The RoadPro Guide to Lithium Batteries for Motorhomes, Campervans, Caravans, Specialist Vehicles and Boats.

- What they do,
- How they work,
- The various models and.
- Why you should seriously consider getting one - or more!



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Lithium Batteries: The Basics

Lithium batteries were invented and developed in the 1970s and 80s and have totally changed the way we use many electrical appliances. It's only recently though, that the advantages of lithium battery technology have begun to be available to motorhomers, caravanners, boaters and anyone who relies on 12V batteries for power.

The difference in performance between a lithium battery and a traditional leadacid battery is so great that anyone who is serious about staying "off-grid" in their vehicle or boat really has to consider installing one. It can only be a matter of time before lead-acid batteries are consigned to the proverbial dustbin of history.

Let's get one thing clear to start off with: there are several different types of lithium battery and the ones that are used as auxiliary / leisure batteries are very different indeed from those used in electric cars, mobile phones and cordless electric tools. Lithium batteries have a reputation for catching fire without warning but the batteries that we are looking at here are completely safe in normal use. These are lithium iron phosphate (LiFePO4) batteries and here are some of their advantages over traditional lead-acid batteries:

- Voltage remains constant for much longer during discharge.
- Much higher charging rate and so faster charging varies according to the charging system used.
- Can be discharged quickly without damaging the cells, making them ideal for use with inverters.
- Can be discharged approximately 95% on average without damaging the battery.
- Thousands of charging cycles compared to just a few hundred from a typical lead-acid battery.
- Very low rate of self-discharge means they can be left unattended for months.
- Zero maintenance required.
- The shape of some models enables them to be installed in places where a lead-acid battery cannot.
- Approximately 50% lighter than a lead-acid battery with a similar Ah rating.
- Very safe in normal use with no toxic fumes or liquid and no risk of fire in normal use.
- The ability to charge quickly from the vehicle's engine can remove the need for a generator or fuel cell.
- Can be used in almost every situation where a lead-acid battery is being used.



There is really only one disadvantage to having a lithium battery in your vehicle or boat and that's the initial cost. This is likely to be approximately 10 times more expensive than a lead-acid battery with

a similar Ah rating. However, as a lithium battery can remove the need to ever use mains hook-up and can be charged and discharged several thousand times, for some people the purchase cost will be more than recovered during the battery's lifetime. In addition, if you normally use a generator or fuel cell to charge a battery or operate 230V appliances, a



LiFePO4 battery means that you probably won't need either of these items. This saves money, inconvenience, excess weight and the necessity for additional fuel.

Let's look at the advantages of LiFePO4 batteries in more detail:

1) Voltage remains constant for much longer during discharge.

If you've ever been watching TV and the picture has suddenly vanished while the sound stays on, you've experienced one of the problems associated with lead-acid batteries. Even though the battery may only be discharged by 40-50%, the voltage can drop to a point where certain appliances won't function as they should.

LiFePO4 batteries maintain usable voltage throughout the discharge cycle, down to as low as 5% state of charge.





This VW Crafter has an EZA 130 powerpack which is used to run all the 12V & 230V appliances, including the heater. Rob & Sue have spent over a year travelling in Asia, Europe and Africa, relying on the EZA for electrical power.

2) Much higher charging rate and so faster charging – within the limitations of the charging system used.

Lead-acid batteries don't respond well to being charged quickly. It can be done but, depending on the battery type, capacity and charging method, it can take many hours to fully charge one. Charging lead-acid batteries quickly can also damage them.

Because LiFePO4 batteries are able to accept a high rate of charge - over 100 Amps in some cases - they can be charged much more quickly. Even when it's almost fully discharged, a LiFePO4 battery can be safely charged up again much faster than a lead-acid battery. Just running the vehicle's engine for 20 minutes or so can put enough Amps into the battery for hours of use.

The charging rate is dependent on the vehicle's charging system and will vary according to how the charging system is performing.

3) Can be discharged quickly without damaging the cells, making them ideal for use with inverters.

Discharging lead-acid batteries quickly is even worse for them than fast charging. It can cause the plates in the cells to deform and, if done frequently and at a high discharge rate, can dramatically shorten a battery's life.

