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CAR BATTERY FREQUENTLY ASKED QUESTIONS 2.2
November 1, 1998

A word of caution. Batteries contain a sulfuric acid electrolyte which is a highly corrosive poison, that will produce gasses when recharged and explode if ignited. This will hurt you--BAD! When working with batteries, you need to have plenty of ventilation, remove jewelry, wear protective clothing and eye wear (safety glasses), and exercise caution. Whenever possible, please follow the manufacturer's instructions for testing, jumping, installing and charging. This FAQ assumes a six cell, 12 volt negatively grounded system found in most cars, light trucks and vans.

The technical stuff is in [brackets].

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1. WHAT IS THE BOTTOM LINE?

A. At the first sign of slow starting, headlights dim at idle, gauges indicate discharge with engine running at high idle, or your battery seems to be loosing performance, test it! (See Section 4.)

B. Perform regular preventative maintenance, especially during HOT weather and before COLD weather, (See Section 3)

C. Remove surface charge before load testing and check the specific gravity in each cell and the terminal voltage, (See Section 4)

D. Keep the battery charged, but do NOT overcharge, (See Section 9)

E. Buy the freshest and largest Reserve Capacity (RC), battery that will physically fit with a Cold Cranking Amp (CCA) rating for your climate

that meets or exceeds the car's Original Equipment Manufacturer's (OEM) cranking amp requirement, and (See Section 7)

F. Retest after deep discharges or jump starts for latent damage. (See Section 4)

2. WHY BOTHER?

Because only the rich can afford cheap batteries.....

A good quality battery will cost between \$50 and \$100 U.S. and, if properly maintained, it should give you an average of five years of service. The primary purpose of a car battery is to START the engine. It also is used to filter or stabilize the power and provide extra power for the ignition, lighting and other accessories when their combined load EXCEEDS the capability of the charging system, i.e., when the engine is idling. In addition, a car battery provides power to the electrical system when the charging system is not operating.

Normally a battery "ages" as the active plate material sheds (or flakes off) due to the expansion and contraction that occurs during the discharge and recharge cycles. Deep discharges, heat and vibration accelerate this "aging" process. Eventually, the sediment builds up and the can short the cell out. Another major cause of faulty batteries is sulfation. When batteries are stored discharged or for over six months, lead sulfate makes the plates very hard and dense and the battery less capable or unable to be recharged. When the active material in the plates can no longer sustain a discharge current and the battery "dies". In a hot climate, the harshest environment for a battery, a recent JCI survey of junk batteries revealed that the AVERAGE life of a good quality car battery was 37 months. Slow cranking, especially on a cold day, is another good indication that your battery is going bad and it should be tested.

Deeply discharged batteries almost always occur at the most inopportune times, e.g., AFTER you have jump started your car, at the airport returning home from a long trip, during bad weather, late at night in a dark parking lot, 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 or tow.

Most of the "defective" batteries returned to the manufacturer are good. This suggests that most SELLERS of new batteries do not know how or take the time to properly test or recharge batteries.

3. HOW DO I PERFORM PREVENTATIVE MAINTENANCE?

Maintaining the correct electrolyte levels, tightening loose hold-down clamps and terminals, removing corrosion, and checking the alternator belt tension is normally the ONLY preventative maintenance required for a battery. The preventive maintenance frequency is dependent upon climate and battery type, but you should perform at least once before cold weather starts and once a month in hot weather.

If the electrolyte levels are low in non-sealed batteries, add DISTILLED water to the level indicated by the battery manufacturer or to 1/8" BELOW the bottom of the filler tube (vent wells). DO NOT OVERFILL, especially in hot climates!

4. HOW DO I TEST A BATTERY?

There are four simple steps to test a car battery--inspection, remove surface charge, state-of-charge test and load test. To test a battery (or to troubleshoot charging or electrical systems), you will need a digital voltmeter with .5% or better accuracy. A digital voltmeter can be purchased at an electronics store and will cost between \$20 and \$200 U.S. If you have a non-sealed battery, you can use a temperature compensating hydrometer which can be purchased at an auto parts store for approximately \$5 U.S.

