

Stay safe – only purchase certified batteries from trusted sources

Expert Insight by Judy Jeevarajan, Ph.D.



Dr. Judy Jeevarajan is Research Director, Electrochemical Safety, UL.

She has been working in the field of battery safety for over 20 years, specifically on rechargeable lithium-ion batteries, which are found in everything from our smart phones to electric vehicles. Since these batteries also pose the greatest risk of overheating (thermal runaway), ensuring consumer safety is top priority. Her article takes a look at the sophisticated safety technology that goes into lithium-ion batteries and the dangers of buying counterfeits, which are not tested or certified to safety standards. Learn more about how properly manufactured batteries keep you and your family safe. Plus, get tips on how to make sure you are buying the real thing.

Through my work in electrochemical safety at UL, we started noticing more and more cases of lithium-ion batteries catching fire and expelling their contents during transport. Looking into the reasons behind this, we noticed that many of these incidents were connected to undeclared shipments, and almost always the quality of the batteries was very low. This led us to investigate more closely and discover that these batteries were counterfeit, that is, pretending to be a brand they were not, and therefore non-compliant to current safety standards.

So besides researching top-tier cells and batteries, we also began to focus on these counterfeit batteries. It is important for us to know what exactly is causing the safety issues, so we can help to better protect the public, and raise awareness for the value of correctly manufactured and certified batteries. What makes our research even more difficult is that some of these batteries may have certified cells within them and then the counterfeiters claim the whole battery is certified, but it is not. The cells are only one part of the battery. Actually, a lot of what goes into a lithium-ion battery are safety mechanisms –

both in and around the cell. Everything in and around the cell is there to contain the power, so it delivers the electricity you need in a safe and measured way.

While alkaline batteries may also be counterfeited, most counterfeiting is of lithium-ion batteries, because the market is bigger and more lucrative. The danger is bigger too, as lithium-ion runs the risk of thermal runaway and deflagration (a more precise word than explosion when it comes to lithium-ion batteries).

What can go wrong when quality is subpar

The main safety hazard posed by lithium-ion batteries, thermal runaway, happens when the battery heats up to over 100°C, a critical threshold after which further heating can no longer be controlled. Once thermal runaway sets in, it can lead to temperatures of up to 1000°C. Besides this extreme heat itself, other dangerous consequences are leakage, smoke, fire or even deflagration, i.e. the expelling of battery content. This can not only damage the device and ignite larger fires, but also cause severe injury to humans.

Thermal runaway is caused by a fault in the battery, or often simply bad design, which leads to a short circuit or overcharging. Certified batteries have been tested to keep this from happening, thanks to complex safety mechanisms that kick in before the battery-internal temperature reaches 100°C.

Have a look at our [interactive infographic](#) to learn more about the complex safety mechanisms in lithium-ion batteries. It will help you appreciate all the work and research a legitimate manufacturer puts into their batteries.

Counterfeiters – experts only in cutting corners

A properly manufactured battery will have safety already built into the cell as well as every other aspect of the battery, not something added as an afterthought. Counterfeiters,

on the other hand, will put some safety mechanisms in their products, but they are usually only the bare minimum to keep the battery from failing immediately. Counterfeiters don't care about your safety or even their own reputation, they just want to make a fast buck.

Manufacturing a proper lithium-ion battery requires a very pure environment, as they are assembled in a so-called clean room, i.e. a room with no dust and very low humidity. Impurities and humidity negatively impact the safety and longevity of the battery cell. Creating these ideal manufacturing conditions are too much work for counterfeiters and cost too much.

Counterfeiters will also use certain cheap materials to boost the capacity of their batteries, so people think they are working, but they do not last long.

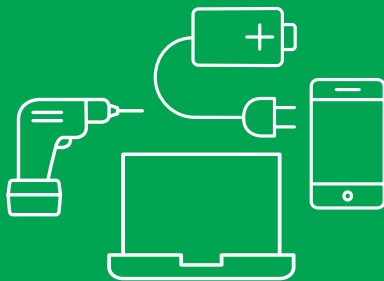
The pervasiveness of lithium-ion batteries

Lithium-ion batteries are already everywhere in our lives, and more than likely they will continue to be the predominant type of battery. Almost all portable electronic devices today have lithium-based batteries in them: laptops, smartphones, camcorders, cameras. They are also prevalent in boats, e.g. providing electricity for lights or small appliances, and in electric vehicles from cars to two-wheelers.

To meet this growing demand, new battery manufacturers constantly enter the market, yet, not all them go to the expense and trouble of ensuring battery safety.

