How to Test Your Car Battery

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Does your car battery contain enough power to start your engine during cold weather. The only way to know if your battery is fully charged or not is to measure the battery's state of charge with a voltmeter. You can use an analog or digital voltmeter, but a digital meter is easier to read and will give you a more accurate reading.

First, make sure the ignition key is **OFF,** and all the vehicle's lights are **OFF.**

To check your battery's state of charge, connect the RED or POSITIVE voltmeter test lead to your battery POSITIVE terminal. The positive terminal will be marked with a PLUS symbol (+), and the battery cable that is connected to the positive terminal is often color coded RED.

Connect the BLACK or NEGATIVE voltmeter test lead to your battery NEGATIVE terminal. The negative terminal will be marked with a minus symbol (-), and the battery cable that is connected to the negative terminal is often color coded BLACK.

Note the reading on your voltmeter and refer to the chart on the next page:

Battery Voltage and State of Charge (at 80 degrees F):
(NOTE: Subtract 0.024 volts for every 10 degree F drop in temperature)

12.66v 100%
12.45v 75%
12.24v 50%
12.06v 25%
11.89v 0%

The photo at the top of this article shows a battery voltage reading of 12.29 volts, which means the battery being tested is low with only about half a charge. The battery needs to be recharged.

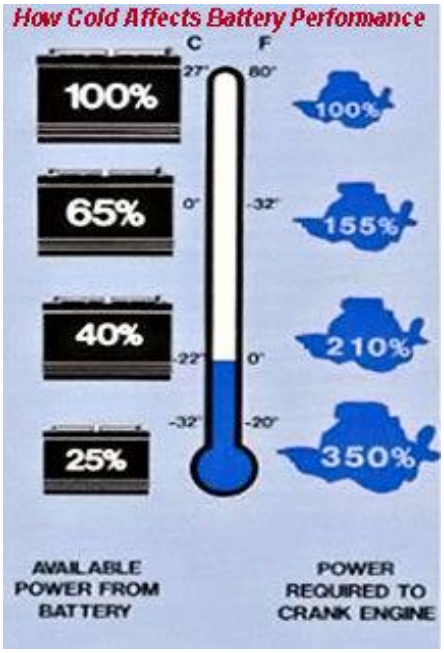
Is Your Battery Low?

If your battery voltage is less than 12.45 volts (75 percent charged), it is low and should be recharged. This can be done by connecting a portable battery charger to your battery, or by driving your car for 15 to 20 minutes at 40 mph or faster.

Automotive lead-acid batteries should be maintained at a 75 percent charge level or higher for best performance and life. If the battery is allowed to run down and is not brought back up to 75 percent or higher charge within a few days, the battery may be permanently damaged. Sulfation can prevent the cell plates inside the battery from accepting a full charge. Over time, this will lead to diminished battery performance and life.

Why You Need a Good Battery for Reliable Cold Weather Starting

A good battery is essential for reliable starting, especially during cold weather because cold weather increases the cranking load on the battery. Oil gets thicker at low temperatures so it takes more amps to crank a cold engine when you try to start it. At 0 degrees F, the number of cranking amps it takes to start a cold engine may increase as much as 2X. At minus 15 degrees below zero F. , it can take 3X or more amps to crank the engine depending on the viscosity of the oil in the crankcase. The thicker the oil, the harder is it to crank the engine.



At the same time, cold temperatures also sap the battery's ability to supply amps. At 0 degrees F, most batteries can only deliver about 65% of their normal cranking amps. At -20 degrees, battery power is cut in half!

Warning: *Do NOT attempt to recharge your battery if it has run down and the liquid inside is frozen. This may cause the battery to explode! Remove the battery and take it inside so it can thaw before recharging or testing it.*

How To Tell If Your Battery Is Good or Bad?

A GOOD battery is one that will accept and hold a charge, and is capable of producing close to its rated amperage output. A BAD battery is one that will NOT accept or hold a charge, or cannot produce adequate cranking amps. A GOOD battery can be recharged and returned to service but a BAD battery needs to be replaced.

Most car batteries only last about 4 to 5 years, and may only last 2 or 3 years in a late model car that is not driven frequently enough or far enough to keep the battery fully charged. Hot climates can also shorten battery life to 2 to 3 years.

If your battery is 4 or more years older and is not holding a charge (keeps running down), or it does not seem to crank your engine a normal speed, you probably need a new battery.

