Can I replace my car battery with a lithium battery?

Karl Young
Li-ion, supercapacitors, EVs, HEVs, BEVs · Author has **1.2K** answers and **4.5M** answer views · Updated Nov 25

I better jump in here before more wrong information is posted. I design Li-ion battery packs for cars, motorcycles, golf carts, buses, trucks, boats, airplanes, etc. for many years, and I work with an excellent packer in China who builds these Li-ion packs for hundreds of applications by the container loads each week. So, we have lots of practical experience.

For many years, there have been drop-in replacements of Li-ion batteries for the 12V car battery. The BMS (battery management system) is programmed to accept the voltage and current from the car's existing alternator charging system, making sure the Li-ion cells do not get over-charged or over-discharged. There are six different Li-ion formulations in the Li-ion family of rechargeable chemistries (LMO, LCO, NCA, NMC, LFP, LTO). Tesla started with the NCA, then to NMC, and now LFP in China market.

The LFP (LiFePO4) is the most popular chemistry for automotive applications being one of the thermally safest formulas in the Li-ion family. LFP has around 3 times the energy per pound or kg than lead-acid batteries. So, around 1/3 to 1/2 the weight of a flooded or AGM battery. It is also smaller, but the same size or group dimensions are maintained to ensure it looks and fits like a 1:1 drop-in replacement.

There are other Li-ion chemistries that have greater energy per lb or higher power output. For example, I recently designed a marine engine starting battery capable of 1,500 MCA, but my final design was able to output 3,000 MCA. The size was less than 1/3 the size and the weight was less than 1/4 that of an AGM equivalent battery. My Li-ion packs can operate at -30°C (-22°F), and still retain more than 70% of their max capacity. At that temperature, AGM will be lower than 40% of its max capacity. So, the Li-ion battery will have many more cranks left by the time the AGM batteries throw their towel in.

So, yes, you can replace your lead-acid car battery with a Li-ion battery. It will last at least 3-4 times longer, so the total ownership cost will be much less than a lead acid battery. Amazon will give you a rough idea of the costs.

Addendum

There are many good comments below, and also some are from less experienced folks; which is good, because this is the main reason I bother posting on a forum like this - to pass on actual facts and hands-on experiences for people to avoid potentially dangerous issues. More answers have been posted since my answer above. Be careful with some, Li-ion batteries have more energy per unit weight and per unit volume than lead-acid batteries (e.g. flooded, AGM, GEL), also more expensive. Li-ion chemistries need more control to maximize benefits and longevity. It is not a good replacement for all situations (e.g. extremely hot or cold climates) unless additional care is applied. One of the big reasons why Tesla EVs can go more than 500,000 to a million miles on the original battery pack is their active thermal management system provides the ideal temperature setting for the cells during charging and discharging, even when parked.

One commenter lectured me for not just saying yes or no to the question, and that I bragged about myself excessively and dragged on in the answer. Like gasoline, Li-ion batteries can be dangerous if not handled or treated with a little respect. Most people, especially me, cannot read minds and learn about new technology thoroughly without some hands-on experience. So, I'm trying to share what I've learned in the past 15–20 years on Li-ion chemistries so you would avoid dangerous mistakes.

I agree with many that for common car starting applications in mild climates the FLA, AGM, or GEL lead-acid battery works fine and is less expensive than Li-ion batteries. However, for applications where you don't want to be stranded out in the ocean, or 2–3X weight savings will make a big difference for an application, then Li-ion would be more applicable. Li-ion prices will continue to drop as production quantity increases. There will be other newer chemistries on the horizon that will be even better and safer than Li-ion, but not for many years yet. I'm demonstrating the dragging-on part here, so I'll stop and look forward to your questions.

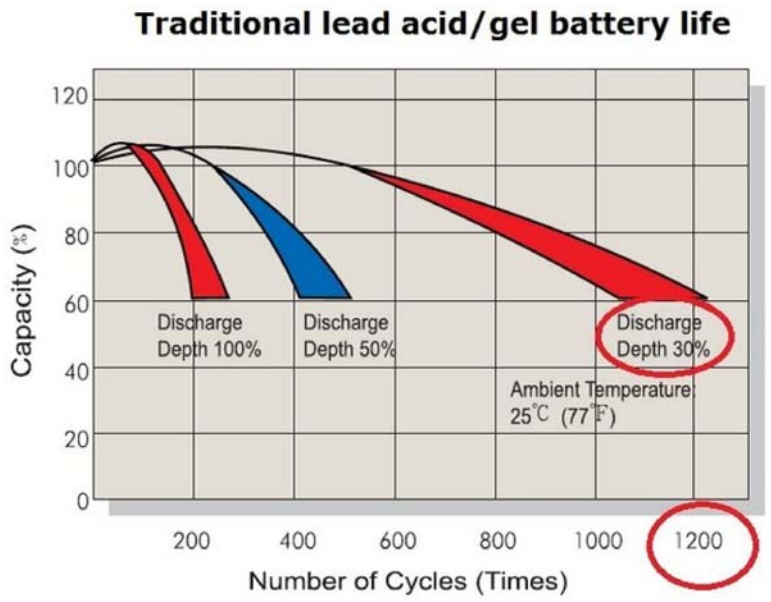
Addendum 2

In my initial answer, I was trying not to get into too many technical details, trying not to be too wordy. Since some of you seem to have a more technical interest in this subject, let me display a few graphs to give you a better visual summary at the risk of "dragging on" in my answer.

