NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.

FACTUAL REPORT OF INVESTIGATION

A. CRASH INFORMATION

Location:	Southbound Interstate 405 south of Washington Boulevard, Culver City, Los Angeles County, California
Vehicle 1:	2014 Tesla Model S
Operator 1:	Private Owner
Vehicle 2:	2006 Seagrave Custom Firetruck (pumper)
Operator 2:	Culver City Fire Department, Culver City, California
Date and Time:	January 22, 2018, at approximately 8:40 a.m. PST
Injuries:	0
Fatalities	0
NTSB #:	**HWY18FH004**

B. INVESTIGATIVE GROUP

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C. CRASH SUMMARY

At about 8:25 a.m. on Thursday, January 22, 2018, the Culver City Fire Department and the California Highway Patrol (CHP) responded to a traffic crash involving a passenger car and a motorcycle in the northbound lanes of Interstate 405 (The San Diego Freeway) near Washington Boulevard. In response to the crash a CHP police vehicle was stopped on the left shoulder of the southbound lanes and a fire truck was stopped ahead of the police vehicle, canted left facing, in the left High Occupancy Vehicle (HOV) lane. The police vehicle and fire truck had their emergency lights activated. About 8:40 a.m. a 2014 Tesla S model sedan was traveling southbound in the HOV lane of I-405 and struck the rear of the stopped fire truck. When the crash occurred, the fire truck was unoccupied, and the driver of the sedan did not report any injuries. Statements from the driver and data downloaded from the Tesla after the crash indicate that the driver was utilizing driver assist technology when the crash occurred.

D. DETAILS OF THE FACTUAL REPORT OF INVESTIGATION

This report focuses on the factors which influenced the operation of the Tesla sedan leading up to the crash. More specifically, this report describes the driver's interaction with the vehicle, a general description of each vehicle, and the roadway environment. Because of the circumstances of the crash, the physical condition of the Tesla driver and the operation of the firetruck were not discussed.

1. 2014 Tesla Driver

The Tesla driver was a 47-year-old male. Information in this section focuses on the driver's licensing, crash history, vehicle familiarity, and the driver's perspective of the crash events. Observations of the driver were made by the California Highway Patrol immediately following the crash. Officers did not observe any signs of impairment; no toxicological testing was performed.

1.1. Licensing

At the time of the crash, the Tesla driver held a valid California Class C driver license.[1] The license was issued on the driver's birthday in 1997; there are no current points or history of traffic violations. A query of the National Driver Registry NDR found no indication that the Tesla driver had been listed in the Problem Driver Point System (PDPS). [2]

1.2. Crash History

An insurance industry database which compiles a list of crash related insurance claims indicates that the Tesla driver has had 6 previous crashes; the most recent occurred in 2006. The database does not indicate cause or culpability in the crashes.

1.3. Crash Trip

When the crash occurred, the Tesla driver was traveling to his job in Los Angles from his home in Woodland Hills. The Tesla driver makes the commute daily and usually takes I-405 because he is able to use the HOV lanes, which he finds faster than alternative routes.

1.4. Vehicle Familiarity

At the time of the crash, the Tesla driver had owned the crash vehicle for about 6 months. This vehicle was the first vehicle that he had owned with driver assist technology. The driver stated that prior to buying the vehicle he had researched the technology and specifically selected

[1] A California Class C Driver License permits the holder to operate; 1. A 2-axle vehicle with a gross vehicle with a vehicle weight rating of 26,000 pounds or less. 2. A 3-axle vehicle weighting 6000 pounds or less. 3. A housecar 40 feet or less. 4. A 3-wheel motorcycle with 2 wheels located in the front or back. 5. A vanpool vehicle designed to care more than 10 persons but not more than 15 persons, including the driver.

[2] The National Driver Registry (NDR) is a database maintained by the National Highway Traffic Safety Administration (NHTSA) which compiles information from state licensing authorities to ensure individual driver licensing information are complete and accessible to all jurisdictions. All 51 US Jurisdictions submit information on individual driving records into the NDR data base for drivers whose license has been revoked, suspended, canceled or denied or who have been convicted of serious traffic-related offenses.

the Tesla for its Autopilot feature. Although the vehicle was purchased from a private individual, the vehicle was taken to a Tesla dealership and underwent a comprehensive mechanical inspection; the vehicle was found to be in good condition. The driver obtained an owner's manual when he purchased the vehicle however, he stated that he did not read the manual and received instruction on how to use the technology from a salesman at the dealership.

