



Lithium-Ion Batteries

1. What factors contribute to battery malfunctions?

- Five factors contribute to malfunctions in lithium-ion batteries:
 - Lack or shortcoming of safety features.
 - Lack of stringent cell and battery manufacturing and quality control.
 - Mismatch of battery and charger performance capabilities.
 - Device performance and environmental issues (temperature, vibration, shock, impact, etc.).
 - The history of how a device was used.

2. What happens if I mismatch a battery and the appropriate charger?

- The charger may fit your device, but may not be compatible with the battery. This practice may lead to overheating.
- Some chargers may not have the required safety features that the battery requires for safety.

3. What can I do to avoid a malfunctioning lithium-ion battery?

- Avoid crushing or bending a device and/or charger during use. Some newer devices are especially thin and can bend when in your pocket, at the bottom of your gym bag or even when slipping underneath the car seat.
- Severe impact such as dropping a device and/or charger can damage any type of battery. The impact can affect a pre-existing flaw or it could create new damage by causing an internal short circuit.
- Use of electrical products in highly damp or humid environments should be avoided due to electrical shock hazard. This is particularly true for battery powered devices with or without an external charger.
- The internal components of a lithium-ion battery may deteriorate if stored in high temperatures. The deterioration of these parts may manifest itself as a failure during future use.
 - This rule is important for devices in parked cars during the summer. Internal temperatures within the car can exceed 120° F, which can cause deterioration.
- Avoid charging devices that are surrounded by combustible materials (under a pillow, bedding or other materials) that prevent adequate air flow.
- Avoid excessive or prolonged charging. Constantly charging a device can lead to irreversible changes within the cell that may reduce life or possibly induce failure.
 - For optimum performance, it's best to re-charge a battery only when it has a low state of charge and then fully charge it to 100 percent.
 - Charging to less than full charge voltage can prolong the long-term battery life.



- Don't pack regular batteries in a rechargeable battery charger.
 - Non-rechargeable batteries are not designed for recharging and become hazardous if placed in a battery charger.

4. How can I avoid purchasing a counterfeit battery?

- Purchase replacement batteries from the original equipment manufacturer or from a reputable source.
 - Purchasing batteries over the Internet from unknown sources at exceptionally discounted prices can be an indication the product may not be authentic.
 - The buyers for big chains are careful about sourcing and, while not perfect, they generally perform quality checks before retailing a product.
- Watch out for incorrect grammar and punctuation. You might not be able to detect inferior materials, but you can spot misspelled words, missing punctuation and stilted and bad translations.
- Avoid products with minimal packaging, no branding and no documentation. Responsible manufacturers want to build trust and attach that trust to their brand.

5. How has UL been involved in travel regulations for lithium-ion batteries?

- In 2012 and 2013, burning and smoking lithium-ion batteries led to the decision to ground Boeing 787 Dreamliners. This action was a dramatic step taken by the U.S. National Transportation Safety Board (NTSB) because of the uncertainty around the batteries used as primary back-up source for the aircraft.
- The NTSB chose UL to conduct a comprehensive investigation. Over the course of several months, the UL teams published seven reports, totaling more than 1,000 pages. These reports contributed to a greater understanding of the root cause of the burning and smoking of the batteries. From these reports, actions have been taken to enhance public safety.
- The process culminated in the decision by NTSB to publicly announce that the probable cause of the failures came from internal short-circuits within cells in the lithium-ion batteries.

6. What can I do to safely travel with lithium-ion batteries?

- Special care should be taken with spare batteries during storage and transit. Spare batteries may come into contact with loose change or any number of metal items if not properly stored. If battery terminals are exposed to metal, the battery can short circuit.
- If you are carrying spare batteries, keep them in your carry-on luggage.
- If you are traveling with spare batteries in addition to the ones inside your devices, consider placing each battery in its own protective case, plastic bag or place tape across the battery's contacts to isolate terminals. Isolating terminals prevents hazards due to short-circuiting.



- If you must carry a battery-powered device in any baggage, package it so it won't accidentally turn on during the flight. If it has an on-off switch or a safety switch, tape it in the "off" position.