LPO4 battery use and installation

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ATTENTION !!!

- Lithium Iron Phosphate (LPO4) batteries cannot and should not be charged below 32F. If this happens the chemical reaction will cause permanent damage to batteries.
    - If any one of the prismatic cells drop below 32F then the entire battery shuts down.
- LPO4 should not be swished/moved/vibrating around when temps are below 32F. This will cause damage to batteries.
- Metal floor and high conductive materials are bad (e.g., metal job boxes) and we should insulate batteries with rubber, plywood, etc.
- LPO4 batteries come with:
    - A BMS control and self-heating element (resembling a heat pad inside the battery case).
    - A BMS control without a self-heating function. In which case you need to buy an external heat pad.

Heat Pad

Make sure you are able to isolate your batteries from metal, and that you've purchased self-heating batteries, or an external heat pad.

Recommended external heat pad: Amazon.com: H&G lifestyles RV Holding Tank Heater Pad Use with Up to 50 Gallons Fresh Water 12V 12" x 18" Holding Tank Heating Pad with Constant Temperature Heating Plate (Pack of 2) : Automotive

Heat Pad information:

- 12V sewage tank heater pads for RVs with internal thermostat that ensures the battery doesn't turn off at freezing temperatures seem to be the best recommended for battery external heat pad use.
    - Some heat pads don't come with internal thermostats
- Some people say to use aluminum sheat (between bottom of batteries and heat pad) to dissipate heat across all surface area of batteries
- You can put more than one heat pad on sides or bottom (but that doubles power draw).
- Some heat pads are too energy demanding and might draw too much power from batteries.
- Best recommended use seems to be putting heat pads below batteries.
- Heat pads seem to not last for that many years (maybe 2-5 years)?
- Amazon.com: H&G lifestyles RV Holding Tank Heater Pad Use with Up to 50 Gallons Fresh Water 12V 7-1/4"x25" Holding Tank Heating Pad with Constant Temperature Heating Plate (Pack of 2) : Automotive
    - This H&G that comes in a 2-pack is cheaper
    - Operates at 38-50F which is much more suitable than others I found
    - Uses less power draw than others, with only 41W vs the 78W of the Falcon, for 3.2 A vs the Falcon's 5.8A.

- Heat Pad recommended on youtube (I did not purchase):
    - 12V heater pad: Cold Temperature LiFePO4 Heater on a Budget! Beginner Friendly (youtube.com)
    - The Falcon heat pad: Amazon.com: Facon 12V Heater Pad for RV Holding Tank, W 12" x L 18" with Automatic Thermostat Control, use with Up to 50 Gallons Fresh Water/Grey Water/Black Water Tank, 12Volts DC, QAI Certificated : Automotive
    - I don't like the Falcon idea because turns on when temp below 45F (and shuts off at 68F) which would use too much battery.

Insulation Plan

- Metal box>packing foam>plywood>felt?>heat pad>aluminum sheat>felt?>batteries
- Do we want this felt sandwich around heat pad and aluminum?
    - Or does the felt cause heat loss?
    - Does the felt tamper with the heat sensor to shut off too early (50F)?
- Surround all sides with reflective cell foam.
    - This helps batteries stay cool in summer, warm in winter.
- Top of batteries → what fabric? Reflective cell foam?
- Connect heat pad plan: directly to the batteries: "The heating pad can be connected to the 12v fuse panel with a switch added inline to turn it on/ off if needed."

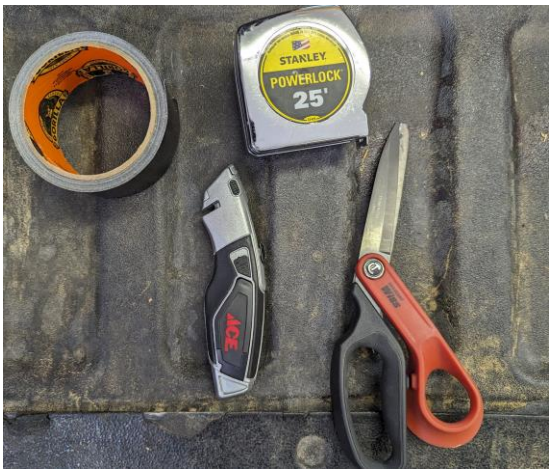
Reflective closed cell foam I purchased: 62.5 SF Reflective Foam Thermal Foil Insulation Radiant Barrier (16X50 Ft Roll) - Amazon.com

