

Tesla Battery Failures Make 'Bricking' a Buzzword

Sunday, March 04, 2012

By BRADLEY BERMAN, The New York Times

AN uproar recently ignited on automotive blogs over a post about a Tesla Roadster whose battery needed replacement after its owner parked the car, low on charge and unplugged, for more than two months. The battery, which had fully discharged, could not be revived.

While controversy has swirled around the incident -- with bloggers arguing about an owner's responsibility to keep the battery charged and the motivation in making the details public -- Tesla has confirmed basic facts about the situation.

The incident made a buzzword of "bricking," a term from the high-tech industry typically used to describe electronic devices rendered useless by corrupted software. In this case, it was the 1,000-pound lithium-ion battery pack of an electric Roadster -- a car that sold for about \$110,000 but whose production has now ended -- that became, effectively, a brick.

At a conference for electric vehicles last month in San Diego, Tesla's chief technical officer, J. B. Straubel, told reporters that all batteries could be subject to this total failure mode, but fewer than 10 Roadsters might be "susceptible" to the problem. He added: "If you ran your conventional engine without oil, whose fault would it be? It would be the owner's."

Since then, technical experts and electric-car enthusiasts have debated whether it is possible for an electric car's battery pack to become irreversibly depleted, and under what circumstances. Coming just weeks after fires in Chevrolet Volt lithium-ion packs resulting from federal crash tests under laboratory conditions, the failures gave fodder to critics who have questioned the viability of battery-powered cars. Here are answers to some questions raised by the Tesla battery situation:

Q. How exactly did this all begin?

A. A description of a Tesla Roadster in California whose battery suffered a total failure was posted on theunderstatement.com. The crux of the matter was Tesla's denial of warranty coverage because the owner had not plugged in the car while it was parked, as specified in the owner's manual and other materials. A replacement battery from Tesla's Los Angeles service center was offered at "around \$40,000," according to a letter to the owner from Tesla's vice president for service, J. Joost de Vries.

Q. How many Tesla Roadsters have experienced this failure?

A. According to J.B. Straubel, Tesla's chief technical officer, "less than 10" cars are "susceptible" to bricking. Several incidents of total battery failure that left cars completely incapacitated have been alleged in online reports by owners. A Tesla spokeswoman, Khobi Brooklyn, said she could not confirm the number of battery failures.

Q. Why would an electric car's batteries run down if the car was not being driven?

A. All modern vehicles, not just electric cars, have systems that draw power even when the car is shut off and parked. Clocks, antitheft alarms and audio systems are just a few of the devices that may be powered at all times by a conventional car's battery.

Cars with electric powertrains, including plug-in hybrids, typically have battery-management systems that are always active. These babysitters monitor and regulate the battery's temperature and charge level. The auto engineer's challenge is to minimize these drains on the battery -- called parasitic losses -- while keeping all systems running.

Q. Under what conditions would an electric vehicle battery become drained beyond saving?

A. An electric car's battery will fail totally only under extreme circumstances, according to Tesla. This occurs if the battery has been discharged "for an extended amount of time." Chemical changes that take place will make recharging impossible.

The electronic vehicle log from the Roadster with the failed battery recorded a span of 36 days from when the state of charge reached zero percent until Tesla said a complete replacement was needed.

Q. Why couldn't the Tesla Roadster batteries be recovered?

A. Because the Roadster lacks a 12-volt backup battery and a wake-up function, according to Jon Bereisa, a former General Motors engineer who is now president of Auto Lectrification. That wake-up feature gives technicians the ability to regain access to the depleted battery. "So, no 12 volts and no computers and no charge," Mr. Bereisa said in an e-mail. "Dead computers mean locked steering, locked Park, locked everything."

He added: "So unless you get a 12-volt battery into the 12-volt socket and leave it inside the car for the towing ride, the car will stay locked and the tow truck will have to drag it on board the flatbed carrier by brute-force winching."

Q. Can this problem be prevented?

A. Yes. Electric vehicles can use fail-safe systems, with multiple features to guard against full discharge, said Tom Gage, chief executive of EV Grid, a company focusing on energy exchange between E.V.s and the electric grid. They include the ability to isolate the battery from any loads (other than monitoring) when the charge gets low, use of a backup 12-volt battery and a separate "wake-up" function, sometimes using an external 9-volt battery, that can restart the vehicle's systems. "At this point, the battery must be slow-charged back to health, but it is fully recoverable," Mr. Gage said.

