THE FINAL LiFePo4 INSTALLATION CONFIGURATION

The replacement of AGM batteries with LiFePo4 "drop in" batteries has been a learning experience, and when the 12 volt RB200 batteries made by Relion were installed it was presumed that would be the end. But that was not to be.

Once installed a lot of tests were performed for the purpose of gathering information and getting questions about their performance answered. The more I learned, the more I wanted to know and one of the questions related to how the Outback inverters were set. A feature on my inverters is the option of continuous float voltage applied to the batteries once they are fully charged, or a "Silent" mode. The silent mode allows the inverters to fully charge the batteries, and when they are in float, float charging current is removed from the batteries and the batteries are allowed to drop to about 12.7 and then float voltage is resupplied. Once the battery charge reaches float voltage again the silent mode begins again. That feature was designed for lead acid batteries and at 12.8 volts AGM batteries are fully charged. But at that voltage or 12.7 Li batteries are at 50% SOC or less. As we use the coach I wanted to know if there was a downside other than potentially having an issue if power to the shore power was lost when batteries were not fully charged.

There is no indication in any of the literature or specifications relating to the batteries or in the charging instructions about a silent mode so an email to Relion opened a conversation relating to this. That conversation with a Relion technician drifted to an explanation about how the batteries were installed. As soon as the series / parallel installation was described the technician expressed concern about the battery charging and the potential for the batteries to go out of balance.

By understanding the method of cabling the technician explained because of the series connections it was possible some of the batteries will fail to get fully charged. Because of that problem they would have to be separated and occasionally individually charged to bring their SOC the same as each other. This exercise could have to be done every three months, or every three years depending on a variety of factors. I explained clearly that is a serious problem and would not be acceptable. The technician kicked the problem up the corporate ladder which resulted in a phone call from a Relion engineer.

In that phone call the engineer and I exchanged information. I explained how a lot of coaches are set up with 12/24 volt DC systems, and that access to the batteries in some cases is very difficult. He explained the technical reasons the technician was concerned about charging the batteries and maintaining their balance. He described what battery set up he would be comfortable with, would eliminate the imbalance potential and would work for a 12 /24 coach. First he suggested the use of all 24 volt batteries in place of the 12 volt batteries. The 24 volt batteries would be connected in parallel and that would eliminate a charging or balance issue.

Then to provide 12 volt power needed for some circuits he suggested a 24/12 volt converter or voltage reducer. The described fix for the potential charging problem sounded simple, but as I started looking at how my batteries were cabled the change as described could be a nightmare or a relatively simple change. The potential nightmare related to if new cables had to be run from the batteries into the electrical compartment. The 24 volt batteries suggested were identical to the 12 volt except for the voltage so there was no issue with swapping them out. There was even room for the 24/12 volt converters in the battery compartment, but the issue of running cables had to be studied.

As it turned out some different cable connections would be required, but that would be in the form of jumper cables, short lengths and all at the batteries and in the battery compartment. There would be no new cables required from the batteries to the electrical compartment. If no new cables had to be run the change to all 24V batteries became relatively simple and inexpensive.

To Relion's credit they understood my concerns, they understood how my understanding of the potential charging issues was not fully addressed in their literature or in discussions with the sales representative, so they offered to swap my 12 volt batteries for the same size only in 24 volt, and even paid for the voltage converters. The company in my opinion went above and beyond anything that most companies would have done. But more importantly the information gained from this is invaluable. I previously stated my motivating factors for the change from AGM batteries to LiFePo4 was driven by the greater available power, the serious weight reduction, but primarily given how I use and manage my batteries, battery replacement would be a thing of the past.

Going through the process of swapping batteries again is not something I want to do. It is difficult to just expose them, and with the change to 24V this time the change is going to be changes to how the batteries are connected. The Vanner equalizer will be removed. Voltage converters or reducers are going to be added. Some cables will be retained. Some will be eliminated. Some will be new and function as jumpers from battery to battery. But this change is the right one. In fact anyone with a 12/24V coach that switches to Li this change to the coach is important because it assures the batteries are going to always be equally charged (balanced) and no periodic balancing or maintenance is required.

With the new 24 volt LiFePo4 batteries in hand it was decided Jeff at East Tennessee Luxury Coach would be called on to make the switch. Until I left to go to ETLC the coach had been continuously provided shore power. As soon as it was disconnected the need to switch to all 24 volt batteries was clear because the entire house went dead. It was clear some of the 12 volt Li batteries had shut down. When they were checked it was learned the 12 volt side of the series / parallel cabling had shut down. The concerns about series / parallel connections was valid. What was not expected was how short the time period was between all batteries being fully charged and equal voltages and ½ of them dropped to their lower limit shut down of 8 volts.

