

# SAFETY HAZARD WARNINGS FOR LITHIUM ION BATTERIES

Rechargeable Lithium Ion batteries are potentially hazardous and can present a serious **FIRE HAZARD** if damaged, defective or improperly used.

**A FIRE IS MOST LIKELY TO OCCUR DURING THE CHARGING PROCESS UNDER THE FOLLOWING CIRCUMSTANCES:**

- **THE BATTERY HAS BEEN FULLY DISCHARGED AND IS NOT RECHARGED SHORTLY AFTERWARD.** This potential is aggravated if batteries are damaged, contain an undetected factory defect, are used or stored at temperature extremes, **or are approaching the end of their useful life.** (See useful life) Ideally, batteries should be recharged within 24 hours of a full discharge.
- **CHARGING IS ATTEMPTED AT TEMPERATURES BELOW 40°F (4°C).** Charging below 40°F (4°C), causes a chemical reaction in the battery cells that can cause permanent damage and the possibility of fire or explosion during charging.
- **THE BATTERY HAS BEEN EXPOSED TO LIQUIDS, ESPECIALLY SALTWATER.** Exposure to liquids can cause internal corrosion or damage to the cells or to the Battery Management System (BMS). The BMS protects the battery from overcharging, high self- discharge or imbalanced charging of the cells, any of which can present the possibility of fire during recharging.
- **OPERATING OR CHARGING A BATTERY THAT HAS BEEN DAMAGED FROM DROPPING OR FROM SHIPPING DAMAGE.**
- **USING A CHARGER OTHER THAN SPECIFICALLY DESIGNATED FOR THE PARTICULAR BATTERY.** Lithium Ion battery chargers provide a specific charging voltage and microprocessor current and voltage control. They are fundamentally different than chargers for SLA, NiCd, NiMH, or other rechargeable batteries. Chargers for LiNiMnCoO<sub>2</sub> (NMC) batteries (VML) and LiFePO<sub>4</sub> batteries (VLX) **are not interchangeable**, and require different charging voltages.

## CHARGING RECOMMENDATIONS

The following recommendations, **in addition to those precautions above**, should be followed when charging Lithium Ion batteries to ensure the avoidance of potentially catastrophic fire or explosion.

- **Charging should be performed in a fire-safe area, away from children or pets. For maximum safety, a metal trashcan with lid placed on a non-flammable surface is suggested.** Never charge batteries unattended, or where objects such as carpet, furniture, wood or vinyl floors, curtains or other flammable objects are present.
- **Charging should be performed at a temperature between 40°F and 110°F (4°C and 43°C). Never charge below 40°F (4°C).**
- **Do not attempt to charge a battery that is swollen or bulging. Use only supplied charging cables and connections.** Make sure connections are in good condition. Do not allow the charging polarity to be reversed or short-circuited. If equipment is connected during charging, equipment should be switched off. As a delayed chemical reaction can occur if a fault is present, observe the battery in a safe place for at least 15 minutes after charging is complete.
- **A healthy battery should only get slightly warm during charging. If the battery becomes hot, smokes, swells, or gives off an odor during charging, terminate charging immediately and contact the manufacturer.** Note – the charger itself may get quite warm to the touch when charging a deeply discharged battery.

## OPERATING AND STORAGE CONSIDERATIONS

- **Batteries may be safely discharged at temperatures between 4°F and 140°F (-20°C and 60°C).** Note this is the safe battery temperature rather than ambient temperature. Heavy use (frequent flashing) will cause the battery to develop internal heat beyond the ambient temperature. **It is recommended that the discharge duty cycle be limited to 50% or less for long-term continuous use (more than 5-10 minutes).** Example: If recycle time is, say 4 seconds, allow 8 seconds between shots. If shooting is in ambient temperatures above **105°F (41°C)**, lower duty cycles are recommended. Typically, in Vagabond units, the inverter will temporarily shut down if overheated from excess duty cycle. Note that battery capacity is lower at cold temperatures.
- **Batteries should be stored at temperatures between 40°F and 80°F (4°C and 27°C) for maximum life and safety.** Higher storage temperatures increase the self-discharge rate from the nominal 1-2% per month to as high as 35% per month, and can reduce battery life and increase the possibility of catastrophic failure with long term high temperature storage. **Never store batteries at temperatures higher than 170°F (76°C) as this can potentially result in self-combustion, particularly in LiNiMnCoO<sub>2</sub> (NMC) batteries.** LiFePO<sub>4</sub> batteries are intrinsically safer, more tolerant and robust than LiNiMnCoO<sub>2</sub> (NMC) batteries.
- **Batteries may be stored at 100% charge if used frequently. However, for maximum life, batteries infrequently used should be stored at 40% to 70% charge.** An easy way to bring a **discharged battery** into the proper long-term storage charge is to charge for about 60 minutes with the supplied charger. An easy way to **reduce a fully charged Vagabond VML or VLX battery** down to the recommended long-term storage charge is to connect and operate the Vagabond into a 100-watt table lamp for about 30 minutes. Batteries in long-term storage at room temperature should receive a refresh charge every three months or so. If you are unsure of the state of charge of Vagabond batteries, turn the Vagabond ON and observe the battery gauge LEDs. Ideal long-term charge is present if the center LED (>50% charge) is lit.



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