



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 13-037
Date Opened: 11/15/2013
Investigator: Will Godfrey
Approver: Frank Borris
Subject: Fire - Propulsion Battery - Road Debris
Date Closed: 03/26/2014
Reviewer: Scott Yon

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: Tesla Motors, Inc.
Products: 2012-2013 Tesla Model S
Population: 15,805
Problem Description: Deformation/intrusion into the propulsion battery by roadway debris may result in a thermal reaction and fire.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	0	2	2
Crashes/Fires:	0	2	2
Injury Incidents:	0	0	0
Fatality Incidents:	0	0	0
Other*:	0	29	29

***Description of Other:** Tesla reports alleging undercarriage strike damage, many of which were minor in nature, and none of which resulted in a battery fire or vehicle disablement.

ACTION / SUMMARY INFORMATION

Action: This Preliminary Evaluation has been closed.

Summary:

The subject vehicles (SV), model years 2012-2013 Tesla Model S, are emerging technology electric vehicles using a high voltage battery (HVB) to provide propulsion energy. The HVB uses lithium-ion cells combined in 60 or 85 kWh capacities, and a control system that monitors the HVB and its liquid cooling system. The HVB is positioned across the width of the vehicle between the front and rear wheels and lies above a flat aluminum pan that forms the bottom of the SV's chassis. About two thirds of the SVs were manufactured with an air-assisted suspension system that actively controls ride height, including automatically lowering the vehicle at higher speeds.

Two separate incidents in 2013 resulted in significant fires involving the SVs, one in Washington (Oct. 13) and one in Tennessee (Nov. 13). Both incidents involved active suspension equipped vehicles operating at highway speeds and reduced ride height running over debris in the roadway. In both incidents, the struck objects penetrated the aluminum pan at the forward area of the battery, damaging the lithium ion cells of the HVB. The SV's information display notified the driver of decreased battery performance and ultimately instructed the driver to stop the vehicle. The SVs were able to travel ~.8 and 1.8 miles after impact respectively. In both cases, smoke appeared shortly after the vehicle stopped and a fire developed in the HVB. Thermal runaway occurred in the HVB cells. The fires destroyed the vehicles but did not result in injuries.

In the Tennessee incident, the object struck by the SV was determined to be a three-ball hitch that apparently fell from another vehicle. Tesla performed a series of tests reconstructing this incident and determined that a similar shaped object contacting the forward edge of the HVB could be "tripped" and potentially penetrate the HVB case. As the object's opposite end digs into the pavement, vehicle momentum causes the object to impart upward force into the case, described by Tesla as a "piking effect". Tesla's testing reproduced damage similar to that seen in the Tennessee

incident, and also showed that a change in ride height strategy, which was implemented in Nov. 2013 via a telematic software update to prevent the SVs lowering at legal roadway speeds, mitigates the risk of battery compartment penetration when a three-ball hitch is struck.

The object struck in the Washington incident was not identified. More severe damage to the incident vehicle and the unknown shape of the object raised concerns regarding the effectiveness of raising the ride height for objects other than a three-ball hitch. In a Mar. 10, 2014 meeting with ODI, Tesla stated it would conduct a free-of-charge service campaign to modify the SVs by adding three new components to the vehicle's undercarriage to protect the HVB. A low-hanging transverse member and an additional underbody plate would be mounted forward of the HVB case and a third plate would overlap the leading edge of the case. Testing conducted by Tesla demonstrated that these modifications improved protection from debris impacts.

ODI was aware of two fires stemming from road debris impacts when the investigation began. According to Tesla, the SV fleet had accumulated ~90M miles of service at the time it revised the ride height strategy. No further incidents have been identified, and Tesla reports the Model S fleet has traveled an additional ~90M miles. ODI believes impacts with road debris are normal and foreseeable. In this case, Tesla's revision of vehicle ride height and addition of increased underbody protection should reduce both the frequency of underbody strikes and the resultant fire risk. A defect trend has not been identified. Accordingly, the investigation is closed. The closing of the investigation does not constitute a finding by NHTSA that a safety-related defect does not exist, and the agency reserves the right to take further action if warranted by new circumstances.