Parasitic Current Draw, Batteries and Battery Tenders

This paper is written as a result of my personal research on three related topics. Opinions expressed here are my own – based on this research as well as personal experience. – *Steve Bisel, Forza Componenti, Scottsdale, Arizona*

Parasitic Current Draw

What is Parasitic Current Draw?

Parasitic current draw occurs on virtually every modern car. Why? Because constant current is required to maintain settings on your radio, the car's anti-theft system, internal memory of car computers, the RF module to lock/unlock your car and many other potential electrical devices.

What is Normal Parasitic Current Draw for Modern Cars?

Most modern cars have a parasitic current draw of between 10mA to 30mA. But it could be as high as 50mA. If it is much more than that, it is likely something is wrong. The more devices requiring constant power, the higher the draw. Luxury cars typically have higher draw than econo boxes.

How Long Can I Leave my Car Unattended before the Parasitic Current Draw Drains my Battery?

The amount of time you can leave your car off and not have the battery drain so low that you cannot start the car depends on two things:

1. What is the parasitic current draw of your car's various electronics on the battery?
2. What is the capacity and charge state of your battery?

Why Should I Care?

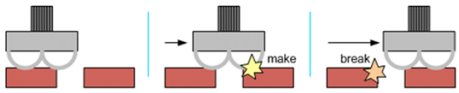
Determining the parasitic current draw on your car is probably more of curiosity factor – until you have a problem with battery life. For the more anal among us, you may want to determine a baseline for the parasitic current draw so you have something to compare to in the future. It is important if you need to diagnose future battery life problems. It is also good to know to help you with battery and battery tender selections. The procedure should take less than an hour.

How Can I Determine the Parasitic Current Draw on my Car?

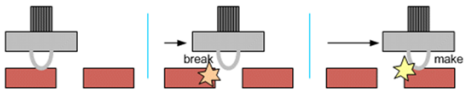
To understand normal parasitic current draw, you need an ammeter. Unfortunately, the methodology for getting the measurement is not as straightforward as you may think. I have seen advice telling the user to merely disconnect the negative side of the battery and then connect your ammeter in series with the negative terminal of the battery and the battery cable. Then, with the ignition off, measure the current that is being drawn. That method works fine on older cars, but on modern computer-controlled cars, the procedure is more involved. The problem is that you must measure the battery drain AFTER the computer goes to sleep (so to speak). After turning off the ignition, many manufacturers have at least one computer (maybe more) that can draw as much as 3 amps for up to 20 minutes. When the car's computer does finally go to sleep, the current draw will drop to a low steady state. After the computer(s) goes to sleep, anything that creates an open circuit (e.g., disconnecting the battery) may wake the computer for another 20 minutes.

The problem is to insert an ammeter into the circuit without breaking the circuit. For example, if you have your ammeter connected in series to measure current draw and you move the probe connection or switch the scale knob on the ammeter, this action may open the circuit which then will wake the computer. Some multi-meters do not have auto ranging capability and even the simple act of selecting a different scale on the meter will open the circuit as the internal switch on the meter is typically a break-before-make type switch – meaning that it breaks one connection before contacting the other one. The illustration below is a good depiction of the difference between a make-before-break switch and break-before-make switch.

Make-Before-Break



Break-Before-Make



That momentary break in the circuit is enough to wake up the computer. And, if the resulting current draw exceeds the range on your ammeter, it may blow the fuse on the meter.

The following procedure is written for use with a multi-meter that does not have auto ranging capability for measuring current. The procedure is valid for any meter, but especially so if your meter has a manual range selection knob. Here is how to connect the ammeter to take your measurements and be able to change meter ranges whilst maintaining circuit continuity and not waking the computer.

