Battery build instructions

Primary reference:   
https://www.mobile-solarpower.com/diy-lifepo4-solar-battery.html

# Step 1: Receiving battery cells

As with any product you order from the internet, check the batteries for damages when you receive it. Depending on the supplier, it may be difficult to order replacement for damaged cells. In this case it might be advantageous to order 10% - 20% more than what you need, if for no other reason to have spares for later replacement.

# Step 2: Balancing the cells

It is important to equalize the cell voltages before using the cells.

1. The very first thing you want to do is to confirm the voltage polarity of each cell, as some manufacturers gives zero regards to Western voltage color coding.
2. Measure the voltage of each cell
   1. **If cell voltages are identical or within 0.05V of each other, go to the next step**
   2. If the cells are within 0.2V of each other, the cells are safe enough for parallel connection and the equalization can begin
   3. If cells have a larger deviation than 0.2V, the cell with the highest voltage must be discharged through a resistor.  
      An example of discharge resistor can be a 25-50W, 2.7 ohm configuration. Use the facility in 329 for this.  
      Attach leads of the discharging configuration to the terminals of each high voltage cell. Discharge until the cells are within 0.2V and follow step 2-2-b.

**The following steps 3 and 4 will require input from the mechanical team concerning their plans for the battery. However, the sections will describe a standard way of achieving the goals.**

# Step 3: Attach cells together to form the pack

This is done through electrical tape/vhb tape/hose clamps. Take care to arrange cells for series connection, see reference.

# Step 4: Series connect cells

Attach bus bars accordingly to a series connection between cell terminals. Fitting bus bars are usually included when buying battery cells or are at the very least offered from the supplier.  
The two remaining open terminals are now the negative and positive potential of the battery pack, and it is from these terminals that we make a parallel connection or connect the battery to the load.

# Step 5: Connect the BMS / cell balancer

The BMS is connected to the battery pack in the following way:

* Voltage
  + 2 wires are used for the positive and negative terminal of the entire battery pack
  + The rest of the wires are connected to the positive terminal of each cell. This means that the first battery cell will have a BMS connector at both the positive and negative terminal, while the remaining cells only have a connector at the positive terminal, see picture for reference.
* Temperature

It should be noted that the above may vary depending on the BMS, but the above serve as a general guideline.

# Step 6: Perform a cell balancing at the current state of charge

The cells must now be balanced so they have an exact equal voltage.  
Refer to BMS or cell balancer instructions to proceed.

# Step 7: Perform bottom balancing of cells

Important step to ensure proper performance of the battery. While we have just performed a voltage balancing of the cells, they may not necessarily be at the same state of charge. If one of the cells are out of balancing, it will show during operation and be a difficult problem to fix on the go.

Perform the following steps:

1. Discharge the entire pack to 5% - 10% capacity, below the intended trimming level (usually 10%). Keep a close watch on the balance of the cells, to ensure one cell does not drop below the minimum voltage and cause internal damage to the cell.
2. When the above capacity level has been reached, perform a new cell balancing as in step 6.
3. Now that the cells are balanced at a low capacity level, charge the entire pack up to maximum voltage (90% - 95%, or above trimming level). Keep watch over the voltage level of the cells while charging, the cells must remain within 0.05V
4. Perform a final discharge of the cells to confirm the cells are balanced properly. This ensures no cells drop too low during operation.

# Step 8: Evaluate performance

If no problems have occurred during the above procedure, the battery pack is ready for use. If one of the cells do not stay within the same voltage has the other cells, it may be a bad cell, and this should be replaced.

# Step 9: Maintenance

The balance should be checked every couple of months