A. INSPECTION

Visually inspect for obvious problems, e.g., loose alternator belt, low electrolyte, corroded cable or terminal clamps, loose hold-down clamps or cable terminals, or a damaged case.

B. REMOVE SURFACE CHARGE

If you have just recharged your battery or driven your car, eliminate any surface charge by one of the following methods; otherwise, go to the next step:

1. Allow the battery to sit for two to three hours,
2. Turn the headlights on high beam for five minutes and wait five minutes, or
3. With a battery load tester, apply a load at one half the battery's CCA rating for 15 seconds and wait five minutes.

C. STATE-OF-CHARGE TEST

Using the following table, determine the battery's state-of-charge:

Open Circuit Battery Voltage	Approximate State-of-charge	Average Cell Specific Gravity
12.65+	100%	1.265+
12.45	75%	1.225
12.24	50%	1.190
12.06	25%	1.155
11.89	0%	1.120

[If the temperature of the electrolyte is below 70 degrees F (21.1 degrees C), then add .012 volts (12 millivolts) per degree below 70 degrees F to the reading.]

For non-sealed batteries, check both the specific gravity in each cell with an external hydrometer AND the battery terminal voltage with a digital voltmeter without the engine running. For sealed batteries, measuring the battery's voltage without the engine running with an accurate digital voltmeter is the only way you can determine the state-of-charge. Some batteries have a built-in hydrometer which only measures the state-of-charge in ONE of its six cells. If the indicator is clear or light yellow, then the battery has a low electrolyte level and should be refilled before proceeding, or if sealed, the battery should be replaced.

If the state-of-charge is BELOW 75% using either the specific gravity or

voltage test or the built-in hydrometer indicates "bad" (usually dark), then the battery needs to be recharged BEFORE proceeding. Replace the battery, if one or more of the following conditions occur:

1. If there is a .050 or more difference in the specific gravity reading between the highest and lowest cell, you have a weak or dead cell(s),
2. If the battery will not recharge to a 75% or more state-of-charge level or if the built-in hydrometer still does not indicate "good" (usually green, which is 65% state-of-charge or better),
3. If digital voltmeter indicates 0 volts, you have an open cell, or
4. If the digital voltmeter indicates 10.45 to 10.65 volts, you have a shorted cell. [A shorted cell is caused by plates touching, sediment build-up or "treeing" between plates.

D. LOAD TEST

If the battery's state-of-charge is at 75% or higher or has a "good" built-in hydrometer indication, then load test the battery by one of the following methods:

1. Turn the headlights on high beam for five minutes,
2. Disable the ignition and turn the engine over for 15 seconds with the starter motor,
3. With a battery load tester, apply a load equal to one half of the CCA rating of the battery for 15 seconds, or
4. With a battery load tester, apply a load equal to one half the OEM cranking amp specification for 15 seconds.

DURING the load test, the voltage on a good battery will NOT drop below 9.7 volts with the electrolyte at 80 degrees F (26.7 degrees C). [If the electrolyte is above 80 degrees F, add .1 volt for every 10 degrees above 80 until you reach 100 degrees. If below 80 degrees F, subtract .1 volt for every 10 degrees until 40 degrees.] After the load is removed, wait five minutes and the battery should "bounce back" to the 50% state-of-charge level or above. If the battery drops below minimum test voltage, does not bounce back, or will not start the engine, then you should replace it. If the battery passes this test, you should recharge it to restore it to peak performance.

5. HOW DO I KNOW IF MY CHARGING SYSTEM IS OK?

A car's charging system is composed of an alternator (or DC generator), a voltage regulator, battery and indicator light or gauge. While the engine is running, it's purpose is to provide power for the car's electrical load, e.g., ignition, lighting, accessories, etc., and to recharge the car's battery.