Chronic undercharging can cause premature battery failure regardless of the age of the battery. Car batteries are not designed for deep discharge (running all the way down), unlike a marine and RV battery which can handle being fully discharged. If a car battery is run down and left in a discharged state for very long (say a week or more), the plates

may become sulfated and not accept a full charge when the battery is recharged. Over time, this will diminish battery capacity and cause it to eventually fail.

Undercharging can be the result of a faulty charging system (low charging voltage), or driving short distances during cold weather with lights, heater, heated seats, defrosters and radio all on. If the charging system can't replace the amps that your electrical system is using, your battery will gradually run down until eventually it won't start your car.

Symptoms of a Low Battery:

Slow cranking when attempting to start or no cranking at all.

Unusual electrical problems such as the power windows not working normally, heated seats or electric defrosters not producing normal heat output, remote keyless entry not opening doors or trunk, etc.

A low or dead battery does not mean your battery has failed, or that it needs to be replaced. A good battery can run down for any number of reasons: somebody left the lights on, you haven't been driving your vehicle enough to keep the battery fully charged, your vehicle has been sitting for a long period of time without being started, there is a problem with the charging system or alternator, or an electrical problem is draining power from the battery when your car is off. For these reasons, you need to test BOTH the battery and charging system.

Battery Testing

The only way to know if your battery is GOOD or BAD is to test it. Many auto parts stores will test your battery for free. If your vehicle is drivable or you can get it going with a jump start, drive to a nearby auto parts store that offers free testing and have them test your battery and charging system. If you can't get your car started, remove the battery and get a friend to give you a ride to the auto parts store so you can have the battery tested. Many repair shops will also test your battery and charging system, but they usually charge a fee for this service (some will test your battery for free or offer to apply their diagnostic fee towards the cost of repair).

CAUTION: *Conventional wet cell lead-acid car batteries are filled with a mixture of water and sulfuric acid. Wear gloves and handle the battery with care so no liquid spills on your skin or clothing. Battery acid can cause severe burns. If a spill does occur, wash with plenty of water and neutralize the acid by applying baking soda. AGM batteries do not contain any liquid, cannot spill and are safer to handle.*

There are essentially two ways to test a battery. The "old fashioned way" is to use a Load Tester. For accurate results with a load tester, the battery must first be recharged

before it is tested. The tester applies a calibrated load to the battery (typically half the battery cold cranking amp [CCA] capacity or three times its amp/hour rating). While the load is applied, the tester monitors battery voltage. If the battery voltage drops below 9.6 volts during the test, the battery is BAD and needs to be replaced. If the voltage remains about 9.6 volts, the battery is GOOD and can be returned to service.

The other (and must faster) method for testing your battery is to use an electronic "conductance" tester like the one shown here. A conductance tester sends a alternating frequency signal through the battery to determine the condition of the cell plates inside the battery. As a battery ages, its internal conductance declines. Shorts, opens and other cell defects also reduce conductance, so measuring conductance gives an accurate indication of battery condition. The best feature of this type of test is that the battery does NOT have to be recharged prior to testing. Most conductance testers will give an accurate reading even if the battery is almost dead.

Some electronic battery testers can also analyze the battery's CCA capacity, which can be used to estimate the battery's remaining service life. Some testers can also measure the amps drawn by the starter while cranking the engine, and analyze charging system output under load once the engine is running. Some testers even provide a built-in voltmeter for checking connections.

Bad Battery Connections

If an electronic tester can calculate the battery/s CCA rating, it can also be used to diagnose bad ground connections. First the CCA capacity is tested at the battery terminal connections, then again using a ground point on the engine or elsewhere. More than a 25 percent difference in the CCA readings between the two tests indicates a bad ground connection.

Diagnostic Tip: You also can use a digital voltmeter to check for voltage drop across all circuit connections, too. Ideally, you should see less than 0.1 volt drop across a good connection. More than 0.4 volts drop indicates high resistance and a dirty or loose connection.