The concern and efforts now switched to replacing the RB200 12 volt batteries with RB24V100 https://relionbattery.com/products/lithium/rb24v100 24 volt versions of the 8D size. The starting point was to figure out how to hook up cables to use 4 24 volt batteries in parallel to replace 4 12 volt batteries connected in series and parallel. Jeff and his guy Alan worked together, one in the electric bay, one in the battery compartment ohming out cables. When some of the cables did not make sense Jeff got clarification from Liberty on how the cables were run, and at that point it was clear which cables could be abandoned, which would be re-used, and where they all went. As it turned out 2 positive cables and three ground cables could and would be reused to convert to all 24 volt batteries. This was good because it would virtually assure equal charging of all batteries eliminating the potential for imbalance.

All of the cables and jumpers used on the 12/24 volt battery bank were able to be reused.

All ground connections are made to a chassis ground in the electrical bay.

Now the only remaining issue was to add DC to DC power converters to provide 12 volt power to the coach 12 volt panel. Jeff selected 3 70 amp converters https://www.victronenergy.com/dc-dc-converters/orion-dc-dc-converters-12v-24v-48v-110v that were connected in parallel to supply the needed 12 volt power.

They drew 24 volt power from the batteries and provided a regulated 13.2 volt output. That output was sent using an existing cable to the 12 volt panel. The converters were mounted on a panel Jeff's shop made.

The panel is easily removed by disconnecting 3 cables and three screws so all batteries are easily accessed.

In the photos above and below below the far right cable with the red insulation is the 24 volt power supply into the converters, and at the extreme left is the red insulated cable supplying the 12 volt house panel. The converters are a good quality and fan cooled. Buy mounting them as shown they have ample room for air flow.

The cables can also be seen clearly in the photo above. As now cabled anyone in the future would not have to guess what cables go where or what they do. All 24V positive connections either go to adjacent batteries or into the coach 24V panel via connections in the electrical compartment which are not only to distribute 24V power, but which connect to the 24V inverter charger output to maintain the batteries.

The learning curve has been steep for all of us. But the bottom line remains the same. It has just taken a while to get there.

My coach is 400 pounds lighter in weight, and most of that reduction in weight has come off the steer axle which was at its limit. The weight was never an issue, but it is nice knowing the coach is dragging around less weight.

The coach now has a lot more available battery power. The way the coach is used the previous batteries would go from fully charged when we went to bed when dry camping to 50% or maybe a little less when we got up 8 hours later. From testing the LiFePo4 batteries will go 14 or more hours to drop down to a 50% SOC so with such modest discharges before engine start or generator start the cycles of battery charge and discharge suggest these batteries are going to last for decades. That sounds almost unreal but even at the harshest use the batteries are going to last about 4 times longer than AGM. In my case I always got 5 years from my batteries and replaced them when they still had life remaining so battery life expectations are not as unreasonable as they might seem.

Coach owners now have options to consider. The LiFePo4 batteries are not inexpensive. So an owner has to plan on having the coach for a long time. But once installed they should add value to a coach. Instead of being a service item like tires and coolant they are almost a permanent part of the coach which has a lot of value. But it is possible to bring the cost down to levels competitive with AGM batteries. A Country Coach that had 8 batteries was converted to Li and 5 batteries

provided the same available power as the original 8, not only bringing the cost closer to a direct AGM replacement cost, but greatly reducing the weight on an already front heavy coach.

Before making a decision to replace AGM with Li coach owners need to investigate what will be involved. Some charging settings on inverters may need to be reprogrammed. If a coach owner used auto-start consideration has to be given to what will be required to engage auto-start. If the coach is an all parallel battery installation not much if any recabling has to be done, however if the coach is a 12/24 coach with series and parallel cable connections the coach is going to require a change in cabling plus the use of DC to DC converters.

Apart from the physical considerations given to a change owners need to assess their true battery power needs because it is possible to get the same amount of available power from fewer or smaller batteries, or to use direct replacement batteries and get at least 50% more power from the batteries.

Additionally Li batteries have some limitations which may or may not become a concern. Charging below 32 degrees F has limits to the amount of current for charging. If the coach is expected to be exposed to low temperatures consideration must be given to adjusting the charging current or not allowing the batteries to drop below that temperature. Some battery sizes have internal heating provision to deal with temperature issues, or as an alternative the batteries may need to be provided with some external heat source to allow normal charging currents.

On my coach in a previous article I outlined what was involved in securing the batteries in a temperature controlled compartment and it is clearly a reasonable alternative to having batteries available with internal heating. Again coach owners have options so switching to Li is not difficult or impossible, but just involves some changes to thinking.

This article would not be complete without a big thank you to Relion for recognizing a potential issue and agreeing to a solution and standing behind their product before the problem was even in existence. That speaks volumes about how the company stands behind their product and serves its customers. But also efforts of Tom Chilcote (my battery supplier and Relion dealer) and Jeff Rowe of East Tennessee Luxury Coach (another Relion dealer) who stepped in and contributed their efforts to insuring the installation was done correctly and potential problems were eliminated.

We coach owners are dependent on our batteries and having the right amount of available power, an installation that protects the batteries, and support for the batteries is important. All of those wants and needs are now at our finger ti[ps.

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