

TIM MOYNIHAN GEAR JAN 22, 2017 9:36 PM

Samsung Finally Reveals Why the Note 7 Kept Exploding

The smartphone maker offered an explanation today regarding the Galaxy Note 7's combustion problems.



SAMSUNG

 SAVE

WELL, IT WASN'T the stylus.

After months of silence following a global recall of its Galaxy Note 7 smartphone last October, Samsung disclosed its lengthy findings as to what caused the device's batteries to overheat and catch fire. Based on the company's own investigation and independent scientific analysis of the issues by three consulting bodies, the overheating was caused by separate problems in batteries sourced from two different suppliers.

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In the case of batteries sourced from Samsung SDI, there wasn't enough room between the heat-sealed protective pouch around the battery and its internals. In the worst scenarios, that caused electrodes inside each battery to crimp, weaken the separator between the electrodes, and cause short circuiting.¹

In the case of batteries sourced from Amperex Technology Limited, some cells were missing insulation tape, and some batteries had sharp protrusions inside the cell that led to damage to the separator between the anode and cathode. The batteries also had thin separators in general, which increased the risks of separator damage and short circuiting.

The findings were announced after testing 200,000 devices and 30,000 batteries in a giant charging and recharging test facility built for the task. Samsung mobile communications chief D.J. Koh says a team of 700 company engineers conducted internal testing, and independent reviews of potential problems were carried out by UL, Exponent, and TÜV Rheinland.

The company offered this explanation at a press event in South Korea Sunday. Samsung did not provide details about its prior quality-control procedures, but the company says it has overhauled its safety testing process as a result of the investigations.

“We are taking responsibility for our failure to identify the issues arising out of the battery design and manufacturing process prior to the launch of the Note 7,” Koh said at the conclusion of the event.

From Dream Phone to Nightmare

As far as smartphone battery sagas go, this one was packed with twists, turns, and then a whole lot of silence. In September, weeks after the Note 7 launched, Samsung issued an initial recall of 2.5 million devices after several phones experienced overheating issues. By the time the US Consumer Product Safety Commission issued a formal nationwide recall two weeks later, nearly 100 dangerous battery incidents had been reported in the United States.

The first fix seemed straightforward---if annoying---to early Note 7 buyers. Samsung had purportedly pinpointed the cause of the problem: It had used two sources for the Note 7 batteries, and the ones made by Samsung's own component division seemed to be faulty. Just trade in your fancy new Note 7, and they'd replace it with a new phone powered by the safer battery. You could tell if your phone had the safer battery inside it if the battery meter was green instead of white.

But then those "safer" replacement phones started overheating and catching fire. It even happened on an airplane when a replacement device was unplugged and powered off, in cooperation with FAA instructions.

According to a Wall Street Journal report, Samsung had misdiagnosed the problem when issuing the first recall. Batteries from both of the Note 7's suppliers were susceptible to similar problems. In October, Samsung expanded its recall and stopped Note 7 production entirely.

Silence and Speculation

After the October recall, very few additional details were released. Instead, Samsung concentrated on making sure people weren't still using the Note 7, even resorting to pushing out updates to all Note 7 phones to brick the devices.

This wasn't the only battery-related scare of 2016, as the CPSC recalled a half-million "hoverboards" due to similar conflagratory problems. Those scooter issues were largely blamed on low-cost batteries---ones that likely had internal flaws and impurities that caused short circuits---that were churned out to meet demand for a hot craze.

But the Note 7 debacle shows that any lithium-ion battery, including those made or sourced by big-name companies, aren't immune. And now that our devices are ever slimmer, more powerful, and more important for a full day's communication, it may exacerbate the danger.

"It's all about size," says Jay Whitacre, who researches materials science and engineering at Carnegie Mellon University. "Lithium-ion batteries are two- to ten-times more energy-dense than other battery technologies, and getting more use time without having a huge phone is a big deal."

For smartphone users, that energy density helps give tiny devices long battery life; the Note 7's 3,500mAh battery was built to get through a full day. Whitacre says that Lithium-ion's efficiency comes at a price. It's the only mainstream battery chemistry that uses a flammable substance as an electrolyte, so while it's more efficient than battery technologies with water-based electrolytes, such as nickel-cadmium and nickel-metal hydride, it also presents a greater fire risk.

But every smartphone has a lithium-ion battery inside it, and the Note 7 presented wildcards that stoked speculation.

Samsung said it explored any potential problems involving system software, manufacturing, and Note 7 hardware during its months-long investigation. They tested with the phone's iris-scanning feature turned on and off, downloaded third-party apps to see if that had any effect, and tested to see if USB-C charging played a role.

It was Samsung's first phone with a USB-C port for charging, and it was a quick-charging phone, designed to deliver an 80-percent charge of its high-capacity battery in just 35 minutes. Samsung also included a USB-C-to-MicroUSB adapter in the box, so users could charge the device with older cables.

With all those variables and new technologies packed into the phone, it seemed possible that something could have gone wrong with the phone's power-management features. But all those tests checked out, according to Samsung and independent researchers. Plus, those components are practically the same in any phone.

“It seems unlikely, since the battery-facing components in most phones are chips that are used broadly in many phones,” Whitacre says. “A cell made to be fast-charged should be engineered to accept the high currents without overheating or having internal shorts. As long as a battery is designed to be fast-charged, it should pose no additional danger.”

Whatever perfect storm of power-management failures could have occurred, they shouldn't have caused the battery to explode. Safe lithium-ion batteries have features that mitigate disaster in these types of situations, but short circuits and internal battery damage are harder to defend against.

“A well-designed battery with good safety considerations should be able to safely fail in the event of a faulty control circuit,” Whitacre says. “It might vent or puff up, but not actually burn or flame.”

According to Samsung's Koh, the company doesn't just intend to make its own batteries safer. As part of its new safety procedures, Samsung will safety-test batteries at every point in the manufacturing process. They'll also train employees at every level of the supply chain.

As for its own phones, the company is designing a new compartment to give batteries more space inside the phone and combat damage from physical drops. Koh finished the event by saying that Samsung will share its lessons with the entire industry to improve overall lithium-ion battery safety.

UPDATE 1/24/2017 12:30pm ET: This story has been updated to clarify the problems found in Samsung SDI's batteries.



[Tim Moynihan](#) covers hardware for Gadget Lab, with a concentration on cameras, TVs, Ultra HD video, virtual reality, and the weirdest things he can find. He has 17 years of tech journalism experience, serving as senior editor at PCWorld, homepage editor at CNET, and an online producer at TechTV prior ... [Read more](#)



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