EXHIBIT 3
Prof. Donald Sadoway of M.I.T. said more extensive tests of the 787 battery were needed this time.
The batteries' original insulation made of polyvinyl chloride, or PVC, can withstand heat of 300 degrees Fahrenheit. Instead, the cells will be wrapped with another insulating material called phenolic glass laminate, made of thin layers of a fiberglass material and resin, with a resistance of more than 900 degrees.

Boeing is also taking steps to reduce vibrations inside the battery that might have been one of the possible causes of the short circuits.

The changes to the two batteries will add 150 pounds to the weight of the airplane — a small addition to the 350,000 pound jet — but enough to offset the weight advantage from using the lighter lithium-ion batteries in the first place.

Boeing said it had been testing its new system for the last six weeks and found that the steel casing could withstand three times the pressure generated when a battery suffered a catastrophic failure.

"We think the likelihood of a repeat event is very unlikely," Ron Hinderberger, a senior Boeing 787 engineer, said on a conference call on Friday.
Mr. Sinnett said that Boeing engineers had identified 80 different ways that the batteries could fail and modified the batteries as a result. But if, for whatever reason, a cell did overheat and combust, the steel casing would contain the smoke and fire, the venting tube would open, and the smoke would be pushed outside the plane instead of venting inside the cabin.

Donald R. Sadoway, a materials chemistry professor at M.I.T., was not persuaded that Boeing’s plan went far enough. He said Friday that the proposals seemed intended to mollify the F.A.A. to lift the grounding of the planes, but the approach seemed to focus more on dealing with a battery failure rather than preventing one. He pointed out that automakers had developed large-format lithium-ion batteries without encountering the problems Boeing has had.

“It doesn’t have the look and feel that they are going to extreme measures to make sure this thing is robust,” he said.

The presence of senior Boeing officials in Japan reflected the central role that Japanese companies have played in financing and manufacturing the planes. Japanese authorities also need to approve Boeing’s new design.

The lithium-ion battery is made in Japan by GS Yuasa, which Mr. Conner called “a tremendous partner.”

During the presentation, Boeing also disputed characterizations made by the National Transportation Safety Board in its investigation of the Boston episode. The safety board has described it as a fire event that was caused when a failure in one cell cascaded to others, in what the board referred to as a thermal runaway. Boeing executives took issue with both assertions, contending there never was a fire inside the battery. They pointed out that the only eyewitness report referred to two three-inch flames on the connectors outside the battery box. The second episode involved only smoke.

In a report last week, the safety board said that firefighters reported “radiant heat waves along with considerable smoke, but no flames, and one firefighter was burned in the neck when the battery exploded.

In response, a safety board spokeswoman said the board stood by its report and would “release only factual information as we are able to corroborate it.”
Boeing officials have detailed for the first time their proposed fixes for the lithium-ion batteries aboard its 787 planes, and the changes include better insulation between the eight cells in the battery, gentler charging to minimize stress and a new titanium venting system.

One change proposed for the Boeing 787 is to seal its batteries in a steel box, which would contain any smoke and fire.

But to prevent any new fire and smoke episodes like the ones that have grounded its fleet, Boeing proposed the crudest tool in its considerable technological arsenal: the battery itself will be sealed inside a steel box that would serve as the last safety rampart if everything else fails.

The Federal Aviation Administration approved these changes on Tuesday, and Boeing has since begun a series of 20 certification tests that it expects to wrap up in one to two weeks. Most of the tests will be conducted inside Boeing labs, with only a single test flight planned since the plane's two batteries are not used while in normal flight.

The 50 787s delivered to airlines so far have all been grounded since mid-January after two planes developed battery problems; one battery ignited while a plane was parked in Boston and another forced an emergency landing in Japan when it began to smoke. With significant commercial and financial stakes in the balance, Boeing is keen to rapidly resume passenger flights, though government officials have been more cautious about the timing.

But the new safety features, made public late Thursday, were an admission that despite its substantial resources, Boeing might never determine what went wrong with the batteries. Still, the changes are intended to reassure regulators.
Why Are the Batteries in Boeing's 787 Burning?

By Drake Bennett on January 18, 2013

Boeing’s (BA) 787 Dreamliner has not had a charmed birth. While some of its problems—a windshield crack, minor fuel leaks—can easily be dealt with, the issues that have arisen with the plane’s batteries are much more serious.