LiFePO4 batteries respond well to fast discharging with no adverse effects. This makes them ideal for use with inverters, especially when the appliances to be powered draw a lot of current: coffee machines, microwave ovens, hair dryers and toasters for example. This ability to reliably power 230V appliances without the need for mains hook-up is one of the main reasons that people install lithium batteries.

4) Can be discharged to as much as 90-95% without damaging the battery.*

When a lead-acid battery gets to 50% state of charge, the voltage will usually drop to a point where some appliances may not work as they should. With a lot of batteries – depending on the type, the quality and the condition - this can occur well before the battery is at 50%. So, although a battery is rated at 110Ah, it may only give a useable 60Ah at most which, for many people, may be what they would use during the course of a day, especially in the winter. **Even when a LiFePO4 battery is discharged to well below 50%, it will continue to provide a high enough voltage to ensure that appliances operate correctly. *When it's been discharged by 95%, a good LiFePO4 battery with a built-in Battery Management System (BMS) will automatically shut down.** However, to maximise useful life, it's

built-in Battery Management System (BMS) will automatically shut down. However, to maximise useful life, it's recommended that lithium batteries are not frequently discharged much below 50%.

5) Thousands of charging cycles compared to just a few hundred from a typical lead-acid battery.

Depending on how a lead-acid battery is designed, manufactured and used, it may have a cycle life (the number of times it can be discharged and charged) of several hundred or far fewer. The way a battery is used makes a huge difference to cycle life and the same make and model of battery could work well for six years or more in one vehicle and less than a year in another.

LiFePO4 batteries have a cycle life in the thousands and, again, the way the battery is used will have an effect. Also, of course, some LiFePO4 batteries are simply better than others and will have a greater cycle life. For most people, a LiFePO4 battery will last longer than the vehicle they're using it in. For example: using 50 Amp-hours per day, 365 days per year, a 100Ah LiFePO4 battery can be expected to work efficiently for at least 11 years. Use it for only six months of the year and it should last for well over 20 years. Battery life varies according to use and constant heavy discharging will reduce the useful lifetime of the battery.

6) Very low rate of self-discharge means they can be left unattended for months.

If you leave a lead-acid battery unattended, even for a few weeks, you may well go back to it to find that it's flat. This is not only inconvenient but probably expensive too as a battery that's left in a discharged state will suffer from sulphation, leading to damaged cells and an inability to hold a charge.

The discharge rate of LiFePO4 batteries will vary according to how the battery is designed but, as a rule, LiFePO4 batteries discharge much more slowly than lead-acid batteries: 3% per month on average. This means that a fully charged lithium battery can be left in place for months without losing a significant amount of charge. So you never need to worry that you'll be faced with a flat battery.

LiFePO4 batteries work in a completely differently way from lead-acid batteries and don't suffer from sulphation. However, it's not recommended to leave a LiFePO4 battery in a discharged state as this could shorten the battery's useful life. Ideally, lithium batteries should be stored with a state of charge between 50% - 80%. The more gently you treat a lithium battery, the longer it will perform efficiently.



There are 3 x 100Ah NDS 3Lion lithium batteries in this Devon campervan. With this amount of electrical power available, even the air-conditioning unit can be run without the need to be on mains hook-up.

7) Zero maintenance required.

Except for AGM and gel types, a good lead-acid battery being used to power appliances will require topping up with electrolyte. Even maintenance-free batteries should be checked regularly.

LiFePO4 batteries are completely maintenance-free.

8) The shape of some models enables them to be installed in places where a lead-acid battery cannot.

With the exception of AGM and gel types, lead-acid batteries have to be mounted with the top of the battery uppermost. This, along with the similar shapes and sizes of most batteries, can make lead-acid batteries difficult to install in certain situations.

Lithium batteries can be installed in any position except upside down. And, because we have a range of models from 20Ah to 150Ah, one of our one campervan or caravan.

batteries can be installed in any motorhome, campervan or caravan.

9) Approximately 50% lighter than a lead-acid battery with a similar Ah rating.

Lead is heavy and, the better the battery, the more lead there will be in it. This is one of the major disadvantages of lead-acid batteries, no matter what the application.