Auto Range Multimeter

Manual Range Multimeter

1. You need a digital ammeter with selectable range for the ammeter. To begin, select a range / probe setting to be able to read at least 10 amps.
2. Disconnect the negative battery cable.
3. Connect a jumper wire with a pair of clips from the battery terminal to the battery cable.
4. Using clips on your ammeter probes connect the ammeter in parallel across the battery terminal and the battery cable. See Figure 1, below. Connect the meter probes in manner that will allow you to disconnect the jumper wire without disconnecting the meter probes. While the jumper is connected, current will flow through the jumper wire as this is the path of least resistance.
5. After turning off the ignition and making the initial connections shown in Figure 1, wait 15 to 20 minutes for the computer to go to sleep.
6. Disconnect the jumper wire whilst maintaining the ammeter probes connection. Do not disconnect the ammeter at this point or you will have to start over. See Figure 2, below. This places the ammeter in series and current will now be flowing through the ammeter.
7. Measure the current draw. If your meter has auto ranging capability, you may very well be able to read in milliamps at this point and will not need to change the scale on your meter. If this is the case, you are done. Otherwise, proceed to the next step.
8. If the measurement is low enough to reduce the range of the ammeter, proceed to the next step.
9. Reconnect the jumper wire. Why? Because moving the scale knob on your ammeter will momentarily open the circuit which will cause the computer to wake up. By reconnecting the jumper wire, you will maintain the integrity of the circuit. Remember, anytime you want to switch meter ranges, you must first reconnect the jumper wire.
10. With the jumper wire connected, set the scale on the meter to the next lowest scale.
11. Disconnect the jumper wire and repeat step 7.
12. Repeat steps 7 to 11 until you have reached a point where you can accurately measure the current drain. You should be down to milliamp range by this time.

CAUTION: During this time, do not turn on the ignition or attempt to start the car. Do not open a car door. Verify that if you leave the engine lid open that there isn't an under hood light that comes on. Do not flick the button on your remote key fob. Do not connect any other electrical devices to the battery. All interior and exterior lights are turned off. Make sure your radio is turned off. The ignition key is in the off position and the key is removed. If you have a proximity sensor key fob, make sure the key fob is far enough away from the car that it is not being sensed as in close proximity. You get the idea.