When the charging system fails, usually an indicator light will come on or the gauge will not register "good". The most common charging system failure is a loose, worn or broken alternator belt, so check it first. If OK, then with a known good battery and the engine running at 2000 RPM or

more for two minutes, depending on the load and ambient temperature, the voltage should increase to between 13.0 and 15.1 volts. Most cars will measure between 14.0 and 14.5 volts on a warm day. [Most voltage regulators are temperature compensated to properly charge the battery under different environmental conditions. As the ambient temperature decreases, the charging voltage is increased to overcome the higher battery resistance. Conversely, as the ambient temperature increases, the charging voltage is reduced. Other factors affecting the charging voltage are the battery's condition, state-of-charge, electrical load and electrolyte level and purity.]

If terminal voltage is below 13.0 volts and the battery tests good after being externally recharged or if you are still having problems keeping it charged, then have the charging system's output voltage and current and car's parasitic (key off) load tested. A loose alternator belt or bad diode will significantly reduce the alternator's current output.

If output voltage is above 15.1 volts with the ambient temperature above freezing, the battery's electrolyte level is frequently low, or you smell "rotten eggs" around the battery, then you are probably overcharging the battery and the charging system should be tested.

6. HOW DO I JUMP START MY CAR?

In cold weather, a good quality booster cable with four to six gauge wire is necessary to provide enough current to the disabled car to start the engine. [The smaller the wire gauge number, i.e., the larger the wire diameter, the better.] Please check the owner's manual for BOTH vehicles BEFORE attempting to jump start and follow the manufacturer's procedure because some cars should not be running during a jump start. However, starting the disabled car with the good car running can prevent having two disabled. DO NOT allow the booster cable clamps touch each other or the POSITIVE clamp to touch the frame or engine block.

A. If BELOW freezing, determine that the electrolyte is NOT frozen in the dead battery. If frozen, allow to thaw BEFORE proceeding. A discharged battery, i.e., battery voltage or 12.0 volts or less or specific gravity of 1.140 or less, will freeze at approximately 8 degrees F (-15 degrees C).

B. Without the cars touching, turn off all unnecessary accessories and lights on BOTH cars, insure there is plenty of ventilation, and put on some protective eye ware.

C. Start the car with the good battery and let it run for at least two or three minutes at fast idle to recharge it's battery BEFORE proceeding.

D. Connect the POSITIVE booster cable clamp (usually RED) to the POSITIVE terminal on the dead battery. Connect the POSITIVE booster cable clamp on the other end of the booster cable to the POSITIVE terminal on the good battery.

E. Connect the NEGATIVE booster cable clamp (usually BLACK) to the NEGATIVE terminal on the good battery and the NEGATIVE booster cable clamp on the other end to a clean, unpainted area on the engine block or frame on the disabled car AWAY from the battery.

F. Let the good car to continue to run at high idle for five minutes OR MORE to allow the dead battery to receive some recharge and to warm it's electrolyte.

G. Start the disabled car and allow to run at high idle. If the car does not start the first time, recheck the connections, wait a few minutes and try again.

H. Disconnect the booster cables in the REVERSE order, starting with the NEGATIVE clamp on the block or frame of the disabled car to minimize the possibility of an explosion.

I. As soon as possible, fully recharge and test the dead battery for latent or permanent damage as a result of the deep discharge.

7. WHAT DO I LOOK FOR IN BUYING A NEW BATTERY?

Battery buying strategy for use in Canada, for example, is different than hot climates that you find in Texas. In the colder climates, higher CCA ratings are more important; whereas, in a hot climate, a higher RC ratings are more important once the CCA rating has satisfied the OEM cranking amp requirement.

A. Cold Cranking Amps (CCA)

The most important consideration is sizing the battery's CCA rating to MEET OR EXCEED, depending on the climate, the car's OEM cranking requirement. [CCAs are the discharge load measured in amps that a fully charged battery at 0 degrees F (-17.8 degrees C) can deliver for 30 seconds and while maintaining the voltage above 7.2 volts. Batteries are sometimes advertised by their Cranking Performance Amps (CA) or Marine Cranking Amps (MCA) measured at 32 degrees F (0 degrees C) or Hot Cranking Amps (HCA) measured at 80 degrees F (26.7 degrees C), which are not the same as CCA. Do not be misled by CA, MCA or HCA ratings. To convert CAs to CCAs, multiply the CAs by .8. To convert HCAs to CCAs, multiply HCAs by .69.]