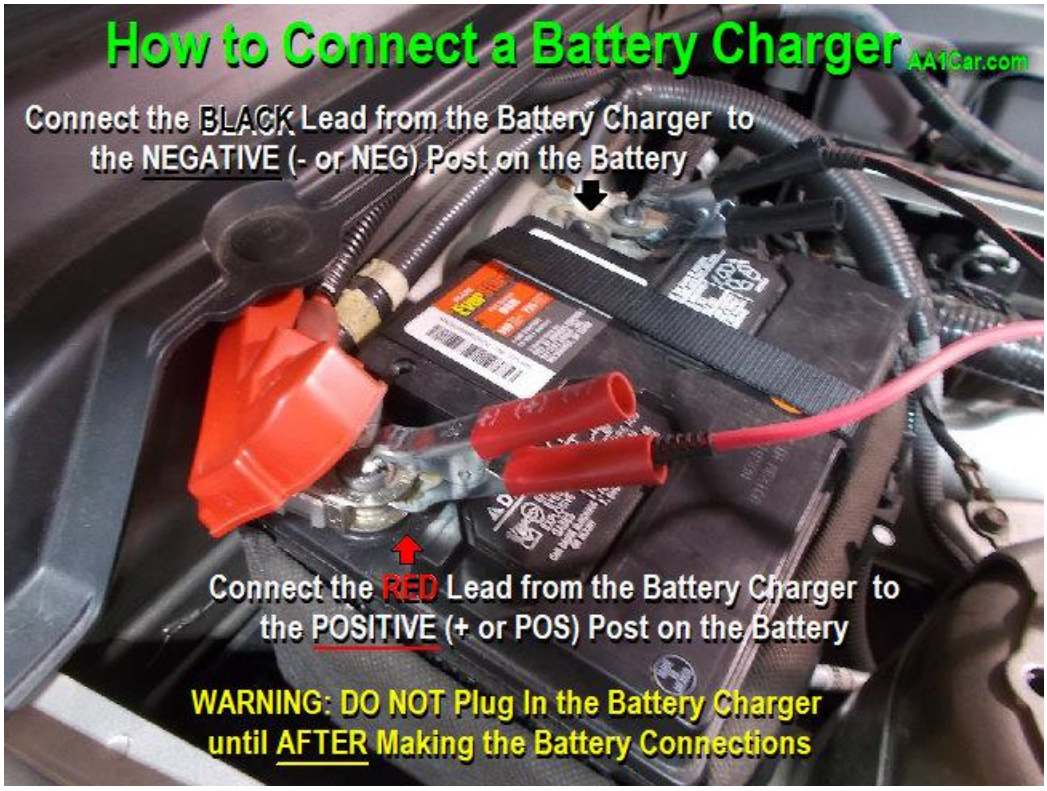
Diagnostic Tip: If the alternator on your car has failed, it might mean your battery is not building up normal resistance as it accepts a charge. This, in turn, makes the alternator keep charging the battery at a higher than normal rate. This can overload the charging system and lead to premature alternator failure. The battery charging output should jump about two volts after starting the engine (14.5 volts or higher), then gradually decrease after the engine has been running for several minutes (unless the battery is really low). The charging current should likewise taper off to less than 10 amps at idle (with no lights or accessories on) after five minutes of running. If a fully-charged battery is still pulling 20 or more amps after five minutes of idling, the battery is defective and needs to be replaced.

How to Recharge A Battery

Whether your battery tests GOOD or BAD, make sure the battery is fully recharged before returning it to service. The alternator is designed to maintain a battery charge, not to recharge a dead battery. Overloading the charging system with a dead battery can tax it to the point of where it may damage the alternator.

The time it takes to recharge a battery will depend on the battery's state of charge and the amp output of the battery charger you are using. The lower the battery voltage, the longer it will take to charge it. The higher the amp output of the charger, the faster it will charge the battery.

A low battery that reads around 12.2 volts (40 percent charged) may take 20 to 40 minutes to reach full charge (12.6 volts) with a 15 to 20 amp charger. A 10 amp charger will take twice as long to charge the battery (up to 80 to 90 minutes), , and a low output 2 amp trickle charger may take overnight.



Make sure you connect your Battery Charger correctly (Negative to Negative & Positive to Positive). Also DO NOT plug in the charger until AFTER you have made the battery connections. This will prevent any sparks that might cause a battery explosion!

The basic procedure for recharging a battery goes as follows:

1. Make sure the ignition is OFF and everything else on the vehicle is off (LIGHTS, RADIO, etc.).

2. Locate the battery (under the hood usually, but it may be inside the vehicle under the back seat, inside the trunk, or behind an inner fender cover).

3. Identify which battery post is POSITIVE (look for a + or POS by the post, and/or a red cover), and which is NEGATIVE (- or NEG).

4. Connect the BLACK NEGATIVE battery charger lead to the NEGATIVE post or clamp on the battery, then connect the RED POSITIVE charger lead to the POSITIVE post or clamp on the battery. With most chargers it makes no difference which lead you attach first. Just don't mix them up. Many chargers have built-in protections in case you mix up the leads and reverse the connections by accident. Even so, reversing connections can damage some chargers.