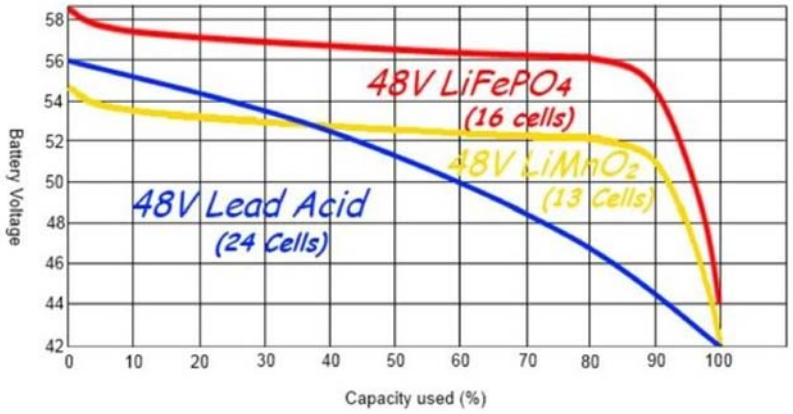
The table below shows you a lead-acid battery's voltage as related to its SOC:

12.5	2.08	90%
12.42	2.07	80%
12.32	2.05	70%
12.2	2.03	60%
12.06	2.01	50%
11.9	1.98	40%
11.79	1.96	30%
11.58	1.93	20%
11.31	1.89	10%
10.5	1.75	0%

The chart below shows the less you discharge a lead-acid battery in-depth, the longer the life. So, if you just start your car a couple of times a day in mild weather, and if the battery is a good quality one, then you can expect more than 5–8 years of service.

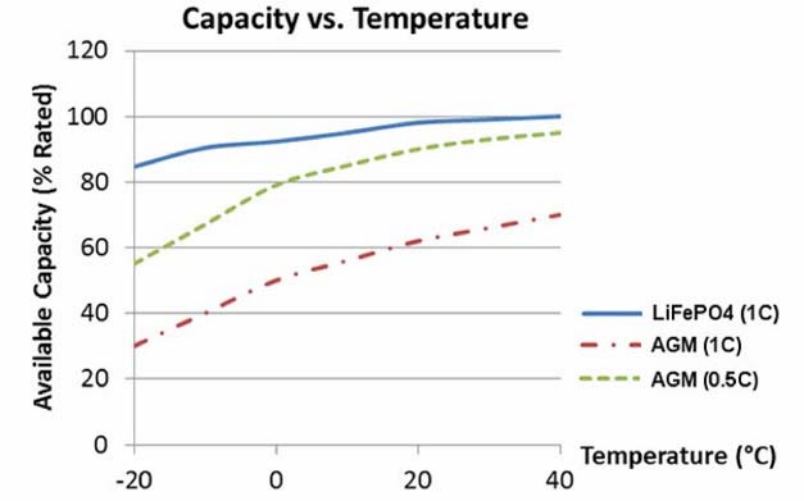


Although this graph below shows 48V batteries, the basic principle still applies. The area below each curve is a rough representation of the energy capacity of that particular chemistry. This is the reason why the LFP battery will always last longer than lead-acid batteries of the same Ah rating. Also, LFP will maintain a higher voltage for a longer period of time to ensure your electrical devices will operate properly or efficiently for a longer period of time.



LFP batteries retain more energy than lead-acid batteries at all temperatures but are especially critical at the lower temperature range. 1C means discharging at the Ah rating. For example, a 100Ah battery can discharge 100A for 1 hour at the rated voltage (12V for ICE car batteries). So, for a 100Ah battery to crank an engine at 600A, then that's a 6C discharge rate. The same rationale applies to charging. Charging a 100Ah battery at 200A would be a 2C charging rate, or charging at 50A would be a C/2 charging rate. By the way, to maximize LFP service life, always charge at C/2 or less. So, 1C charging means a 1-hr charge at 100A and a C/2 charge will take around 2-hrs at 100A for a 100Ah battery. For Li-ion batteries in general, the lower the charging rate, the better their longevity. You can also

not have a 14.4V 100A charger at home, less than 100A will be fine. If you have a 12V 50Ah LFP battery, then be sure to charge at 25A or less for longevity (13.8–14.4V), above 32°F (0°C).



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- Active in 1 Space
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