Ms. Brooklyn of Tesla said there was "no facility to prevent this full discharge" in the more than 2,000 Roadsters produced since 2008. Tesla said it planned to employ a "deep sleep" mode and other protective systems in its new Model S sedan.

Tesla's corporate blog explained the fail-safe provisions of the new model this way: "A Model S will not allow its battery to fall below about 5 percent charge. At that point the car can still sit for many months. Of course you can drive a Model S to 0 percent charge, but even in that circumstance, if you plug it in within 30 days, the battery will recover normally."

Q. How does a fail-safe system work?

A. A fail-safe essentially disconnects the E.V. battery pack from other vehicle systems that drain the battery. When cut off from the rest of the car, the battery will still drain, but it could take a year or more before the battery loses all power.

Q. Do all electric car batteries that reach zero state-of-charge become bricked?

A. No. E.V. engineers say that in most cases, a battery whose level has fallen to a zero charge level can be recovered, though with some loss of useful life. As Mr. Gage of EV Grid put it, "To brick a battery, it really has to be sucked dry."

Even when depleted, there's hope, according to Prabhakar Patil, chief executive of Compact Power, a battery company, and formerly chief engineer of Ford's hybrid technologies.

"If a battery is at zero state of charge for a couple of months, that should not by itself prevent you from being able to charge it," Mr. Patil said.

However, to save the battery, vehicles must be engineered with a recovery process for such occurrences. This may include using an on-board 12-volt battery or an electric connector to bring the vehicle's control systems back to life, making it possible for the propulsion battery to be recharged. (The Tesla Roadster does not use a conventional 12-volt battery.) Mr. Bereisa of Auto Lectrification, said G.M.'s defunct EV1 electric car used a 12-volt motorcycle battery to wake up the car's control systems and allow a grid recharge.

Q. How long can a Tesla Roadster be left without being plugged in before the battery is totally depleted?

A. According to a Feb. 24 post on Tesla's corporate blog, "The earliest Roadsters will take over two months to discharge if parked at a 50 percent charge without being plugged in." Depletion does not occur in a linear fashion, so it is hard to pin down how long it would take to reach zero from other charge levels.

In Tesla Roadster online discussion forums, several owners reported an average loss of about 0.5 percent state-of-charge per day. That half-percent figure is generally regarded by experts as high.

Q. What systems did Tesla create to prevent bricking in its Roadster?

A. Tesla's primary strategy is customer education. At purchase, owners must sign a document acknowledging the need to plug in the car when it is parked for extended periods. The owner's manual explains the same requirement. Customers are periodically reminded by e-mail and during service calls to plug in. When the battery reaches a low state of charge, the owner

is alerted with audible and visual warning signals. Tesla said that starting with production of the Roadster 2.0 (after the first 500 or so cars), a wireless communication system, capable of notifying the company of a dying battery, was added.

Q. What has Tesla told owners of Roadsters about the potential for bricking and how to prevent it?

A. Tesla's essential advice to customers is straightforward: if you're going to store your Roadster, plug it in. If for any unforeseen reason, the car becomes unplugged or the power to a plugged-in car is interrupted, the onboard warning lights and beeps will warn the customer, and the wireless communication (on later models) will notify Tesla, which then contacts the owner. Tesla will then attempt to contact the owner to recharge the car.

Q. Are bricked Roadster batteries under warranty?

A. No. "Because this issue is avoidable, it is not covered in the warranty," according to Tesla. "Similarly, combustion vehicles require regular oil changes or the engine will be destroyed. This is the owner's responsibility."

Q. Are all types of electric car batteries potential victims of total irreversible failure?

A. All batteries will eventually fail if left to drain slowly for many years, but bricking is avoidable with a fail-safe provision that could sustain some level of charge for years.

Nissan said in a statement that the Leaf's battery pack "will never discharge completely, thanks to an advanced battery-management system designed to protect the battery from damage."

And, said a Nissan spokeswoman, Katherine Zachary, "Never means never."

This article originally appeared in [The New York Times](#).

First published on March 4, 2012 at 12:01 am

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