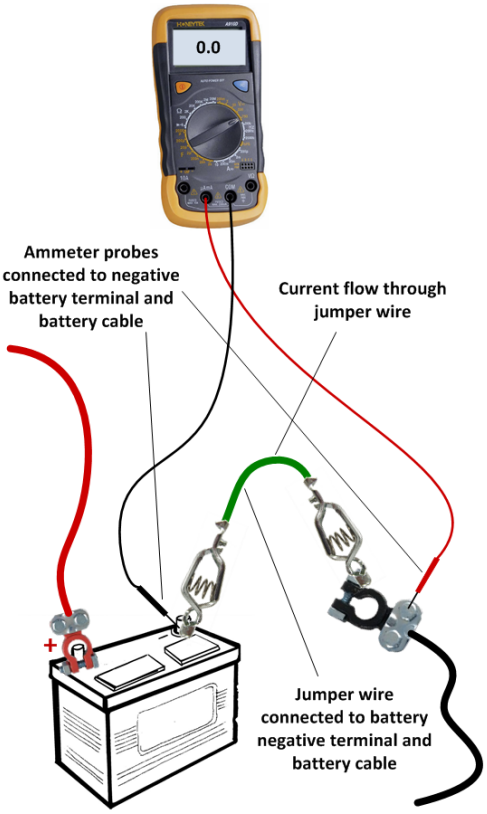


Figure 1
Ammeter Connected in Parallel

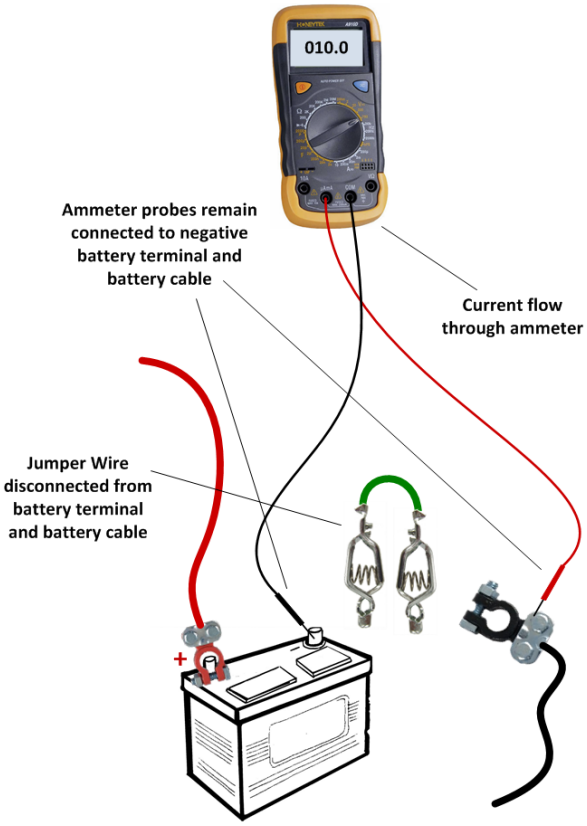


Figure 2
Ammeter Connected in Series

Side Note

Since you are taking the time and trouble to do this, I highly recommend you install a disconnect switch on the negative terminal of your battery. A simple and inexpensive solution is a knife-blade switch. Here is an example:

Knife Blade Switch installed on Battery Negative Terminal

A disconnect switch is an inexpensive and very safe way to conveniently isolate the battery from the car. With one of these, you can easily use an ammeter as discussed above without needing a jumper wire.

Once you have determined the parasitic current draw, you can then decide if it is too high. If the parasitic draw is less than 50mA, then you likely do not have a problem. This is normal. If the draw is higher, then you may want to take steps to determine the cause. Again, it might be higher than 50mA and be normal. But, certainly if it is approaching 100mA, then you definitely should diagnose where the draw is coming from and determine what you need to do to ameliorate the problem.

How long will it take for Parasitic Current Draw to Drain the Battery?

Over time, parasitic current draw will drain down your battery to the point where you cannot start the car. A simple calculation to determine how long a battery will last is to divide the battery capacity (in amp-hours) by the parasitic current draw (in amps). This will give you the total time your battery will last. For example, a 35 mA parasitic current draw will drain a 60 amp-hour battery in about 1700 hours (71 days). If the parasitic draw was only 15 mA, the battery will last 166 days. Now this is misleading because once the battery drains to about 40% of its capacity, it will not likely have enough capacity to start the car.

To use an example ... assume a battery with a reserve capacity of 130 minutes @ 25 amps. Multiplying the Reserve Capacity by 0.4167 will give the approximate Amp-Hour rating. So this battery has approximately 54 amp hours. And 40% of that is 22 amp hours – which leaves you with 33 amp-hours of useful capacity, so to speak. The formula to convert the battery reserve capacity to useful capacity in amp-hours is:

$$Reserve\ Capacity\ (min)\ x\ \frac{0.4167\ amp\text{–}hour}{min}\ x\ 0.60 = Useful\ Battery\ Capacity\ (amp\text{–}hr)$$

So, using this same battery, and assuming it is at 100% capacity, if your car's parasitic current draw is say ... 25mA, then you could leave your car unattended for about 55 days before draining the battery to the point of no start.

$$\frac{33\ amp - hours}{0.025\ amp}\ x\ \frac{1\ day}{24\ hours} = 55\ days$$

This formula does not take into account the self-discharge rate that a battery experiences when sitting unattended – approximately 3% monthly depending on ambient temperature.

The following table can be used to estimate the number of days your battery can sustain a constant parasitic current draw. This assumes the battery is at 100% capacity.

Battery Reserve Capacity (min)	Useful Battery Capacity (amp-hour)	Parasitic Current Draw (mA)									
		10 mA	20 mA	30 mA	40 mA	50 mA	60 mA	70 mA	80 mA	90 mA	100 mA
60 minutes	**15 amp-hr**	63	31	21	16	13	10	9	8	7	6
70 minutes	**18 amp-hr**	73	36	24	18	15	12	10	9	8	7
75 minutes	**19 amp-hr**	78	39	26	20	16	13	11	10	9	8
80 minutes	**20 amp-hr**	83	42	28	21	17	14	12	10	9	8
85 minutes	**21 amp-hr**	89	44	30	22	18	15	13	11	10	9
90 minutes	**23 amp-hr**	94	47	31	23	19	16	13	12	10	9
95 minutes	**24 amp-hr**	99	50	33	25	20	17	14	12	11	10
100 minutes	**25 amp-hr**	104	52	35	26	21	17	15	13	12	10
105 minutes	**26 amp-hr**	109	55	36	27	22	18	16	14	12	11
110 minutes	**28 amp-hr**	115	57	38	29	23	19	16	14	13	11
115 minutes	**29 amp-hr**	120	60	40	30	24	20	17	15	13	12
120 minutes	**30 amp-hr**	125	63	42	31	25	21	18	16	14	13
125 minutes	**31 amp-hr**	130	65	43	33	26	22	19	16	14	13
130 minutes	**33 amp-hr**	136	68	45	34	27	23	19	17	15	14
135 minutes	**34 amp-hr**	141	70	47	35	28	23	20	18	16	14