LiFePO4 batteries weigh around half what a lead-acid battery with a similar Ah rating would weigh. And, because you can use almost all the energy in a lithium battery, the weight saving can be huge. 2 x 100Ah lithium batteries are roughly the equivalent of 4 x 100Ah lead-acid batteries but the difference in weight can be 60Kg or more.

10) Very safe in normal use with no toxic fumes or liquid and no risk of fire in normal use.

If lead-acid batteries were invented now, they would be forbidden on health & safety grounds. They're full of lead which is poisonous, and acid which burns. And they can explode! Some countries have considered banning them but, as there is no alternative as yet, that hasn't happened.

LiFePO4 batteries are completely safe when used correctly. They are non-toxic, they don't give off dangerous fumes and, in normal use, they cannot explode or catch fire.

11) The ability to charge quickly from the vehicle's engine can remove the need for a generator or fuel cell.

Generators are often used to both charge a leisure battery and to provide 230V as well. But generators have many disadvantages as anyone who's used one or had to listen to someone else's will know. Fuel cells are excellent for charging lead-acid batteries but they are very expensive, take up space and require the use of special fuel which is expensive, often difficult to obtain, hazardous and heavy.

A LiFePO4 battery gives the advantages of both generators and fuel cells. It can be charged simply by running the vehicle's engine and charging is many times faster than even the best fuel cell. If you want to run 230V appliances, an inverter can do the job just as efficiently as a generator and without the inconvenience and noise!

12) Can be used in almost every situation where a lead-acid battery is being used.

Lead-acid batteries have been developed to the point where there's a range of models to suit most applications. But, whatever the type of lead-acid battery, it will have the unavoidable disadvantages.

There are many different types and models of lithium batteries too but here we are only referring to leisure / auxiliary batteries. Whatever the Ah capacity of the batteries you need, there is probably a LiFePO4 model to suit. Batteries can be joined together to create a battery bank that's big enough even to run air-conditioning systems.



In this motorhome installation, 300Ah of NDS LiFePO4 batteries with an NDS 2kW inverter will enable the use of the air-conditioning as well as the coffee maker!



Motorhome manufacturers including Morelo are fitting lithium batteries as standard.

FAQs on lithium batteries.

Are lithium batteries safe to use in my motorhome?

At RoadPro we have fitted lithium batteries to dozens of different makes and types of motorhome, caravan and boats. More and more manufacturers are fitting them as an option or even as standard equipment.

Changing a lead-acid battery for a LiFePO4 unit won't affect the vehicle's warranty as long as it's installed properly.

How do I choose which lithium battery to install?

It's essential that, before installing a LiFePO4 battery, you know what you want to achieve from the installation. It's then necessary to ensure that the battery you fit really is designed for the job. If you don't do these things, you can waste a lot of money.

The best way to ensure that you get what you need is to think about how you want to use electricity in your vehicle. Most importantly, do you want to use an inverter and, if so, what will you want to run from it? You'll need to work out what your daily usage is likely to be, the maximum amount needed at any one time and how you will be charging the battery. Then, you can decide what size of battery bank you'll need, how best to keep it charged, where to install it and what additional features you may want in the system.

Always use the services of a company that has experience of lithium batteries and will install them correctly.

Why would I need an inverter?

An inverter changes 12V DC (or 24V) to 230V AC. You'll need an inverter if you want to run 230V appliances when no mains hook-up is available.

What sort of inverter should I get?

That all depends on what you want to run from it. Find out the total rating in Watts of the 230V appliances that you'll be using at the same time. Then, add 25% to be on the safe side. If you just have a phone charger, go for an inverter with the lowest output you can find, measured in Watts. If you want to run a hair dryer, a coffee machine or a microwave oven, you'll need to consider a 2kW or even 3kW model.

There are two types of inverter: modified sine wave and pure sine wave. (Beware of cheap ones as they may not do what it says on the box.) A pure sine wave inverter will produce electricity almost identical to what comes out of a 13A socket at home. This is essential for the proper operation of some appliances including coffee machines and electric toothbrushes but any appliance will run better on electricity from a pure sine wave inverter.

