Extend the Life of Your Lithium Battery

Follow these five important tips, and you'll help ensure that your Li-ion batteries will deliver long, full, safe service lives in all your portable devices.

Tip 1: Keep your lithium batteries cool

Heat is the number-one enemy of Li-ion batteries. Heat issues can be caused by usage factors such as the speed and duration of battery charging and discharging.

The external, physical environment also matters. Simply leaving your Li-ion-powered device in the sun or in an enclosed car — even if the device isn't being used at the time — can significantly reduce the battery's ability to take and hold a charge.

Li-ion batteries perform best at about normal room temperature (68F). If the device warms to 86F, its ability to hold a charge drops by about 20 percent. If the battery is used at 113F — a temperature easily reached by devices that are working hard or that are in the sun (say, on a car dashboard), battery capacity can be reduced by half.

So if your device or battery becomes noticeably warm while you're using it, consider moving to a cooler location. If that's not possible, try reducing the amount of power the device is using by turning off unneeded apps, features, or functions; by reducing screen brightness; or by activating the device's power-saving mode.

If that still doesn't help, turn the device fully off until its temperature returns to normal. For fastest cooling, remove the battery (if the device allows that) — the battery and the device will cool off faster if they're physically separated.

Incidentally, although ***high*** temperatures are a major issue with Li-ion batteries, ***low*** temperatures aren't as much of a worry. Low temps usually won't cause any long-term damage, although a cold battery won't produce as much power as it otherwise would. The power drop becomes very noticeable at temperatures lower than about 40F. Most consumer-grade Li-ion batteries are essentially useless at temperatures around or below freezing.

If your Li-ion powered device becomes excessively chilled for any reason, don't try to use it. Leave it powered off and move it to a warm place (a pocket or a warm room) until the device is at normal temperature. As with overheating, physically removing the battery (if your device allows this) and warming it separately from the device will speed the warm-up process. Once the battery warms to a normal temperature, so will its electrical performance.

Tip 2: Unplug the charger to save the battery

Overcharging — leaving a battery connected to a too-high voltage source for too long — can reduce a Li-ion battery's ability to hold a charge, shorten its life, or kill it outright.

Most consumer-grade Li-ion batteries are designed to operate at around 3.6 volts per cell but will accept a temporary overvoltage of around 4.2 volts while charging. If a charger outputs the higher voltage for too long, internal battery damage can occur.

In severe cases, overcharging can lead to what battery engineers delicately refer to as "catastrophic failure." Even in moderate instances, the excess heat produced by overcharging will negatively affect battery life, as you saw in Tip #1.

High-quality chargers can work in concert with circuitry inside well-designed Li-ion-powered devices and their batteries, reducing the danger of overcharging by properly tapering off the charging current.

But the simplest, can't-fail method is not to leave your Li-ion devices connected to any charger longer than is needed.

These properties are quite different from those of older Ni-Cd and Ni-MH battery technologies, which did best when left on their chargers for as long as possible. That's because those older battery types have a high rate of ***self-discharge*;** that is, they start losing a significant amount of stored energy the moment you take them off the charger, even if the device they power is turned off.

In fact, a Ni-Cd battery can self-discharge at a rate of 10 percent in the first 24 hours. The self-discharge curve flattens after that, but a Ni-Cd battery will still lose an additional 10–20 percent charge per month.

Ni-MH batteries are even worse. Their self-discharge rate is about 30 percent higher than that of Ni-Cd.

But Li-ion batteries have a very low rate of self-discharge. A healthy, full, lithium battery will self-discharge at about only 5 percent in the first 24 hours off the charger — with only an additional 2 percent or so per month after that.

Thus, it's simply not necessary to leave a Li-ion device on the charger until the last possible moment. For best results and the longest battery life, unplug the charger when it or the lithium-powered device shows a full charge.

It's also not necessary to give new Li-ion devices an extended charge before first use. (Ni-Cd or Ni-MH devices used to come with warnings to provide an initial charge of anywhere from 8 to 24 hours.) Li-ion batteries are fully ready for use

when the charger or the device reads 100 percent charge. No extended charging is needed.