Battery Reserve Capacity (min)	Useful Battery Capacity (amp-hour)	Parasitic Current Draw (mA)									
		10 mA	20 mA	30 mA	40 mA	50 mA	60 mA	70 mA	80 mA	90 mA	100 mA
140 minutes	**35 amp-hr**	146	73	49	36	29	24	21	18	16	15
145 minutes	**36 amp-hr**	151	76	50	38	30	25	22	19	17	15
150 minutes	38 amp-hr	156	78	52	39	31	26	22	20	17	16
155 minutes	**39 amp-hr**	162	81	54	40	32	27	23	20	18	16
160 minutes	40 amp-hr	167	83	56	42	33	28	24	21	19	17

Table 1: Battery Life Expectancy (days) with Given Parasitic Current Draw

Choosing a Car Battery

Information on battery selection is frequently marketing hype with a scattering of facts. As with many consumer products, you will get as many different reviews as there are reviewers. Based on research in automotive magazines, industry papers and major consumer publications, I have put together some information on battery selection.

- Select a battery no more than six months old.
- Select the correct size and form factor (physical size and location of terminals). Avoid using a battery with physical size different than the original size specified for your car.
- Chose the type you prefer. Typically your choices are either an AGM or Lead-Acid battery. AGM (Absorbed Glass Mat) batteries stand up to repeated draining and recharging better than lead-acid type. They also have better life expectancy. AGM batteries are better suited for modern cars with the various electronic devices – but they cost significantly more. More detail below.
- Choose a battery that offers the longest service life. This is more difficult to ascertain and is affected by several factors. See below.

Determining the Age of a Battery at Time of Purchase

All batteries lose strength over time, even when idle. So choose one no more than six months old. Most have a shipping code on the case. Some use a letter for the month ("A" for January) and a number for the year ("5" for 2015); others use a numeric date.

Battery Size and Form Factor

Battery sizes are typically defined the BCI (Battery Council International) Group Number. This group number defines the battery case size and terminal location. It does not define the battery capacity. Although larger batteries typically have higher capacity, this is not always the case. When selecting a battery, choose the correct size, terminal location and terminal orientation that are correct for your vehicle. The following chart lists some common automotive batteries. A complete list of BCI group number batteries can be found on the Internet. Go a simple search for “BCI group number chart”.

BCI Group Number	Inches			Millimeters			Positive Terminal Orientation	Terminal Location
	L	W	H *	L	W	H *		
24	10.3	6.8	8.9	260	175	225	Left	Top
24F	10.3	6.8	8.9	260	175	225	Right	Top
25	9.1	6.9	8.9	230	175	225	Left	Top
34	10.3	6.8	7.9	260	175	200	Left	Top
34R	10.3	6.8	7.9	260	173	200	Right	Top

BCI Group Number	Inches			Millimeters			Positive Terminal Orientation	Terminal Location
	L	W	H *	L	W	H *		
34 - 78	10.3	6.8	7.9	260	175	200	Center	Top & Side
35	9.1	6.9	8.9	230	175	225	Right	Top
48	12.1	6.9	7.6	278	175	190	Right	Top
48/91	12.1	6.9	7.6	306	175	192	Right	Top
51	9.4	5.1	8.8	238	129	223	Left	Top
51R	9.4	5.1	8.8	238	129	223	Right	Top
65	12.1	7.5	7.6	306	190	192	Left	Top
75	9.1	7.1	7.3	230	179	186	Left	Side
78	10.3	7.1	7.3	260	179	186	Left	Side