5. After the charger has been connected to the battery, it is safe to plug the charger into a 120 volt electrical outlet. DO NOT plug in the battery first because this may cause the

last lead connection to spark when the connection is made. Batteries vent hydrogen gas, so a spark could ignite the hydrogen causing the battery to explode!

6. Leave the charger on until the battery is fully charged. Smart chargers will automatically adjust the charging rate to fast charge the battery. A simple charger or one with an adjustable charging rate will apply a constant charge that should gradually taper down as the battery charges up.

When you think the battery has been charging long enough (or when the charging rate has dropped to a minimum), unplug or turn off the charger, wait a minute or so then recheck battery voltage with a voltmeter to see if it is at or near full charge. If it is still low, plug the charger back in or turn it back on and let it charge some more. Repeat as needed until the battery is fully charged.

If the battery is NOT coming up to full charger after spending a long time connected to a charger, it means the battery is BAD and needs to be replaced. Slow charging rather than fast charging can sometimes help bring an old battery back to life, but if it is slow to accept a charge it has likely reached the end of the road.

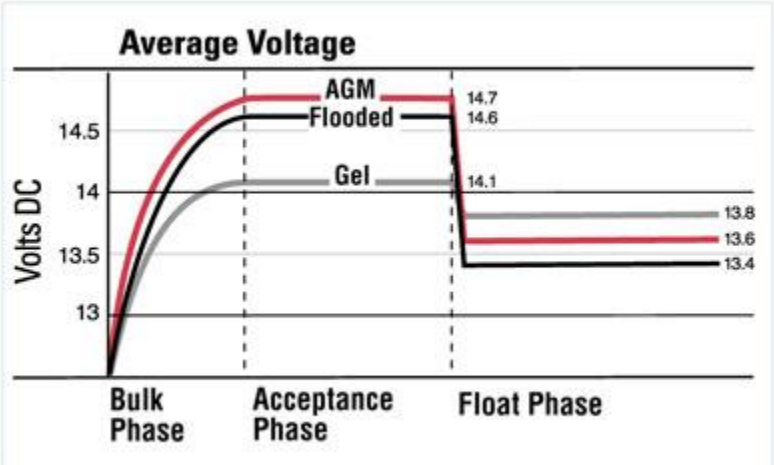
WARNING: DO NOT OVERCHARGE YOUR BATTERY! Leaving a battery on a constant rate charger past the point where it is fully charged may overheat and damage the cells and/or cause excessive boiling and evaporation of the electrolyte inside the battery.

WARNING: DO NOT ATTEMPT TO RECHARGE A FROZEN BATTERY! This may cause an explosion!

Different Types of Battery Chargers

You can use any type of battery charger to recharge your battery. Basic chargers run the gambit from simple and inexpensive "trickle" or maintenance chargers (2 amp output) to the general purpose 5 to 15 amp units that are commonly sold in many parts stores and retail outlets. "Smart" chargers include electronics that automatically adjust the charging rate and voltage for faster charging with less risk of over-charging or battery damage. Many Smart Chargers will automatically detect the battery voltage (6V or 12V) as well as the type of battery (wet cell, AGM or gel cell) and adjust its output and charging rate to match the battery type.

A smart charger typically has three charging stages. The first is the "bulk" stage that applies maximum voltage (14.4 to 14.7 volts for a 12V car battery) and maximum amperage to quickly bring the battery up to 80 percent of its capacity. This is followed by the "absorption" stage where the charging amperage is cut back while the output voltage remains constant. This stage takes longer because of increased resistance inside the battery as it comes up to full charge. Once the battery reaches about 90 to 95 percent of full charge, the charger goes into a "float" stage and maintains a steady charging voltage at minimal current. Some chargers will also automatically turn themselves off once full charge is achieved.



The charging voltage applied by a battery charger will vary with the type of battery. Many Smart Chargers will recognize the type of battery and adjust the charging rate accordingly.

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Charging System Checks

Connect a digital voltmeter to the positive (+) and negative (-) battery terminals, then start your engine. The voltage reading should jump up to 13.5 to 14.5 volts if the charging system is working.

If there is NO change in the voltage reading, your charging system is malfunctioning and is not charging the battery. You may need a new alternator. You can take your alternator to an auto parts store and have them bench test it on a special machine that measures the unit's current and voltage outputs. If the alternator tests BAD, it needs to be replaced. However, it it tests GOOD the problem is not a bad alternator but something else in the charging system such as a bad wiring connection or possibly a fault in the engine computer that regulates the charging voltage.

