job.
- Start the dead car, hopefully as the batteries are now connected in parallel, there is twice the amount of current available to turn the engine over. Once running disconnect the jump leads in the opposite order of connection.

### **Why can't the jump lead be connected to the negative (-) terminal of the dead battery?**

**A young Medway man received burns to his eyes, face and hands after his car battery exploded. The 18-year-old was driving along Watling Street in**

When a battery is charging a chemical reaction is present. This produces a waste product, which is flammable gas. When you connected the last jump lead up to the dead car, there should be a spark (generated from the good battery). You want this spark as far away as possible from the battery. Otherwise there is a possibility that the gas will ignite and the battery could burst! Which means your hands

could be covered in sulphuric acid!

See the news snippet on the left. Unfortunately any spark or naked flame can ignite the flammable gas. Which in this persons case has now lead him to hospital with burns to his face and hands.

### **What difference is there between a petrol car battery and a diesel one?**

Not much, only the storage capacity of diesel batteries are much bigger, hence they are physically a bit larger. Plus they have a higher CCM so they seem to last longer.

### **Can I fit a diesel battery to my petrol car?**

Yes you can, they will both technically work. The only thing is that your alternator will take longer to charge it up to full capacity purely because it has greater capacity than your standard petrol battery.



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