In hot climates, buying batteries with double or triple the CCA ratings that exceed the OEM requirement is a WASTE of money. However, in colder climates the higher CCA rating the better, due to increased power required to crank a sluggish engine and the inefficiency of the cold battery. As batteries age, they are less capable of producing CCAs.

One of the major battery manufacturers, Exide, publishes the following table:

Available Power From Battery	Temperature degrees F	Power Required To Crank Engine
100%	80	100%
65%	32	155%
40%	0	210%
25%	-32	350%

[If more CCA capacity is required, two (or more) 12 volt batteries can be connected in parallel. Within a BCI group size, generally the battery with more CCA will have more plates because a larger surface area is required to produce the higher current.]

B. Reserve Capacity (RC)

The second most important consideration is the Reserve Capacity rating because of the effects of an increased parasitic (key off) load and in emergencies. [RC is the number of minutes a fully charged battery at 80 degrees F (26.7 degrees C) can be discharged at 25 amps until the voltage falls below 10.5 volts.] More RC is better in every case! In a hot climate, for example, if your car has a 360 OEM cranking amp requirement, then a 400 CCA rated battery with 120 minute RC with more electrolyte would be more desirable than one with 1000 CCA with 90 minutes of RC.

[If more RC is required, two six volt batteries can be connected in series or two (or more) 12 volt batteries can be connected in parallel. Within a BCI group size, generally the battery with larger RC will weigh more because it contains more lead.]

C. Type

The two most common types of CAR batteries are low maintenance (non-sealed) and maintenance free (non-sealed or sealed). [The low maintenance batteries have a lead-antimony/calcium (dual alloy or hybrid) plate formulation; whereas, the maintenance free batteries have a lead-calcium/calcium formulation.] The advantages of maintenance free batteries are less preventative maintenance, longer life, faster recharging, greater overcharge resistance, reduced terminal corrosion and longer shelf life, but are more prone to deep discharge (dead battery) failures due to increased shedding of active plate material. In hot climates, buying non-sealed batteries is recommended because a sealed battery will NOT allow you to add water when required or to test the specific gravity with an external hydrometer.

Some manufacturers introduced a third type of car battery, "dual", that combined a standard battery with switchable emergency backup cells. For about the same cost a better approach was to buy two batteries and isolate them.

In the future, you can expect to see more expensive valve regulated (gel cell and absorbent glass mat (AGM), e.g., Interstate's Extreme Performance, and Optima, batteries used. This is because car manufacturers want to extend their "bumper-to-bumper" warranty periods or as the batteries are relocated from under the hood to avoid temperature extremes. Please refer to the Deep Cycle Battery FAQ for more information on valve regulated batteries.

For off road applications in trucks, recreational vehicles (RVs), 4x4s, vans or sport utility vehicles, some manufacturer's distribute "high vibration" or RV battery versions designed to reduce the effects of moderate vibration. For excessive vibration applications, it is best to buy a commercial or AMG battery.

Car batteries are specially designed for high initial cranking amps (usually for five to 15 seconds) to start an engine; whereas, deep cycle (or marine) batteries are designed for prolonged discharges at lower amperage. A "dual marine" battery is a compromise between a car and deep cycle battery; however, a CAR battery will give you the best performance in a CAR. For RVs, a car battery is used to start the engine and a deep cycle battery is used to power the accessories. [The batteries are connected to a diode isolator and both are automatically recharged by the RV's charging system when engine is running. For additional information on multi-battery applications, call (800) 845-6269 or (503) 692-5360 and request a free copy of "Introduction to Batteries and Charging Systems" by Ralph Scheidler.]

