



EXEMPLAR VEHICLE TESTING

Spring, TX

HWY21FH007

(4 pages)



National Transportation Safety Board

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Subject: Exemplar Vehicle Testing – Spring, TX, HWY21FH007

Tesla Model S P100D Exemplar Test

1. Introduction

The crash investigation found evidence that there was no occupant in the driver's seat of the 2019 Tesla Model S P100D after the fire/rescue responders extinguished the vehicle fire. Media reports speculated that the vehicle may have been operated with Autopilot engaged. NTSB investigators conducted a series of vehicle tests using a representative vehicle at the scene of the crash to determine whether Autopilot, adaptive cruise control, or lane keep assistance would have been available at the crash location. The investigators also examined if the Tesla could have detected the speed limit at that location and examined the operation of door release mechanism when power supply is interrupted.

2. Background

One of Tesla's Advanced Driver Assistance Systems (ADAS) is called "Autopilot". The Autopilot system is a combination of Traffic Aware Cruise Control (TACC) and Autosteer components. Both systems must be available for Autopilot to engage. Autosteer is a lane keeping system that uses optical sensors to monitor roadway lane markings and maneuver the vehicle within the marked lanes. If lane lines are not present, or become disrupted, the Autosteer function becomes unavailable. Traffic Aware Cruise Control is an adaptive cruise control system which maintains set cruise speed (as a traditional cruise control would) and decelerates the vehicle when approaching another vehicle in front. Autosteer can be engaged only after activating TAAC; Autosteer cannot operate without TACC. When TACC and Autosteer are both engaged, the system (1) monitors the environment on the traveling path, (2) maintains the set cruise velocity, (3) maintains vehicle's position in the traveling lane, (4) brakes when detecting a slower moving vehicle or an obstacle ahead, and (5) decelerates and follows a slower-moving vehicle in front at the predetermined following distance.

The Vehicle and Battery Group Chairman's Factual Report, available in the docket for this crash, also contains information about the vehicle performance and functionality.

3. Objective

The objective of the Tesla Model S Exemplar tests was to determine which ADAS features were able to be engaged at the location of the crash. Information about the door functionality of the vehicle in powered non-power conditions was obtained. These tests were not intended to characterize the full functionality of these systems and solely focused on system availability specific to this location.

4. Procedure

NTSB Investigators requested, and were provided, an exemplar 2017 Model S P100D by Tesla. The vehicle identification number (VIN) of the exemplar was 5YJSA1E4XHF*****. The software and firmware on the exemplar were configured by Tesla to be similar to the crash involved Model S. Although the exemplar had different firmware, investigators were assured by Tesla that any difference would not affect the systems being tested. A testing protocol was established and agreed upon by Tesla. This protocol was organized as follows:

- Determine the ability to engage Traffic Aware Cruise Control (TACC). If TACC was possible, determine the speed the vehicle could achieve using TACC at this location.
- Determine the ability to engage autosteer. This function is dependent on the system recognizing lane lines.
- Determine if Autopilot can be engaged.
- Answer questions about the vehicle concerning what speed limit was detected for this location, and to document vehicle egress methods.

A Tesla representative was present for the entire testing process. Due to his familiarity with the vehicle systems, the representative drove while NTSB Investigators observed and directed the testing from the right front passenger seat and the right rear passenger seat.

Beginning at 1930 hours on April 24, 2021, roadway tests were performed on Hammock Dunes Place, the roadway leading to the crash location. A minimum of three tests of each system were performed at various speeds, in each direction, during daylight as well as in darkness at a similar time as the crash.

5. Tests Conducted

5.1. Engage Traffic Aware Cruise Control (TACC)

Every attempt to use TACC was successful as long as a minimum speed was attained prior to using the system. The engagement of TACC was indicated on the exemplar vehicle's display by a circle with the set speed within the circle. The TACC was set by pulling the control lever located on the lower left side of the steering column once.

When the TACC was engaged and the driver's seatbelt was unbuckled, three warning chirps were sounded, a visual warning on the display was flashed, an additional seatbelt icon on the display flashed, and the vehicle automatically slowed to a stop.

With the TACC engaged, the acceleration rate was tested on the exemplar using the right scroll wheel on the steering wheel to increase the set speed and it was found the system would only accelerate to a maximum of approximately 30mph in the distance available. The system then began to automatically decrease speed as vehicle entered the curve.

NTSB investigators determined that the Tesla detected no speed limit in the area of the testing and crash. The driver's display was blank where the roadway speed limit would normally show. Since Autopilot would not engage, investigators were unable to determine what the system default speed limit, if any, would be.

5.2. Engage Autosteer

When Autosteer is available on the Tesla, a steering wheel icon will be illuminated on the display in front of the driver. If the steering wheel icon is not showing, Autosteer is not available. The exemplar vehicle was tested at speeds ranging from 10 to 30 mph. Multiple trips were made on the roadway, in both directions and in daylight and darkness.

Attempts to engage autosteer in all conditions were unsuccessful. The steering wheel icon was not displayed, and the system was not available. Attempts were made to engage the system without having the icon displayed. This was done by pulling a control lever located on the lower left side of the steering column twice. The vehicle responded with a series of three audible indications (a chirping sound), and the steering wheel icon flashed, indicating engagement was not possible. There was also an additional visual warning notification illuminated at the bottom of the display located directly in front of the driver indicating Autosteer was temporarily unavailable. It was also noted that the Tesla did not recognize the mountable curbs present on the roadway as lane lines. The mountable curbs had no effect on the Autosteer functionality.

5.3. Engage Autopilot

Autopilot would not engage since Autosteer was not available on the exemplar vehicle, and both Autosteer and TACC are required to use Autopilot. Additionally, since the Tesla would not enable Autopilot, it was impossible to document the driver input required to engage autopilot and the time and distance it takes.

5.4. Additional Testing

NTSB Investigators also documented occupant egress methods from the rear seating positions, both with and without power supply. With the vehicle off, investigators were able to access the mechanical door release mechanism in the rear seats on both the driver's and passenger's side. By reaching into an approximately 1-inch U-shaped flap cut in the carpet below the seat, a tab was located. When grasped and pulled toward the center of the vehicle, the respective rear door would unlatch.