Testing of heat pad and insulation box

- From testing at my home office for a month in January-February, the batteries did discharge at a faster rate than expected each night (11.07V minimum) but batteries did not die during testing when insulation box was installed and nightly temperatures dropped below 14F. Obstructions from cloud cover, heavy snow, etc. inhibiting solar panel activity during the day may cause overdischarging issues in the future if heat pad power draw drains batteries at night and solar panels can't fully charge batteries during the day. Will need to explore in winter 2024-25.
- Make sure you plug any holes where cold air may be entering the action packer/job box.

Illustrated steps to insulation compartment

1. Gather necessary tools.



2. Remove batteries from box.

3. Place batteries on packaging foam pads to approximate tight fit and plan for sides juxtaposition.

4. Draw out foam pad edges to cut and make sure you have a tight fit around batteries.

5. Make sure the external heat pad fits your cut battery base. If needed, fold up the edges.

6. Cut the foam pad edges, and the base pieces.

7. Tape the two base pieces together.

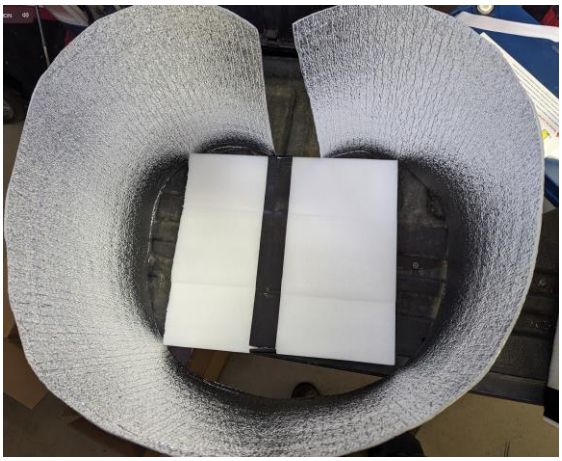
8. Line up the batteries back on the base, with the heat pad, and start taping outside edges of side foam pads together.

9. Tape all the other edges of the foam pads together with duct or gorilla tape used on the outside.

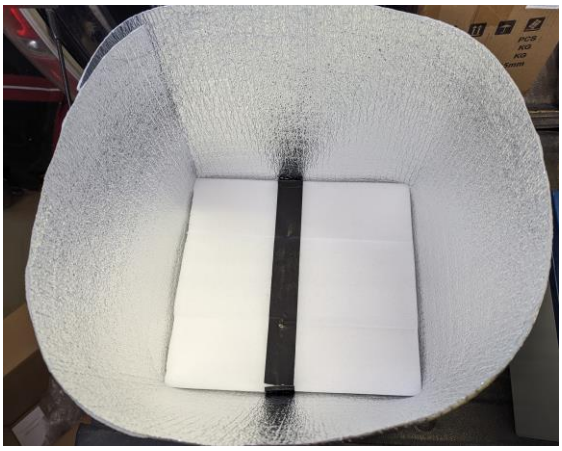
10. Measure your foam pad circumference and give yourself a couple extra inches of overlap.

11. Take your reflective cell foam roll and cut the measured length.

12. Place the reflective cell foam roll around the foam base.



13. Tape the external edges of the reflective roll flush with the foam base.



14. Place heat pad then sides back. Ensure heat pad with folded sides fits well and keep thermostat inside the reflective cell foam walls.

15. Place batteries one at a time to ensure tight fit.

16. Ensure prior to placing insulation box in the action packer or job box, that the top of the reflective foam can fold as to contain heat.

17. Place the insulation box into the action packer/Motus bin, by folding inward the foam pad edges.

18. Reconnect batteries in parallel, place leftover packaging foam over battery leads to isolate leads with non-conductive material before folding and closing the reflective cell foam walls. Place charge controller atop.