D. Size

Manufacturers build their batteries to an internationally adopted Battery Council International (BCI) group number (24, 26, 70, 75, etc.) specification, [which is based on the physical case size, terminal placement and terminal polarity.] The OEM battery group number is a good starting place to determine the replacement group. Within a group, the CCA and RC ratings, warranty and battery type will vary in models of the same brand or from brand to brand. Batteries are generally sold by model, so the group numbers will vary for the same price. This means that for the SAME price you can potentially buy a physically larger battery with more RC than the battery you are replacing, e.g. a 34/78 group might replace a smaller 26/70 group and give you an additional 30 minutes of RC. If you do this, be sure that the replacement battery will fit, the cables will connect to the correct terminals, and that the terminals will NOT touch the hood when closed.

BCI and the battery manufacturers publish application guides that will contain the OEM cranking amperage requirements and group number replacement recommendations by make, model and year of car, and battery size, CCA and RC specifications. Manufacturers might not build or the store might not carry all the BCI group numbers. To reduce inventory costs, dual terminal "universal" batteries that will replace several group sizes are becoming more popular and fit 75% or more of cars on the road today.

Battery manufacturers or distributors will often "private label" their batteries for large chain stores. Below is a list in alphabetical order of the largest domestic battery manufacturers/distributors in North America and my understanding of some of their brand names, trademarks and private labels.

AC Delco/Delphi (800-223-3526 or www.acdelco.com)
 DieHard Gold (Sealed) (Contact local Sears store or www.sears.com)
 Double Eagle (Contact local Goodyear store)
 Dura Power
 Everstart (888-387-8278 or contact local Wal-Mart store)
 Freedom (Contact local Sears store or www.sears.com)
 Lastcell (Contact local Trac Auto store)
 Professional
 Tough One (Contact local Western Auto store or www.westernauto.com)
 Voyager

East Penn (610-682-6361 or www.eastpenn-deka.com)
 American
 Dominator
 Electro
 Deka
 Hi-Tech
 Inferno
 Pow-R-Surge
 Unitech

Exide (800-782-7848 or www.exideworld.com)
 Auto Express (Contact local Wards store)
 Centura (Contact local K-Mart store)
 Challenger
 DieHard (non-Gold) (Contact local Sears store or www.sears.com)
 Edge(Angler's, Arctic, Commander's, Cutting, Mariner's

and Universal)
 Heat Guard
 Legend (800-538-6272 or contact local NAPA store or
 www.napaonline.com)
 Max
 Mega Cell and Mega Cycle
 Motorvator (Contact local K-Mart store)
 Muscle Man
 NASCAR Select
 Nautilus and Nautilus Gold
 Power GLX (800-538-6272 or contact local NAPA store or
 www.napaonline.com)
 Power-Tron
 Prestolite (Contact local HiLo store)
 Pro Start (Contact local Pep Boys store or
 www.pepboys.com)
 Quick Start (Contact local Wards store)
 Sears (Contact local store)
 Sure Start (800-538-6272 or contact local NAPA store or
 www.napaonline.com)
 Titan
 Value-Life (Contact local Firestone store)

Douglas (800-368-4527 or [Douglas web site](#))
 Farmland (Contact local store)
 Guardian
 Omni

GNB (800-242-6750 or www.gnb.com)
 American
 Action Pack
 Champion (Contact local Sams store)
 Dominator
 Dunlop
 High Energy
 National
 Omega (800-925-6278 or contact local Wal-Mart store)
 Power Breed
 Scorcher
 Super Crank
 Switch
 Voyager (Contact local Sams store)

Johnson Controls Inc. (www.jci.com)
 Diehard Gold (Non-sealed) (Contact local Sears store or
 www.sears.com)
 Dura-Last (Contact local Auto Zone store or
 www.autozone.com)
 Energizer (Contact local Target or Wards store)
 Equalizer (Contact local Wards store)
 Eveready (800-331-9926 or contact local Costco or Wards
 store)
 Interstate Ameriton, Mega-tron or MT-Plus (800-272-6548
 or www.interstatebatteries.com)
 Motorcraft Tested Tough (800-392-3673 or contact local
 Ford dealer)
 Power Connection

E. Freshness

Determining the "freshness" of a battery is sometimes difficult. NEVER
 buy a battery that is MORE than SIX months old because it is starting to

sulfate. [Sulfation occurs when lead sulfate can not be converted back to charged material and is created when discharged batteries stand for a long time or from excessive water loss.] The date of manufacture is stamped on the case or printed on a sticker. It is usually a combination of alpha and numeric characters with letters for the months starting with "A" for January (generally skipping the letter "I") and digit for the year, e.g., "J6" for September, 1996. Like bread, fresher is definitely better.