Tip 3: Don't deep-discharge your battery

Not all discharge cycles exact the same toll on a battery. Long and heavy usage generates more heat, putting more stress on the battery; smaller, more frequent discharges extend the overall life of lithium batteries.

You might think that a higher number of small discharge/recharge cycles would eat into the battery's overall lifespan. That was true with older technologies, but it's not the case with Li-ion.

Battery specs can be confusing because most manufacturers count a full Li-ion ***charge cycle*** as whatever it takes to add up to a 100 percent charge. For example, two 50 percent discharge/recharge events equal one full-charge cycle. Likewise, three 33 percent discharge/recharge cycles equal one full-charge cycle, five 20 percent cycles equal a full charge, and so on.

In short, a higher number of small discharge/recharge cycles doesn't reduce a lithium battery's total available full-charge cycles.

Again, heat and stress from heavy discharges reduce battery life. So try to keep your deep-discharge events to a minimum. Don't let your device routinely run down to zero charge (where the device turns itself off). Instead, think of the bottom 15–20 percent of battery capacity as a reserve — for emergency use only. Get into the habit of swapping in a fresh battery (if possible) or plugging the device into external power well before the battery is empty.

Tip 4: Slow and steady charge/discharge is best

Both fast discharging and fast recharging generate excess heat and exact a toll on battery life.

If you've run a device long and hard, let the battery cool to room temperature before recharging it. Batteries won't accept a full charge when hot.

And when recharging, make sure your charger doesn't make the battery become hot to the touch — a hot battery is a sign the charger is pumping too much current, too fast, through the battery.

Overcharging is more likely with chargers that are cheap, off-brand models; that use fast-charge circuitry; or that are wireless (inductive).

A cheap, generic charger could be little more than a transformer in a case with some connecting wires. These "dumb" chargers simply pump out current,

accepting little or no feedback from the device being charged. Overheating and overvoltages can easily occur, damaging or even destroying the battery.

Fast chargers are designed to provide a useful charge to a drained battery in minutes rather than hours. There are various approaches to fast-charging technology, and not all of them are compatible with all lithium batteries. Unless the charger and the lithium battery are specifically designed to work together, fast charging could cause overheating and overvoltages. Generally, it's best not to use one brand of fast charger on a different brand's device.

Wireless (inductive) chargers use a special charging mat or surface to restore a battery's power. It sounds wonderfully convenient, but inductive charging ***always*** generates excess heat, even when it's working normally. (Some hi-tech kitchen stove tops actually use induction to heat pots and pans.)

Not only is the excessive heat produced by a wireless charger not good for lithium batteries, it also wastes energy. By its nature, inductive charging's efficiency is always going to be significantly lower than a standard charger's. Higher heat and less efficiency easily outweigh convenience.

In any case, the safest approach is to use only chargers sold by the OEM of your lithium-powered device. It's the only way to be sure that the charger will keep temperatures and voltages within specs.

If an OEM charger isn't available, use a low-output charger that's unlikely to pump damaging amounts of power into the device you're charging.

One source of low-output, non-OEM charging that's often available is the USB port on a standard PC. A typical USB 2.0 port provides 500mA (.5 amps) per port; USB 3.0 provides up to 900mA (.9 amps) per port. In contrast, some dedicated chargers will output 3,000-4,000mA (3-4 amps). The low amperages offered by USB ports will usually provide cool, safe charging of almost any Li-ion device.

Tip 5: Whenever possible, carry a spare battery

If your device allows for easy battery replacement, carrying a spare battery is cheap insurance. It not only gives you twice the run time but also helps you avoid the need to fully discharge a battery or use a quick charge. When the in-use battery approaches 15–20 percent charge, simply swap out the drained battery for a fresh, cool one — you get instant full power, with no heat worries.

A spare battery also allows for other benefits. For example, if you find yourself in a situation where the installed battery is running hot (say, because your device was working extra hard at some long task or because the ambient temperature is exceptionally high), you can swap out the hot battery to let it cool.

Having two batteries should also eliminate any need to use fast chargers — you can charge the spare at a safe, slow rate while the other is in use.