* *Height of battery is to the top of the terminals (if top terminal battery) or top of case (if side terminal battery).*

Battery Selection Criteria

- Virtually all batteries are now maintenance-free. There is no need to check or top off electrolyte levels.
- The most important criterion for consideration is battery service life – unfortunately, this criterion is difficult to ascertain and one must rely on unbiased testing versus hearsay and manufacturer's marketing statements.
- Battery size and terminal location
- Manufacturers' ratings, in order of importance are:
  - Reserve Capacity (RC)
  - Amp-hour rating (AH)
  - Cold Cranking Amps (CCA)
- Battery type. AGM vs Lead-Acid vs Gel Cell. There are cost differences and usage pros and cons.
- Driving characteristics. Frequent short trips or less frequent long trips.
- Deep discharge occurrences.
- Battery location, e.g., trunk or inside vehicle versus engine bay.
- Original equipment on your car.

How to Determine a Battery's Capacity in Amp-Hours

Most manufacturers do not list amp-hours as part of the specifications. Typically, batteries are rated in Cold Cranking Amps and reserve capacity.

- **Reserve Capacity** – how long the battery can maintain a constant 25 amp discharge until the voltage drops to 10.5 volts. This is the most important specification of a car battery. The reserve capacity is generally given in minutes @ 25A. This criterion is an indication of how long your battery can run you vehicle if the charging system fails.
- **Amp-Hours** – this is the number of hours a battery can deliver a current of one ampere before discharging to zero volts. Some manufacturers provide this data, but many do not. There is direct relationship between Reserve Capacity and Amp-Hours. See below for conversion factor using the reserve capacity data.
- **Cold Cranking Amps** – basically, how many amps the battery can deliver at 0° F. for 30 seconds and not drop below 7.2 volts. It is a means of comparison between different batteries, but virtually any car battery has more than enough amps to start the car. This criterion is more important if you live in a cold climate; otherwise only use this criterion primarily when choosing between different batteries. If all else is equal (e.g., price, etc.), choose the battery with higher CCA.

A simple conversion generally used to approximate Amp Hours given the Reserve Capacity when expressed in minutes:

$$\textit{Reserve Capacity in minutes } x \ 0.4167 = \textit{Amp} - \textit{Hours}$$

Battery Brand Names

Avoid purchasing a battery based on solely on the brand name. There are significant differences between batteries of the same brand. And, it is worth noting that most batteries sold in the US are made by three companies with multiple brand names and they also build batteries for various retailers using the retailer's specifications. Even within retailer brands, more than one manufacturer may be used. For example, Sears DieHard may be made by any of the three major manfucaturers.

There are three major manufacturers for automotive batteries:

- Johnson Controls
- Exide Technologies
- East Penn Manufacturing

Some major brands include:

- AutoCraft
- EverStart
- Nascar Select
- Bosch
- Exide
- Odyssey
- DieHard
- Interstate
- Optima
- Duralast
- NAPA
- Varta

Warm versus Cold Climate

If you live in a warmer climate, have your battery checked every year once it is two years old. If you live in a colder climate, have the battery checked every year once your battery is four years old. In warmer climates, AGM batteries have an advantage over lead-acid batteries. In colder climates, place a greater weight on Cold Cranking Amps than if you live in warmer climate.

Battery Service Life

Do not rely on the manufacturer or retailer to provide an unbiased opinion on life expectancy. The best source I have found for battery ratings and life expectancies is *Consumer Reports*. And their ratings vary depending on battery type and size. As a general rule of thumb, AGM batteries have longer life expectancy than lead-acid batteries and they are more tolerant of frequent short trips that do not allow much time for recharging. Lead-acid batteries are lower cost and their lower cost may offset their shortcomings compared to AGM batteries.

Driving Style and Needs

What is your driving style? If you make frequent short trips, there is less time for your car to recharge the battery. For this style of driving, an AGM battery has a distinct advantage over lead-acid batteries. On longer trips, neither battery has an advantage as there is generally adequate time to complete the recharge cycle after starting the car.