In two incidents in recent weeks, lithium-ion batteries malfunctioned—the battery in a 787 on the tarmac in Boston caught fire, and a second 787 was forced to make an emergency landing Wednesday morning in Japan, when smoke from the battery made its way into the cockpit. That led to a worldwide grounding of Dreamliners while authorities investigate the batteries and other 787 systems.

It isn’t the first time this type of battery has shown itself to be combustible. Recent years have seen reports of lithium-ion batteries catching fire or exploding in smartphones and laptop computers. What is it about these batteries that makes them so prone to blowing up?

The first thing to know about lithium-ion batteries (li-ion batteries, for short) is that lithium is extremely flammable. The other thing to know is that li-ion batteries carry much more energy per weight than any other battery; in technical parlance, they have a higher energy density. That’s why they’re the battery of choice in everything from iPhones to laptops to electric cars, whose designers want to get the greatest potential power out of the smallest, lightest power source. In the Dreamliner, the use of li-ion batteries was part of what made the plane so much lighter—and therefore more fuel-efficient than its predecessors.

The problem is that these qualities make li-ion batteries much more sensitive to heat than traditional lead acid batteries (the sort that start your car). And any time you run an electric current through something, whether it’s a light bulb filament or a battery, you produce heat. If a battery is being used to start the engine of a jetliner, as one of the Dreamliner’s li-ion batteries is, that requires a considerable pulse of energy and so it creates a correspondingly large amount of heat (the battery doesn’t directly start the engine; it starts a device called the auxiliary power unit, which in turn starts the engine). It’s too soon to know exactly what happened in the 787s,
but according to Donald Sadoway, a battery researcher and MIT professor, if a li-ion battery is generating that much energy and isn’t being properly cooled, it’s very possible that it could heat itself to the point at which it would burst into flames. “You’ve got to draw very, very high amperage for a very short time, so you’re generating a boatload of heat,” he says.

Another option is that the problem plaguing the 787 batteries has plagued li-ion laptop batteries in the past: an internal short-circuit. A byproduct of the battery manufacturing process is that tiny bits of metal float in the lithium liquid in the electrolyte, the portion of the battery that separates its positive and negative ends. The metal dust serves no purpose, but so far manufacturers have been unable to figure out how to eliminate it. Normally those metal bits are harmless, but once in a very long while they can cause short-circuits (PDF) in the battery cell; if enough of the particles cause shorts at the same instant, this can trigger a “thermal runaway.” In essence, the battery releases all its stored energy at once, and since li-ion batteries can carry so much energy, their thermal runaways are particularly dramatic. The resulting spike in temperature can then ignite the lithium in the battery, causing the battery to catch fire, melt down, spew flames, explode, or some unpleasant combination of all four.

Battery makers try to limit the likelihood of shorts and to protect against the consequences of them. Li-ion batteries have what are, essentially, different sorts of internal circuit-breakers, plus vents to allow for pressure relief. Many are built using lithium compounds that have been synthesized to maximize stability at the expense of energy density. Sadoway’s own work at MIT is on developing a solid polymer electrolyte that would avoid the volatility and flammability of today’s li-ion batteries.

Still, it’s a testament to the cost of jet fuel that airplane makers (Airbus’s forthcoming A350 also relies heavily on li-ion batteries) are putting them in planes. And it’s a testament to our unquenchable desire for smaller, more powerful electronics that we’re willing to place something so potentially combustible on our laps and in our pockets—and even put them next to our ears.
The issue is this: what happens when a battery catches fire? Boeing has put forth a superior containment so that the fire won't spread to the rest of the plane. But in the event of fire the reserve power contained in the battery becomes no longer available. How does Boeing address this inadequacy? There is a turbine that emerges and acts as a windmill. So why require a battery at all -- failure to deploy the windmill? Maybe one battery can substitute for the other, i.e., the APS battery can service the front of the plane -- redundancy. I suspect that the plane needs to land if there is a fire and it loses battery backup. Maybe not. The question is this: how long are you willing to fly without full backup power on an aircraft that is "fly by wire"? Boeing is betting that the odds of losing all generator capacity plus failure of the deployable wind turbine are vanishingly small. Maybe they're right. The question you gotta ask yourself is "do you feel lucky, do ya?"

~Donald Sadoway