



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 21-020
Date Opened: 08/13/2021
Investigator: Steven Posada
Approver: Stephen Ridella
Subject: Autopilot & First Responder Scenes
Date Closed: 06/08/2022
Reviewer: Gregory Magno

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: Tesla, Inc.
Products: 2014-2022 Tesla Model Y, Model X, Model S, Model 3
Population: 830,000 (Estimated)
Problem Description: Subject vehicle crashes with in-road or roadside first responders.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	0	0	0
Crashes/Fires:	14	0	14
Injury Incidents:	7	0	7
Number of Injuries:	15	0	15
Fatality Incidents:	1	0	1
Number of Fatalities:	1	0	1
Other*:	2	0	2

***Description of Other:** Collisions identified by Tesla in their response to NHTSA's April 2021 Information Request: Belmont CA, Mount Pleasant SC

ACTION / SUMMARY INFORMATION

Action: This investigation has been upgraded to an Engineering Analysis (EA22-002)

Summary:

On August 13, 2021, NHTSA's Office of Defects Investigation (ODI) opened a Preliminary Evaluation (PE21-020) to assess the performance of Tesla's Autopilot system (a system characterized by Tesla as an SAE Level 2 driving automation system designed to support and assist the driver in performing the driving task) available in Tesla vehicles. The investigation opening was motivated by an accumulation of crashes in which Tesla vehicles, operating with Autopilot engaged, struck stationary in-road or roadside first responder vehicles tending to pre-existing collision scenes. Upon opening the investigation, NHTSA indicated that the PE would also evaluate additional similar circumstance crashes of Tesla vehicles operating with Autopilot engaged, as well as assess the technologies and methods used to monitor, assist, and enforce the driver's engagement with the dynamic driving task during Autopilot operation.

PE21-020 is upgraded to an Engineering Analysis (EA) to extend the existing crash analysis, evaluate additional data sets, perform vehicle evaluations, and to explore the degree to which Autopilot and associated Tesla systems may exacerbate human factors or behavioral safety risks by undermining the effectiveness of the driver's supervision. In doing so, NHTSA plans to continue its assessment of vehicle control authority, driver engagement technologies, and related human factors considerations.

The attached Detailed Summary further describes NHTSA's review to date and the basis for upgrade to an EA.

PE21-020 Upgrade to EA22-002 Detailed Summary

On August 13, 2021, NHTSA's Office of Defects Investigation (ODI) opened a Preliminary Evaluation (PE21-020) to assess the performance of Tesla's Autopilot system (a system characterized by Tesla as an SAE Level 2 driving automation system designed to support and assist the driver in performing the driving task) available in Tesla vehicles. The investigation opening was motivated by an accumulation of crashes in which Tesla vehicles, operating with Autopilot engaged, struck stationary in-road or roadside first responder vehicles tending to pre-existing collision scenes. Upon opening the investigation, NHTSA indicated that the PE would also evaluate additional similar circumstance crashes of Tesla vehicles operating with Autopilot engaged, as well as assess the technologies and methods used to monitor, assist, and enforce the driver's engagement with the dynamic driving task during Autopilot operation.

Between August 31, 2021, and September 13, 2021, NHTSA sent information request (IR) letters to Tesla and twelve other vehicle manufacturers, requesting production and field incident reporting data as well as information concerning the engineering and performance of their systems designated as Level 2.

On October 12, 2021, NHTSA sent two additional sets of requests to Tesla: (1) an IR letter to obtain information on the company's changes to subject vehicles' functionality through software updates intended to improve the detection of emergency vehicle lights in low light conditions; and (2) a Special Order (SO) to request information concerning Tesla's use of nondisclosure agreements with consumers whose vehicles were included in a Full Self-Driving (FSD) "beta" release program.

NHTSA augmented its PE21-020 analysis with crashes reported by Tesla in response to an IR letter sent on April 19, 2021, and via the Standing General Order (SGO) issued by NHTSA on June 29, 2021 (amended on August 5, 2021).

Collectively, these sources provide NHTSA with a significant number of complaints and crashes involving vehicles equipped with systems designated as Level 2. Throughout the course of this investigation, NHTSA has prioritized the collection and review of this information.

NHTSA undertook a detailed review of the crash pattern that formed the principal basis for opening PE21-020: the eleven collisions of subject Tesla vehicles with other vehicles stopped at first responder scenes reported between January 2018 and July 2021. During this investigation, six additional such incidents were subsequently identified and added to the crash analysis: Three crashes (Orlando, Petaluma, Desert Center) involved first responder or crash attenuator trucks in the roadway and occurred after PE21-020 opened. A 2020 additional crash (El Paso) in which a police vehicle was struck was reported via the SGO in March 2022. Two additional 2021 crashes (Belmont and Mount Pleasant) involving a first responder and a crash attenuator truck, respectively, were reported to NHTSA in response to NHTSA's April 19, 2021, IR letter to Tesla. Further review of the Laguna Beach crash listed on the PE21-020 opening resume has led to its removal from this consideration because the struck vehicle was parked out of traffic with no lights illuminated. The Laguna Beach incident remains within NHTSA's broader crash analysis within this investigation.