Additional Electrical Accessories on Your Car

If you have electrical accessories on your car that contribute to a significant current draw, you should be choosing batteries with the higher reserve capacity. For example, high-end car audio system or additional lighting systems such as fog / driving lights. In some cases the battery manufacturer may even void the warranty if your vehicle is equipped with electrical devices that require unusually high current requirements. AGM batteries will provide superior performance over lead-acid batteries.

Battery Location in the Vehicle

If your battery is located in the trunk (boot) or inside the vehicle, AGM and gel cell batteries have the distinct advantage of not requiring venting of free hydrogen, which poses an explosive hazard. And it is not uncommon for vent tubes from lead-acid batteries to become dislodged or missing entirely. AGM and gel cell batteries, by design, pose less risk of danger and are preferred on cars with battery locations that could potentially contribute to a buildup of hydrogen gas.

Deep Discharge Cycles

If you occasionally are guilty of leaving an electrical device turned on – for example a dome light, that runs down your battery, this is generally considered a deep discharge. Also, leaving your car unintended for many weeks or months may also inflict a deep discharge on your battery. When this occurs, the lead plates in the battery will become coated with sulfate deposits which can reduce the life span of a battery by a third or more. A single deep discharge on a lead-acid can reduce the life of the lead-acid battery up to 33%. AGM batteries are more tolerant of deep discharge cycles, but still susceptible.

Battery Technology

Four types of battery technologies are in common use for automotive batteries … they all use lead-acid technology. The electrodes and grids are made from lead. The polarity of the plate is determined by the active material that is placed in physical contact with the grid. The electrolyte within the battery is sulfuric acid – hence the name, "lead-acid".

Flooded-cell lead-acid batteries

These batteries require inspection and topping up of electrolyte. They are much less common than in the past and should now be avoided for automotive use.

Maintenance free lead-acid batteries

Modern maintenance free batteries consume far less water. The caps on these batteries are not meant to be removed. Lead acid batteries do not do well if they experience deep discharge cycles. In addition, lead-acid batteries give off free hydrogen during the charge cycle which can be an explosive hazard. If placed in a closed space (e.g., the trunk or passenger compartment of a car), the battery must be vented to the outside. Lead-acid batteries are subject to leakage if not kept in an upright position. These batteries are typically the lowest cost batteries. *For the purpose of discussion, I use the term lead-acid to refer to this type of battery.*

AGM batteries

Absorbed Glass Mat batteries contain very small amounts of acid electrolyte and they are in a sealed case. The internal glass mat is designed to wick the electrolyte between battery plates. Internal chemistry reabsorbs loose hydrogen molecules back into water which eliminates the need to replenish electrolytes, extending battery life. The risk of explosion from free hydrogen is greatly reduced and most AGM batteries do not require ventilation if placed in a closed space. AGM batteries generally will not leak and can be placed in any position. AGM batteries typically cost between 50% and 100% more than their common lead-acid equivalents. AGM batteries typically have lower capacity than comparable lead-acid batteries, but they generally will last longer due to their inherit ability to withstand deeper discharge cycles and lower loss of electrolyte during their life cycle.

Gel cell batteries

Similar technology but less common than AGM batteries, gel cell batteries are typically more costly and do not offer the same power capacity as the same physical size AGM battery. Gel batteries contain a silica type gel that the electrolyte is suspended in. The thick paste is in contact with the plates but will not leak if the battery is broken. The advantage of a gel cell battery is its slower discharge rate and slightly higher ambient operating temperatures. One issue that must be addressed is the charging profile. Gel cell batteries must be recharged correctly or the battery will suffer premature failure. The battery charger or battery tender being used to recharge the battery(s) must be designed or adjustable for gel cell batteries.

What type of battery did your car come with originally?

If your car came with a lead-acid battery, you can replace it with either a lead-acid battery or an AGM battery. If it was originally equipped with an AGM battery, replace it only with another AGM battery.

Can a Deep-Cycle Battery be used in Car?