F. Warranty

As with tire warranties, battery warranties are NOT necessarily indicative of the quality or cost over the life of the car. Most manufacturers will prorate warranties based on the LIST price of the bad and replacement battery, so if a battery failed half way or more through its warranty period, buying a NEW battery outright might cost you less than paying the difference under a prorated warranty. The exception to this is the free replacement warranty period. This represents the risk that the manufacturer is willing to assume. A longer free replacement warranty period is better and is usually an indication of the quality of the battery.

8. HOW DO I INSTALL A BATTERY?

A car battery weights between 30 and 60 pounds, so the first question is do I want to install it myself? The second question is what do I do with the old battery if not exchanged for the new one?

A. Thoroughly wash and clean the old battery, battery terminals and case or tray with water to minimize problems from acid or corrosion. Heavy corrosion can be neutralized with a mixture of baking soda and water. Also, mark the cables so you do not forget which one it is which when you reconnect.

B. Remove the NEGATIVE cable first because this will minimize the possibility of shorting the battery when you remove the other cable. Next remove the POSITIVE cable and then the hold-down bracket or clamp. If the hold down bracket is severely corroded, replace it. Dispose the old battery by exchanging it when you buy your new one or by taking it to a recycling center. Please remember that batteries contain large amounts of harmful lead and acid.

C. After removing the old battery, be sure that the battery tray and cable terminals or connectors are clean. Auto parts stores sell a cheap wire brush that will allow you to clean the inside of a terminal clamps and the terminals. If the terminals, cables or hold down brackets are severely corroded, replace them. Corroded terminals or cables will significantly reduce starting capability.

D. Thinly coat the terminal and terminal clamps with a high temperature grease or petroleum jelly (Vaseline) to prevent corrosion.

E. Place the replacement battery so that the NEGATIVE cable will connect to the NEGATIVE terminal. Reversing the polarity of the electrical system will severely damage or DESTROY it or cause the battery to explode.

F. After replacing the hold-down bracket, reconnect the cables in reverse order, i.e., attach the POSITIVE cable first and then the NEGATIVE cable last.

G. Before starting the engine, check the electrolyte levels and

state-of-charge. Refill or recharge as required.

[If you want to retain your car's computer memory, security codes or radio settings, a second battery can be temporarily connected to the electrical system in parallel before disconnecting the first one. A cigarette lighter plug can be used to easily connect a parallel battery.]

9. HOW DO I RECHARGE MY BATTERY?

In addition to the earlier cautions, some more words of caution:

A. NEVER, NEVER disconnect a battery cable from car with the engine running because the battery acts like a filter for the electrical system. Unfiltered [pulsating DC] electricity can damage expensive electrical components, e.g., computer, radio, charging system, etc.

B. Check the electrolyte level and be sure it is not frozen BEFORE recharging.

C. Do NOT add water if the electrolyte is covering the top of the plates because during the recharging process, it will warm up and expand. After recharging has been completed, RECHECK the level.

D. Reinstall the vent caps BEFORE recharging, recharge ONLY in well ventilated areas, and wear protective eye ware. NO smoking, sparks or open flames because while the battery is being recharged because they give off explosive gasses.

E. If your battery is sealed, do NOT recharge with current ABOVE 25 amps.

F. Follow the charger manufacturer's procedures for connecting and disconnecting cables and operation to minimize the possibility of an explosion, but generally you should turn the charger OFF before connecting or disconnecting cables to a battery.

G. If a battery becomes hot, or if violent gassing or spewing of electrolyte occurs, turn the charger off temporarily or reduce the charging rate.