The agency's analysis of these sixteen subject first responder and road maintenance vehicle crashes indicated that Forward Collision Warnings (FCW) activated in the majority of incidents immediately prior to impact and that subsequent Automatic Emergency Braking (AEB) intervened in approximately half of the collisions. On average in these crashes, Autopilot aborted vehicle control less than one second prior to the first impact.

All subject crashes occurred on controlled-access highways. Where incident video was available, the approach to the first responder scene would have been visible to the driver an average of 8 seconds leading up to impact. Additional forensic data available for eleven of the collisions indicated that no drivers took evasive action between 2-5 seconds prior to impact, and the vehicle reported all had their hands on the steering wheel leading up to the impact. However, most drivers appeared to comply with the subject vehicle driver engagement system as evidenced by the hands-on wheel detection and nine of eleven vehicles exhibiting no driver engagement visual or chime alerts until the last minute preceding the collision (four of these exhibited no visual or chime alerts at all during the final Autopilot use cycle).

During the PE, the agency also closely reviewed 191 crashes involving crash patterns not limited to the first responder scenes that prompted the investigation opening. Each of these crashes involved a report of a Tesla vehicle operating one of its Autopilot versions (Autopilot or Full-Self Driving, or associated Tesla features such as Traffic-Aware Cruise Control, Autosteer, Navigate on Autopilot, and Auto Lane Change). These crashes were identified from a variety of sources, such as IR responses, SGO reporting, SCI investigations, and Early Warning Reporting (EWR). These incidents, which are a subset of the total crashes reported, were identified for a particularly close review not only because sufficient data was available for these crashes to support a detailed evaluation, but also because the crash scenarios appeared characteristic of broader patterns of reported crashes or complaints in the full incident data.

A detailed review of these 191 crashes removed 85 crashes because of external factors, such as actions of other vehicles, or the available information did not support a definitive assessment. As a primary factor, in approximately half of the remaining 106 crashes, indications existed that the driver was insufficiently responsive to the needs of the dynamic driving task (DDT) as evidenced by drivers either not intervening when needed or intervening through ineffectual control inputs.

In approximately a quarter of the 106 crashes, the primary crash factor appeared to relate to the operation of the system in an environment in which, according to the Tesla owner's manual, system limitations may exist, or conditions may interfere with the proper operation of Autopilot components. For example, operation on roadways other than limited access highways, or operation while in low traction or visibility environments, such as rain, snow, or ice.

For all versions of Autopilot and road types, detailed car log data and enough additional detail was available for 43 of the 106 crashes. Of these, 37 indicated that the driver's hands were on the steering wheel in the last second prior to the collision.

Although this subset of crashes is not exhaustive, the crash review identified patterns in system performance and associated driver behavior across different sets of circumstances that enable the agency to identify areas of engineering inquiry that warrant an upgrade of this Preliminary Evaluation to an Engineering Analysis (EA).

With respect to driver behavior, during this PE, NHTSA examined information submitted by Tesla and peer manufacturers in response to an IR question that requested driver engagement and attentiveness strategies to the DDT during system operation designated as Level 2. Of those crashes involving first responder or roadside maintenance vehicles for which car log data existed, under the driver engagement strategy alerts were presented to only two of the drivers within 5 minutes of the crash. This suggests that drivers may be compliant with the driver engagement strategy as designed.

A driver's use or misuse of vehicle components, or operation of a vehicle in an unintended manner does not necessarily preclude a system defect. This is particularly the case if the driver behavior in question is foreseeable in light of the system's design or operation. For systems labeled as SAE Level 2 ADAS, important

design considerations include the ways in which a driver may interact with the system or the foreseeable ranges of driver behavior, whether intended or unintended, while such a system is in operation. This is because these systems still depend upon the driver to maintain supervisory responsibility for the DDT, whereas the vehicle features perform only a support role. As such, ensuring the system facilitates the driver's effective performance of this supervisory driving task presents an important safety consideration.

Accordingly, PE21-020 is upgraded to an Engineering Analysis to extend the existing crash analysis, evaluate additional data sets, perform vehicle evaluations, and to explore the degree to which Autopilot and associated Tesla systems may exacerbate human factors or behavioral safety risks by undermining the effectiveness of the driver's supervision. In doing so, NHTSA plans to continue its assessment of vehicle control authority, driver engagement technologies, and related human factors considerations.

Incident List (PE21-020 Opening)

Date	City/County	State
Jul 2021	San Diego	CA
May 2021	Miami	FL
Mar 2021	Lansing	MI
Feb 2021	Montgomery County	TX
Aug 2020	Charlotte	NC
Jul 2020	Cochise County	AZ
Jan 2020	West Bridgewater	MA
Dec 2019	Cloverdale	IN
Dec 2019	Norwalk	CT
Jan 2018	Culver City	CA

Incident List (EA22-002 Upgrade)

Date	City/County	State
Jan 2022	Desert Center	CA
Sep 2021	Petaluma	CA
Aug 2021	Orlando	FL
Apr 2021	Belmont	CA
Jan 2021	Mount Pleasant	SC
Nov 2020	Houston	TX