Typical everyday products with lithium-ion batteries inside:

- Laptop
- Smartphone
- Tablet
- VR glasses
- Power bank
- Camcorder
- Camera
- Power tools
- Portable home appliances
- Boat and camping gear, e.g. for flashlights, floodlights, radio, radar
- Electric vehicles from hover boards, scooters and e-bikes to cars, trucks and buses



Stay on brand when reordering or recharging batteries

Lithium-ion batteries tend to be highly specialized for their specific use in a certain device. This means they are often not readily available in retail stores. As a result, people have increasingly turned to purchasing replacements online, which is where the counterfeiters have profited most. To be on the safe side, always order lithium-ion batteries directly from the manufacturer of the device you need it for.

This also applies to battery chargers. Using a generic or non-branded charger can cause thermal runaway in even a properly manufactured and certified battery. An incorrect or counterfeit charger will not know how to “talk to” the battery in the right way, e.g. because lithium-ion batteries work in different voltage ranges based on the chemistry of the components.

Lithium-ion cells and batteries that have passed safety testing by UL will have a RU Mark, indicating that it is “UL Recognized”.

How to recognize fake batteries

Many manufacturers let you buy directly from their website or they list trusted vendors of their batteries. If it is not possible to buy from one of these vendors, here are a few tips to guide your purchasing decision:

- Does the battery have the RU or similar mark (e.g. CE in Europe)? This indicates the battery complies with national/international safety requirements. Counterfeiters will not bother getting their products certified, so if it does not have one of these marks, don't buy it. Unfortunately, counterfeiters may also fake the mark, so this is not the only thing you can go by.
- Look for visual clues of inauthenticity. Familiarize yourself with the legitimate manufacturer's design and if you notice any significant aberrations, stay away from it. Counterfeiters can be very crafty. We have seen name brands on batteries that use the same logo and typeface but just change a letter or two and most people do not notice.
- Compare prices. You should find out what the original battery usually costs and if you find something much cheaper, it is very likely a counterfeit. It's not worth risking your health to save some money on a potentially dangerous battery.
- Be wary of false claims. Look at the specifications on the original battery. If the new one you want to buy promises more power or longer endurance, the sellers are probably trying to fool you.

- Fast delivery is another red flag. While you may need your battery quickly, if you order it online and it is immediately available, something is probably not right. Remember, lithium-ion batteries are highly specialized for a specific purpose. An online vendor is not likely to have exactly what you need on stock.
- Be on the lookout for formulations like “brand equivalent” or “brand compatible”. This means the battery is definitely not from the original manufacturer, and it will most likely not work properly in your device and is potentially hazardous.

If you are buying in bulk, e.g. not only for yourself but for an association or company, you should also consider verifying the serial number. Manufacturers and/or reputable suppliers should be able to verify the serial number of cells and inform about the dates when the cells were manufactured.

Safety is a shared responsibility

Many organizations collaborate on working to protect consumers. The United Nations, for instance, has strict regulations governing air transport of lithium-ion batteries (Manual of Tests and Criteria, UN 38.3, 7th edition). One example of a UN requirement travelers may be familiar with is not being allowed to transport a laptop in your check-in luggage. Law enforcement and airlines that carry cargo also keep an eye out for undeclared shipments which contain batteries, which is often in an attempt to avoid being caught as counterfeits.

Still, counterfeiters' determination knows no limits when seeking new ways to slip past such controls. That's why consumers also play an important role as a partner in the fight against counterfeiters: by avoiding purchasing their substandard products in the first place.

By learning about counterfeit batteries, consumers can help make the world a safer place. When you get into the habit of purchasing lithium-ion batteries the right way, you will also serve as a role model for younger people, for whom it will become second nature to keep an eye out for authentic and safe products.

What to do in an emergency

While an important part of safety is prevention, there may be times when you need to act fast in response to an emergency. If you happen to have a counterfeit or faulty battery and an incident happens, such as a fire, you need to know how to react correctly. Here are a few tips on what to do when a battery fails.

- In extreme cases, there may be hazardous liquid spill, smoke, fire, venting and deflagration (energetic expulsion of battery content).
- Use appropriate personal protective equipment (PPE), spill control kit, and fire extinguisher, depending on the type of cell and the extent of the hazard.
- When a battery fails, remove all charging sources or loads on the battery, and then move it to a safe area after the battery has cooled down completely. Report to the manufacturer and follow instructions from manufacturer for safe disposal.
- In the event of a catastrophic failure that causes physical injury to individuals, it is advisable to go to the ER to take care of any burn or toxic fume ingestions.

Learn more about lithium-ion batteries

UL has learning resources designed to explain all the ins and outs of lithium-ion batteries to non-experts, suitable for ages 10 and up. The resources are free and include a teacher guide, as well many videos and PDF downloads.

[Go to ULxplorlabs](#)