H. Insure that in car charging with an external charger will not damage the car's electrical system with high voltages. If this is even a remote possibility, then disconnect the car's negative battery cable from the battery BEFORE connecting the charger.

Usually, when a car is jump started, it is run to recharge (or equalize) the battery. This might NOT fully charge it! 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, RPM, and temperature. That is, an alternator is sized by the car manufacturer to carry the maximum accessory load and maintain a battery-- NOT recharge a dead one.

[For example, if 300 amps are consumed for ten seconds to start a car from a fully charged battery, it will take the charging system approximately two and one half minutes to replace the power used if 25 amps are available to the battery, six minutes at ten amps, or an hour at one amp. Using the same example with a dead 120 minute RC battery, it would take approximately 86 times longer to recharge it or three and one half hours at 25 amps, 8.7 hours at 10 amps, or 86.4 hours at one amp].

If you have added lights, audio amplifiers, alarms, cellular telephones or other accessories, and "stop-and-go drive occurs frequently, 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 lights, fans, and accessories should be less than 75% of the charging system's maximum output, so that at least 25% is available to recharge the battery.]

A better method to recharge batteries is to use an external constant current charger which is set not to deliver more than 12% of the RC rating of the battery and monitor the state-of-charge. For fully discharged batteries, the following table, published by BCI, lists the recommended battery charging rates and times:

Reserve Capacity (RC) Rating	Slow Charge	Fast Charge
80 Minutes or less	15 Hours @ 3 amps	2.5 Hours @ 20 amps
80 to 125 Minutes	21 Hours @ 4 amps	3.75 Hours @ 20 amps
125 to 170 Minutes	22 Hours @ 5 amps	5 Hours @ 20 amps
170 to 250 Minutes	23 Hours @ 6 amps	7.5 Hours @ 20 amps
Above 250 Minutes	24 Hours @ 10 amps	6 Hours @ 40 amps

The BEST method is to SLOWLY recharge it using an external constant voltage (or tapered current charger) because the electrolyte has more time to penetrate the plates. A constant voltage "automatic" charger applies regulated voltage at approximately 14.4 volts. A 10 amp automatic charger will cost between \$30 and \$60 U.S. at an auto parts store. [To prevent damage to a fully discharged battery, the current should be less than 1% of the CCA rating during the first 30 minutes.] With a taper charger, a high current, up to 30 amps, can be applied to non-sealed batteries for a short period up to 30 minutes maximum and then is regulated downward until the charge state reaches 100%.

[An excellent automatic constant voltage battery charger is a 15 volt regulated power supply adjusted to 14.4 volts at 80 degrees F (26.7 degrees C). If 32 degrees F (0 degrees C), then increase the charging voltage to 15.3 volts, but do NOT recharge a frozen battery. When charging a maintenance free battery, add .2 volts.]

If left unattended, a cheap, unregulated trickle battery chargers can overcharge your battery because they can "boil off" the electrolyte. Do NOT use fast, high rate, or boost chargers on any battery that is sulfated or deeply discharged. This condition requires a constant current from one to two amps for 60 to 120 hours. The electrolyte should NEVER bubble violently while recharging because high currents only create heat and excess explosive gasses.

10. WHAT IS PARASITIC LOAD?

Parasitic (key off) is the cumulative load produced by electrical devices, e.g., clocks, computers, alarms, etc., that operate after the engine is stopped. Parasitic loads typically run 20 to 120 milliamps. To test the parasitic load an amp meter must be inserted in series with either the positive or negative battery terminal and it's cable without the engine running. If the parasitic load is prematurely discharging your battery, start removing fuses one-at-a-time until the offending electrical

component is identified. Leaving your headlights on will generally discharge a fully charged battery (with 90 minutes of Reserve Capacity) in two to six hours.