It can. But, it is not advisable. A deep-cycle battery (aka deep-discharge battery) is designed to deliver a steady current over a long time. An automotive battery is designed to deliver a very large amount of current for a short period of time. A deep-cycle battery is designed to discharge to 25% of its full capacity and then recharge over a long period (as much as 24 to 36 hours). An automotive battery should not be discharged to less than 75% of its full capacity and it is generally recharged rapidly. It is not unusual for an automotive battery to not drop below 90% of its full capacity over its lifetime. Deep-cycle batteries typically have higher reserve capacity times and lower cold cranking amps than automotive batteries. Deep-cycle batteries will generally cost more than automotive batteries.

Does Your Car have the Automatic Stop-Start System?

The Stop-Start system automatically shuts down and restarts the engine to reduce the amount of time the engine spends idling, thereby reducing fuel consumption and emissions. This is most advantageous for vehicles which spend significant amounts of time waiting at traffic lights or frequently come to a stop in traffic jams. This feature is present in hybrid electric vehicles, but has also becoming increasingly available in non-hybrid vehicles. Typical fuel economy gains range between 5 and 10 percent. If your car is equipped with this technology, you should only use AGM batteries as lead-acid batteries do not cope as well with the frequent start-ups.

Battery Cost

Cost is obviously an important criterion in battery selection. And here, the lead-acid battery has the advantage as they can be up to half the cost of an AGM battery. In addition to initial purchase cost, you should also weigh the likelihood that lead-acid battery

will not have the life expectancy of AGM batteries. And, you have to decide if other criteria can outweigh the initial cost advantages of lead-acid batteries versus AGM batteries.

Side Note: Can I safely store a battery on a concrete floor?

Yes. There is a thought that has been around as long I can remember that if you store a battery directly on a concrete floor, it will ruin the battery. In the early part of the 20th century, car batteries were encased in hard rubber, which was porous enough that battery acid could seep through and create a conductive path through damp concrete, thereby draining the battery. Today's batteries use high density plastics and electrolyte seepage and migration is a thing of the past.

If you wish to remove the battery from your car, you can safely store it on a concrete floor without any fear that doing so will adversely affect your battery. There is even a school of thought that the cool nature of the concrete floor will actually slow the self-discharge rate versus storing the battery on a shelf.

My Preference and Recommendation

- For most applications, I prefer an AGM battery over a common lead-acid battery. The cost is higher, but the ability to withstand deeper discharge cycles and high temperatures with potentially longer life outweigh the higher cost.
- In my opinion, gel cell batteries do not have a significant advantage over AGM batteries to justify their additional cost.
- Minimum Reserve Capacity:
  - 120 minutes for larger cars with larger engines
  - 80 minutes for smaller cars with smaller engines

Battery Tenders

On modern cars with multiple electronic devices, if you have a lead-acid battery and you leave your vehicle unattended for extended periods, then absolutely get a battery tender. Why? All batteries will be affected by deep discharge and long term inattention, lead-acid batteries more so than AGM batteries. If you have an AGM battery, the use of a battery tender is less critical, but is still highly recommended.

What is a battery tender?

A battery tender is a low-current battery charger that will maintain battery charge (without overcharging) while vehicle is in extended storage.

What are the criteria for using a battery tender?

Leaving a vehicle unattended for an extended time will reduce the battery capacity due to parasitic current drain on the battery and the inherent self-discharge that all batteries experience. This is generally not a problem if you regularly start the car and drive for a bit as your battery will re-charge during the drive cycle. In addition to parasitic draw, a vehicle battery will self-discharge at a rate of about 3% per month.

The problem is that vehicle batteries do not do well if they are drained too low or too often. Most car batteries are not designed for deep cycle discharge. AGM batteries are better than lead-acid, but deep cycle discharging will reduce the life in any car battery. It is a good idea to not allow the battery to drain to less than 90% of its fully charged state. Allowing the battery to drain to 75% of full charge will likely cause degradation of battery life, especially with lead-acid batteries. Leaving it fully discharged, even for a short time, may kill it completely. If you intend to leave your vehicle unattended for a period where parasitic current drain could reduce the capacity of the battery less than 90%, then a battery tender is recommended.

