

CLAIMS

1. A thermal management system for rechargeable battery comprising:
 - a metal case having an exterior surface and an interior surface lined with an electrically insulating material;
 - a cell pack made from individual battery cells arranged within end frames and disposed in said metal case; and
 - a thermally conductive granular filler occupying the interstices between said individual cells and between the cell pack and the electrically insulating material lining, wherein said thermally conductive filler decreases the thermal impedance from the cell pack to the exterior surface of the metal case to reduce cell pack temperature and increase battery life.
2. A thermal management system according to claim 1, wherein said metal case includes a five-sided box and a cover made from one of iron/carbon steel and high temperature steel, wherein all surfaces of the case are galvanized for rust prevention.
3. A thermal management system according to claim 1, wherein said metal case includes a five-sided box and a cover made from one of iron/carbon steel and high temperature steel, wherein all surfaces of the case are provided with a highly-crosslinked non-porous coating that protects the metal from biological, radioactive and chemical contamination and withstands chemical cleaning and decontamination without corroding.
4. A thermal management system according to claims 1 and 3, wherein said highly-crosslinked non-porous coating comprises one of urethane, polyurethane, aliphatic polyurethane, epoxy, epoxy polyamide, epoxy polyamide enamel and combinations thereof.
5. A thermal management system according to any of the preceding claims, wherein said cover is sealed to said five-sided box to provide a waterproof metal case that protects the cell pack from moisture intrusion, wherein the metal case includes a pressure relief vent.

6. A thermal management system according to any of the preceding claims, wherein said pressure relief vent comprises an aperture through the metal case and a film adhered over the aperture.
7. A thermal management system according to any of the preceding claims, wherein said electrically insulating material lining said interior surface of said metal case comprises a thermoplastic film adhered to said interior surface.
8. A thermal management system according to any of the preceding claims, wherein said thermoplastic film is one of polyester, nylon and polycarbonate, preferably polyester.
9. A thermal management system according to any of the preceding claims, wherein said thermoplastic film is between 0.2 mm and 2.0 mm thick, preferably 0.5mm thick.
10. A thermal management system according to any of the preceding claims, wherein said metal case includes metal panels lined with the electrically insulating material that divide the internal space into compartments, wherein said system includes multiple cell packs, each including dozens of cells, wherein each compartment contains one cell pack.
11. A thermal management system according to any of the preceding claims, wherein two cell packs are arranged adjacent to each other within the case with one lower end frame of the first cell pack facing one upper end frame of the second cell pack, wherein the thermally conductive granular filler is disposed between the facing end frames.
12. A thermal management system according to any of the preceding claims, wherein said thermally conductive granular filler comprises alumina trihydrate having a particle size between 2-200 microns which decomposes at 220 degrees C to release 35% of its weight as water vapor, wherein excessive water vapor pressure will breach the film adhered over the aperture to open the pressure relief vent.
13. A thermal management system according to any of the preceding claims, wherein said system includes electrically insulated sleeves which contain the cell packs.
14. A thermal management system according to any of the preceding claims, wherein said end frames are bonded to the battery cells with epoxy and wherein a silicon-based filler is disposed between the end frames and the metal case to stabilize the cell packs.

15. A thermal management system according to any of the preceding claims, wherein the thermal management systems allows the battery to be cycled in excess of +70 amps charge and -70 amps discharge whereby the thermally conductive filler decreases thermal impedance from the cell pack to the outside surface of the metal case so that the over-temperature protection circuit is not tripped.