Modified sine wave inverters are cheaper but won't operate some equipment. Simple appliances like hair dryers or kettles will probably be OK but others either won't run at all or may even catch fire. With a pure sine wave inverter, you can be certain that all your appliances will work correctly.

Can I use the 230V sockets in the motorhome when I'm not on hook-up?

Yes, this can be enabled using a special inverter or separate switch which prevents mains hook-up and the inverter trying to supply the sockets at the same time.

Is it really true that we can get away without ever using 230V hook-up?

Yes it is, as long as you run your 3-way fridge and heating on gas. These appliances use too much energy to make running on 12V feasible. Otherwise, a lithium battery and suitable inverter will enable you to run everything that you would if you were on hook-up, possibly with the help of a solar panel and an occasional charge from the engine.

What are the charging voltages for lithium batteries and how important are they?

To achieve maximum performance and useful life, it's essential that a lithium battery is charged correctly. The charging requirements of lithium batteries are very different to those of lead-acid batteries. Different batteries need different voltages but a typical LiFePO4 battery should be charged at a constant voltage of no more than 14.6V. Charging at a lower voltage (14.4V for example) will do no harm but charging at above this should be avoided by using suitable charging equipment. Check your battery's specifications before buying a charger.

Does it matter what alternator my vehicle has?

Almost any 12V alternator rated at 120 Amps or more will charge a lithium battery efficiently as long as the output is between 13.8V and 14.6V. At lower voltages, the battery will not reach 100% state of charge but it will be so close that it's not worth worrying about. Charging at a lower voltage can also help to increase a lithium battery's life.

What if my vehicle's engine has a "smart" alternator?

Whatever type of leisure battery you have, if your vehicle's engine has a "smart" alternator and you want to charge the battery efficiently, a battery-to-battery charger is essential. Some motorhomes are fitted with these as standard. For lithium batteries, it's essential that the battery-to-battery charger has a LiFePO4 setting.

Can I use a solar panel with a lithium battery?

Yes, but it's essential to make sure that the voltage regulator is suitable. As with the Votronic range, it should have a setting for LiFePO4 and this is what we would always recommend for maximum efficiency and long useful life. It's not necessary and not a good idea to keep a lithium battery constantly on charge and a suitable regulator will avoid this. Your supplier or installer will be able to advise further.

Do lithium batteries need special 230V chargers?

For fast, safe charging, a special LiFePO4 charger is the best way to keep a lithium battery charged. However, if your motorhome, caravan or boat is already equipped with a charging system, it will charge most lithium batteries

satisfactorily as long as it's switched to a gel setting. If your vehicle is connected to mains hook-up, make sure that you disconnect it when the lithium battery has been fully charged. Do not leave the charger connected after the battery is at or near 100% state of charge and do not charge it when the battery's temperature is below 0°C.

How are lithium batteries affected by temperature?

As a rule, lithium batteries will charge at 0° C - +45°C and discharge at -20°C - +60°C. If the temperature of the battery reaches 0°C, care must be taken not to charge it from the engine, a solar panel, mains hook-up or any other charging source. All the lithium batteries sold by RoadPro have built-in protection so that, even if they do reach 0°C, they will prevent charging and avoid damage to the battery. We recommend the use of temperature sensors with solar regulators, battery-to-battery chargers and 230V chargers. This will help to ensure the most efficient charging.

What's the best way to store a lithium battery: over winter for example?

Unlike lead-acid batteries, LiFePO4 batteries don't deteriorate if left for weeks or even months. They don't self-discharge as quickly either, about 3% per month is typical. So, you can safely leave a lithium battery installed in your motorhome, caravan or boat even over the winter. To maximise the useful life of the battery, keep an eye on the state of charge and try to keep it between 50% - 80%. In cold weather, the BMS in a good lithium battery will prevent charging at temperatures below 0°C but we also recommend using lithium-compatible chargers & solar regulators with temperature sensors.

Can I use a lithium battery in my caravan and charge it from the towing vehicle?

Yes, we have specialist equipment to enable this.

I always stay on campsites and hook-up to the mains supply. Do I need a lithium battery? No!! Save your money and buy the cheapest starter battery that you can find.