11. CAN I INCREASE THE LIFE OF MY BATTERY?

A. Keeping your battery and engine well maintained is the BEST way to extend the life of your battery.

For cold climates, keeping the battery fully charged and the engine warm will help increase the life of the battery. In the warmer climates and during the summer, the electrolyte levels need to be checked more frequently and DISTILLED water added, if required. This is due to the high underhood temperatures. In a study conducted by the Society of Automotive Engineers (SAE), the underhood temperature have increased 30% since 1985. Heat shields are becoming more popular and are being used by a number of car manufacturers to protect the batteries from the high underhood temperatures. Some battery manufacturers build "hot climate" versions by increasing the amount of electrolyte in the battery to provide more "cooling" or by special plate formulations. Batteries last approximately two thirds as long in hot climates as cold ones.

B. Add distilled water--NEVER add acid or tap water and DO NOT OVERFILL.

C. Turning off unnecessary accessories and lights BEFORE starting your car will decrease the load on the battery while cranking, especially when it is cold.

D. Leaving your lights or other accessories on and fully discharging the battery can ruin your car battery, especially if it is maintenance free. If this should this occur, you should test the battery AFTER it has been fully recharged to determine if there is any latent or permanent damage.

E. Reduce the parasitic (key-off) load to 120 milliamps or less.

F. Storing fully charged batteries in cool locations and periodically recharging when they reach 80% state-of-charge or less OR six month; whichever occurs first.

G. In cold climates, increasing the diameter (smaller wire gauge) of the battery cables will increase the power available to the starter motor.

12. WHAT ARE THE MOST COMMON CAUSES OF PREMATURE BATTERY FAILURES?

A. Loss of electrolyte (which account for over 50% of the failures) due to underhood heat or overcharging,

B. Deep discharges (leaving your lights on),

C. Misapplication or using an undersized battery,

D. Undercharging or loose alternator belt,

E. Excessive vibration (due to a loose holdown clamp),

F. Using tap water,

G. Corrosion, and

H. Freezing.

13. WHAT ARE SOME OF THE MYTHS ABOUT BATTERIES?

A. Storing a battery on a concrete floor will discharge them.

Modern lead acid battery cases are better sealed, so external leakage causing discharge is no longer a problem. [Temperature stratification within large batteries can accelerate the internal "leakage" or self discharge if the battery is sitting on an extremely cold floor in a warm room or installed in a submarine.]

B. Driving a car will fully recharge a battery.

There are a number of factors affecting alternator's ability to charge a battery. The greatest factors are how much current from the alternator is diverted to the battery to charge it, how long the current is available and temperature. Generally, running the engine at idle or short "stop-and go trips" during bad weather at night will not recharge the battery.

C. A battery will not explode.

While spark retarding vent caps help, recharging a battery produces hydrogen and oxygen gasses. Battery explosions can also occur when the electrolyte level is below the top of the plates. If a spark or flame occurs, an explosion will occur. Remember the "Hindenburg"!

D. A battery will not lose it's charge sitting in storage.

A battery has self discharge or internal electrochemical "leakage" that will cause it to become fully discharged and sulfated over time. Prior to storing a battery, it should be fully charged, placed in a cool location above freezing, and recharged when it reaches the 80% state-of-charge level or once every six months, whichever occurs first. If left in a vehicle, disconnect the negative cable.

E. Maintenance free batteries never requires electrolyte.

In hot climates, the electrolyte could be "boiled off" due to the high underhood temperatures . Electrolyte could also be lost due to excessive charging voltage or charging currents.

F. Test the alternator by disconnecting the battery with the engine running.

A battery as like a voltage stabilizer or filter to the pulsating DC produced by the alternator. Disconnecting a battery while the engine is running can destroy the electronic components, e.g., computers, radio, stereo, alarm system, etc., or the charging system. Just say NO! if anyone suggests this.

14. WHERE CAN I FIND MORE INFO ON BATTERIES?

Most of the battery manufacturers have a Battery FAQ posted on their web sites and addition to product information.

The FAQ , Literature, and Newsgroup Links are [here](#).

Comments are always welcomed by Bill Darden at william.darden@wcom.com or (214) 361-9567. Copies of the Car and [Deep Cycle Battery](#) FAQ's are available from Bill by e-mail or telephone.

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