For more information, see Charging System Checks (alternator testing).

Replacement Car Batteries

A replacement battery must have the same post configuration as the original (top post or side post), and fit the battery tray. Your first order of business, therefore, is to figure out the correct "Group Size" for your vehicle.

Next, you have to figure out how many CCAs the vehicle needs for reliable cold weather starting. The replacement battery should have the same or higher CCA rating as the original battery. Bigger is usually better, especially in colder climates. But keep in mind that some batteries sacrifice "reserve capacity" to achieve higher CCA numbers.

Another number that is important is the months of prorated warranty coverage provided by the battery manufacturer. As a rule, the higher the warranty months on the battery, the higher the battery CCA rating and the better the battery. So consider upgrading from a basic 24-month replacement battery to a premium battery with a longer warranty. Most premium batteries offer a warranty of 36-months or longer. A warranty typically offers free replacement if the battery fails during the first two years, with a prorated credit if it fails during the remainder of the warranty.

There are also differences in battery technology and design. Though all automotive batteries today are still based on lead-acid chemistry, redesigned grids, thinner plates and new connectors allow more amps to be packaged into smaller cases. Some batteries use a "spiral wound" cell configuration instead of flat plates to achieve a higher packaging density, more power output and increased durability. AGM (Absorbent Glass Mat) batteries contain no liquid because the electrolyte is a paste between the cell plates. AGM batteries are spill-proof, more resistant to vibration damage, and typically outlast conventional wet-cell batteries by a year or two. AGM batteries are often used in late model vehicles with fuel-saving idle stop-start systems.

For a listing of worldwide battery manufacturers and brands, Click Here.

Some batteries also use a "gel" electrolyte or "recombination" technology that replaces the liquid acid. Some have "absorbed glass mat" (AGM) separators between the plates that hold the acid much like a paper towel soaks up water, making the battery "spill-proof" even if the case is punctured. AGM technology also makes batteries more resistant to vibration damage and helps extend battery service life.

Gel-type batteries don't use liquid electrolytes and can't spill. Even so, they wear out the same as liquid lead-acid batteries. Testing is essentially the same.

Car Battery Ratings

Before you can test or replace your car battery, you need to know something about battery ratings:

Cold Cranking Amps (CCA) This is the most common battery capacity rating. The rating is the number of amps the battery can deliver for 30 seconds at 0 degrees F. while maintaining post voltage of 7.2 Volts. For reliable cold weather starting, most vehicles require 400 to 600 cold cranking amps. Larger displacement engines require more cranking amps. Some batteries are rated up to 1000 CCA, but may sacrifice reserve capacity to achieve high short term outputs.

Cranking Amps (CA) This is a less meaningful rating. It is the same as CCA except it is measured at 32 degrees F. A battery's CA rating can be converted to CCA by dividing the number by 1.28 (Example: a CA rating of 500 amps becomes 390 CCA).

Reserve Capacity (RC) Think of this as the battery's staying power. This is the number of minutes the battery will deliver 25 amps and still maintain a post voltage of 10.5 Volts. The higher the reserve capacity rating, the longer the battery will last if the charging system fails. Most car batteries have a RC rating of 90 to 120. The higehr the rating, the better.

*** Amp Hour Rating (A/H)** This rating is not used much any more. It measures low current draw for 20 hours while maintaining a minimum post voltage of 10.5 Volts at 70 degrees F. (Example: a drain of 3 amps for 20 hours = 60 A/H rating).

Battery Installation

When installing a new battery, clean the posts and inspect the battery cables. Also, check the negative battery cable ground connection and the integrity of any engine ground straps. Loose or corroded connections can cause starting and charging problems. See BATTERY REPLACEMENT for more details on how to replace your car

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More Battery & Charging System Articles:

Battery Safety & Jump Starting (Read First!!!)
Battery Disconnect Problems (Read This BEFORE Disconnecting or Replacing Your Battery)
Diagnosing A Battery That Runs Down
Battery Replacement
Battery, Starting & Charging System Diagnosis
Starting & Charging System Troubleshooting
Charging System Checks (alternator testing)
Hybrid Safety Hazards
Voltage Drop Testing
Troubleshooting electrical problems
Power Centers: Relays & Fuses
Diagnosing An Engine that Won't Crank or Start