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Safety with Lithium-ion Batteries

Many electronic devices use lithium-ion batteries. These include laptops, cellphones, tablets, cameras and power tools. Electric vehicles as well as micro-mobility devices such as hoverboards, E-scooters and E-bikes have become increasingly popular and use this type of battery. Compared with traditional battery technology, lithium-ion batteries charge faster, last longer and have a higher power density for more battery life in a lighter package. While these batteries provide an effective and efficient source of power, the likelihood of them overheating, catching fire and even leading to explosions increases when they are damaged or improperly used, charged, or stored.

Lithium-ion batteries exposed to thermal, physical and operational “abuse” are more likely to suffer breakdown (short circuit) and the potential for thermal runaway and fire. Let’s explore these three common causes of lithium-ion battery failure and thermal runaway.

Thermal Abuse: Thermal abuse refers to the condition where lithium-ion batteries are exposed to temperatures, either from the surrounding environment or internal chemical reactions, outside their designed operating range. If not controlled, elevated environmental temperatures may lead to internal cell damage, internal short-circuits and thermal runaway. This could theoretically occur, for example, when the lithium-ion battery of an AED stored outside is exposed to direct sunlight. While controlling ambient temperatures is important, batteries also generate their own heat and aggressive charging or discharging operations increase heat generation. High current charging can especially lead to rapid lithium-ion movement, generating significant heat and causing a dramatic increase in a battery’s temperature.²

Physical Abuse: When lithium-ion batteries are subjected to physical stress, including puncture, crushing, penetration, impact or immersion, it can lead to the breakdown of the separator inside the battery and result in short circuiting and fire. In some cases, physical damage allows the direct reaction of anode and cathode in the electrolyte,

leading to internal short circuits. Exothermic side reactions including electrolyte decomposition may also trigger thermal runaway.²

Operational Abuse: Excessive charging and discharging at a battery's maximum current rate would be considered an aggressive operational mode and could damage the system. When batteries break down due to operational abuse, short circuits can develop which increase the risk for thermal runaway. Repetitively and rapidly charging and discharging in low-heat-transfer environments can cause internal heating which can lead to thermal runaway.²

Familiarize yourself with the signs of failing lithium-ion batteries and use best practices to protect the battery integrity:

- **Read Manufacturer Instructions:** Always follow the manufacturer's instructions for the battery, charger, and tool.
- **Use Original Components:** Use only original manufacturer-approved batteries, chargers and tools to ensure compatibility and safety.
- **Avoid Damage:** Regularly inspect batteries for damage and avoid using them if they are punctured, crushed or show signs of malfunction.
- **Avoid Modifications:** Never modify or disassemble a lithium-ion battery.
- **Prevent Short Circuits:** Avoid storing batteries with loose metal objects and cover battery terminals when not in use.
- **Monitor Battery Behavior:** Look out for unusual behavior such as prolonged charging times or reduced performance.
- **Proper Storage:** Store batteries in a cool, dry place away from direct sunlight or high temperatures.