Choosing a Battery Tender

- What type of battery do you have? Some tenders are designed specifically for lead-acid batteries and are not recommended for AGM batteries. Some tenders state they are compatible with all battery types. Check that the battery tender is compatible with your battery type.
- What is size is your battery? In Amp-Hours, not Cold Cranking Capacity. Most battery tenders will tell you the maximum battery amp-hour rating they are compatible with.
- Select a battery tender rated for 12 volts. Many tenders are designed for lower voltage or battery capacity.

Recommended Battery Tenders

I recommend one of two manufacturers:

1. Deltran
2. CTEK

Both Deltran and CTEK are widely used. Both manufacturers have a good reputation for quality. Both make tenders as OEM for several manufacturers. For example, CTEK makes tenders for General Motors (Corvette and Camaro), Porsche, Ferrari and others. Deltran makes tenders for Harley Davidson, Lexus and others.

Budget Battery Tenders

These budget battery tenders will be quite satisfactory for automotive batteries. As a budget tender, they have a lower current rating and they will charge a weaker battery more slowly than higher current capacity models. If a battery has a particularly low state of charge, they may not work at all. But, for normal batteries in good condition they are very suitable to the task. They are compatible with lead-acid, AGM and gel cell batteries.

- **CTEK US 0.8.** MSRP of $55 from CTEK. This lower current model will work very well for normal car batteries. It will take longer to bring a battery up to charge for maintenance, but for most applications will work quite well. It is fully automatic with several charging levels. Suitable for batteries up to 100 amp-hours.
- **Deltran Battery Tender Junior High Efficiency P/N 022-0192**. MSRP of $40 from Deltran. This tender provides low current output, but will bring a battery to maintenance level and then maintain it indefinitely. It is fully automatic with several charging levels. This is a very good buy.

Better Battery Tenders

The following battery tenders have higher current ratings and will more rapidly bring a low battery to a high state of charge and then switch over to maintenance level. They are compatible with lead-acid, AGM and gel cell batteries.

- **CTEK Multi US 4.3.** MSRP of $85 from CTEK. Fully automatic charger with technology for charging and maintaining a car battery. Has 4A output for quicker recharge. Rated for batteries up to 110 amp-hours.
- **Deltran Battery Tender 5A Power Tender High Efficiency P/N 022-0186G-DL-WH**. MSRP of $99 from Deltran. Fully automatic charger with technology for charging and maintaining a car battery. Has 5A output for quicker recharge. Will easily charge and maintain batteries up to 110 amp-hours capacity.

More Expensive Battery Tenders

You can pay upwards of $200 to $300 … or more … for a battery tender. In some cases, you will be getting more capacity (e.g., charging / maintaining multiple batteries). But in many cases you will be paying for a perception that higher costs equates to a better product. In all likelihood, you neither need nor use the advanced functions and features that these more expensive battery tenders offer.

Connecting the Battery Tender

Battery tenders are easily connected. Plug in the tender into a 120VAC electric source and then connect the tender to the positive and negative terminals of your battery. Always make sure of correct polarity. The models recommended in this paper have a polarity protection circuit built-in … but better to pay attention when you connect to the battery. The battery tender will come with a pair of cables with clips to connect to the battery terminals. Using these standard cables is fine for occasional use, but if you plan to use your battery tender regularly, a very useful accessory is a cable that allows you to permanently connect to the battery

terminals and provide a quick-disconnect for your battery tender. Most battery tenders include this accessory cable, but if not, get one as it is a highly recommended accessory.

You can attach the quick-disconnect cable directly to the battery or other convenient location. On my car, I attached this cable to a negative and positive terminal located in one of the fuse panels in the passenger compartment. The quick disconnect plug then extends out from under the fuse panel where I can easily reach it when I want to connect the battery tender. It neatly tucks away when not in use.

Some vehicles will allow you to charge through the accessory plug on the car (formerly known as the cigar lighter socket). This may not work on your car as many cars disable the accessory outlet when the ignition is turned off. If your car allows this, you can get an accessory that will let you plug your battery tender into the accessory socket on your car.

References

Besides personal experience and picking the brains of automotive experts, I used the following resource to develop this paper.

- Wikipedia
- CTEK Sweden AB
- Deltran USA LLC
- Consumer Reports
- Johnson Contols
- Battery Council International