In a nutshell, here are ten reasons why you should seriously consider installing a LiFePO4 battery in your vehicle or boat.....

- 1. You want to be able to spend as much time as possible "off-grid".
- 2. You want to run a coffee maker, hair dryer, microwave oven, toaster or any other 230V appliance when you're not on mains hook-up.
- 3. You need to use medical apparatus such as a PAP or CPAP device in your vehicle and need to be certain that it will function correctly when needed.
- 4. You'd rather use electrical energy than rely on LPG in your vehicle or boat.
- 5. You want to save money by not having to pay for mains hook-up ever again.
- 6. You don't want to ever have to worry again about the lights, the TV or other 12V appliances going off because the battery "has died".
- 7. You want to save weight in your vehicle.
- 8. You've had enough of lead-acid batteries "leisure" batteries that only last a couple of years or so.
- 9. You're tired of having to check your batteries and maintain them even when they're not being used.
- 10. And finally, because LiFePO4 batteries last so long, they can actually save you money in the long run.

The RoadPro range of LiFePO4 batteries

All LiFePO4 batteries offer the same advantages and the various models from different manufacturers are all similar in some respects. There are hundreds of different models on the market, but lithium batteries are expensive and so, to get your money's worth, we strongly recommend getting yours from a reputable dealer who understands what's involved in putting a lithium battery into a motorhome, campervan, caravan or boat. Equally importantly, find out what after-sales support you can expect. Sending a battery back to China or the USA for a warranty claim is not something that you may want to do.

At RoadPro, we have a range of LiFePO4 batteries to suit just about every requirement. Quality is assured, so is after-sales service and, as we've been selling lithium batteries for several years, we know what we're talking about. Whatever your vehicle or boat, we can help you get a system that will free you from the hook-up lead. We really mean it when we say that you may never have to hook up to the mains again: ever!

If you're on-line, click here to get more information on these lithium batteries.



NDS 3Lion Batteries:

The 3Lion range from NDS includes 20Ah, 30Ah, 60Ah, 100Ah and 150Ah LiFePO4 batteries. All models 100Ah & 150Ah models come with a 3Link connection box and a touch-screen display which shows how the system is performing.

The 3Link unit is integral to the system: connecting to the existing system and ensuring maximum performance with charging currents up to 75 Amps.

There are three 100Ah models, one of which is the same size as a standard 110Ah lead-acid battery, making installation even simpler. Another is a low-priced battery and the third is designed to handle current demands of up to 150 Amps.

Aceleron "Essential" Battery:

The Aceleron "Essential" is the only lithium battery for motorhomes, caravans & boats that's both designed and built in the U.K. - Yorkshire to be precise. The construction is unique, using a patented "compression" technique which enables the battery to be easily upgraded or repaired should a cell need replacing. The "Essential" comes with a 10-year warranty and cycle life is up to 5,000 depending on how the battery is used.

We recommend the use of Votronic monitoring systems with the "Essential" battery.

The EZA Power-Pack System:

We've been selling the EZA Power-Pack for longer than any other LiFePO4 battery and it's still the only lithium battery of its kind available. What makes it different is that it's not just a battery but a complete system with built-in battery-to-battery charger, solar regulator and simple connections for inputs, outputs and an inverter. Everything is incorporated into a sturdy aluminium box and two models are available, 130Ah and 80Ah.

Another feature of the EZA Power-Pack is the Bluetooth connection which enables you to see exactly how the system is performing on a tablet or smart phone.





The EZA Energie 100:

The rugged aluminium case of the Energie 100 holds a 100Ah

LiFePO4 battery. Its unique shape and footprint make it ideal for use in situations where any other battery may not fit.

EZA also produce a special battery-to-battery unit which makes installation quick and easy. It's essential if a vehicle has a "smart" alternator and highly recommended even if the alternator is a standard model. This is a simple and practical way to get the benefits of lithium in even the smallest campervan.







Here's some of the stuff you may need to get the most from your lithium battery.

To get the best performance out of any lithium battery, it's essential to make sure that the installation is up to the job by having appropriate cabling and charging equipment. The battery will usually be charged from three sources: the alternator (via the starter battery), solar panel/s and mains power. Because the charging requirements of a lithium battery are different from those of a lead-acid battery, it's not a good idea to just swap one for the other in a vehicle. Doing this will reduce the efficiency of the lithium battery and reduce its useful life. Below is some of the equipment that you should consider when installing a lithium battery.



Taking energy from the alternator is the most important way of charging for most people with a lithium battery. This can be done in different ways depending on what type of alternator your vehicle has. Many installations require a battery-to-battery charger such as those from CTEK, NDS & Votronic. This will charge the battery in the same way as a mains charger but by taking its power from the alternator. NDS & Votronic also have 3-way models which charge from the alternator, mains hook-up and solar panels. Whichever model you choose, you can be sure that your lithium battery will be charged correctly.



A lithium battery can accept a high charge – up to 100A in many cases – and this makes it essential that the cables used in the installation are capable of carrying such a high current. Some vehicle manufacturers tend to use the thinnest cable they can get away with and this will prevent a lithium battery from performing at its best. All the charging equipment we sell has instructions on what type of cable to use.

For charging from mains hook-up/shore-power, the charger that comes with many vehicles may be sufficient if there's a gel or AGM setting. Again though, for maximum performance and long life, a dedicated lithium charger may be advisable. The same applies to solar regulators: one with a lithium setting is well worth it in the long run.



Many people like to keep any eye on their battery and a monitor such as Votronic's battery computer will show you exactly what's happening: state of charge, voltage and current in and out. Lithium batteries work well with inverters, enabling you run almost any mains appliance at any time, including microwave ovens and hairdryers.

It doesn't matter what type of motorhome you have or caravan, lithium will set you free!

Since February 2015, RoadPro has been singing the virtues of lithium batteries and we've supplied hundreds to manufacturers, dealers, installers and our own customers. The most common reaction from people when they convert to lithium is "It's great not having to worry about the battery any more". Other people have told us that having a lithium battery is "like wild-camping with hook-up", enabling them to stay in places like the lakeside in the



photo. We have two lithium batteries in our Rapido and, over two years and many thousands of miles, haven't been on mains hook-up once. That's in spite of regularly using a toaster, microwave oven, coffee maker and hair dryer.

To be frank, if you mostly stay on campsites, don't even think about converting to lithium, it's just not necessary. An interesting exception to that rule is if you have a caravan and use a mover. If you do, you may find that an NDS 20Ah or 30Ah lithium battery will stop you running out of juice every time you try to use it.

If you spend time off hook-up though, a lithium battery can change the way you use your motorhome or caravan and, whatever you've got, there's a battery to suit.



Merve is a keen caravanner who enjoys the more relaxed atmosphere of campsites without hook-up and other facilities. Thanks to a 100Ah NDS 3Lion lithium battery, inverter and solar panel he now has complete electrical independence and can still use all his mains appliances without worrying about having hook-up available. Merve says that now he wouldn't even consider not having a lithium battery in his caravan.

A lot of Hymer owners convert their vans to lithium and this 4x4 model is a great example of how lithium batteries can set you free. The owner has travelled all over Europe and Morocco and spends months at a time on the road. Thanks to 400Ah of NDS 3Lion batteries, he can stay away from campsites as much as he wants and yet still run the airconditioning when the going gets hot.





A lithium battery will usually fit in the same place as the leadacid battery it's replacing. Even under one of the front seats is possible as there are lithium batteries available which are almost exactly the same size as standard lead-acid models.



So, whatever size your vehicle is, if you want to set it and yourself free from the worries of 12V power, you can!



Lithium batteries are for boats as well as land-based vehicles. We've supplied them for use on narrowboats, sailing boats and work boats too.

Even if a boat doesn't have or doesn't use an engine, because lithium batteries are so efficient, they can make perfect sense on the water.



You can get more information on the LiFePO4 batteries & accessories that we sell by visiting our website.

<u>www.roadpro.co.uk</u>

If you don't want to install one yourself, any good dealer or autoelectrical specialist should be able to do the job for you.

To find one near you or to ask about installation at RoadPro, send a message from our website.



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