When questioned about the autopilot technology, the Tesla driver described it as reliable. He stated that the name autopilot did not accurately describe its use because the vehicle does not fully drive itself. The driver stated that he would most likely use the autopilot system on a freeway with stop and go traffic, normal flowing traffic, and freeways in which he did not intend to exit or change lanes. He like using the technology most in carpool lanes because traffic does not typically change lanes ahead which the technology requires in order to follow the leading vehicle. The driver stated that he would not likely use the autopilot system when driving towards the sun because he has noticed that the system does not work well under such conditions.

When asked about his past experiences using the technology the driver described instances when the autopilot feature would disengage. During these instances the driver stated that if he gave manual steering input, it would override the autopilot steering. The system would respond by disengaging. When this occurred, he would re-engage the system and resume driving. The driver stated that when using the autopilot system, he would maintain touch with the steering wheel. On occasion, when the vehicle sensed there were no straight lines, a light would come on indicating that he needed to control the car. Once he was holding the wheel, the light would go off.

1.5. Driver Statement

On January 22, 2018 the Tesla driver participated in a recorded interview with NTSB investigators about the events of the crash.[3] The Tesla driver stated that about half way into his commute he entered I-405 from US Route 101 near Sherman Oaks, California. About a half mile after entering I-405, he entered the HOV lane and activated the auto pilot technology. As he approached the crash location, he was traveling behind a large SUV or pickup truck. While he drove, he rested his hand on his knee while he touched the bottom of the steering wheel. As he drove, he had a bagel and a cup of coffee next to him. As he reached the stopped firetruck, the large vehicle ahead changed lanes. Although the driver stated that he was looking forward, he was unable to see the firetruck in time enough to avoid the crash. The driver states that he was not using his phone when the crash occurred. However; because after the crash his coffee spilled and his bagel was smashed, the driver is not sure if his coffee or bagel was in his hand when the crash occurred.

1.6. Cellphone Use

NTSB investigators obtained the Tesla driver's cellphone records to determine if he was using his cellphone to talk or text when the crash occurred.[4] The records indicate that the driver was not using his cellphone to text or talk in the minutes leading up to the crash. The records does not reflect information about manual manipulation of the device or the use of applications within

[3] Factual Report Attachment – 2014 Tesla Driver Interview Transcript
[4] Factual Report Attachment – 2014 Tesla Driver's Cellphone Records

the phone. Staff from the Tesla corporate office obtained a written witness statement from a vehicle passenger who was traveling alongside the Tesla when the crash occurred.[5] The witness stated that leading up to the crash, the Tesla Driver "appeared to be looking down at a cellphone or other device he was holding in this left hand." The witness further stated that the Tesla driver appeared to be touching the steering wheel with his right hand and was focused on the phone, not the roadway.

2. Vehicle Factors

There were two vehicles involved in this crash; a 2014 Tesla S passenger sedan and a2006 Seagrave Custom Firetruck (pumper). This section provides a general description of each vehicle, the observations of a post-crash inspection and a review of the perspective maintenance records.

2.1. Vehicle 1 – 2014 Tesla Model S Sedan, Passenger Vehicle

The Tesla was towed from the crash scene and stored at Tip Top Tow, in Santa Monica, CA. The vehicle was examined on January 25 and 26, 2018. All major vehicle operation systems were examined; including the powertrain, steering, braking, electrical, and suspension systems. Overall collision damage, along with any damage or anomalies within major vehicle operation systems were documented. Supporting photographs, vehicle specifications, and available maintenance records were reviewed. The media center (center stack), forward facing camera, and radar unit were removed from the passenger vehicle by NTSB investigators and transported to NTSB headquarters in Washington, DC., for further analysis.

2.1.1. General Information:

Make/Model:	2014 Tesla, 4-Door Sedan / Model S
VIN:[6]	5YJSA1H13EF[redacted]
Date of Manufacture:	November 2014
Curb Weight:	4,300 lbs.
GVWR:[7]	5,710 lbs.
GAWR (front axle):	2,813 lbs.
GAWR (rear axle):	3,131 lbs.
Single Electric-Motor:	Three phase, four pole AC induction motor with copper rotor, liquid cooled, with variable frequency drive
Battery:	85 kWh (346 V DC), Liquid-Cooled Lithium ion (Li-ion)
Transmission:	Single Speed Fixed Gear (overall final drive ratio 9.73:1)

[5] Factual Report Attachment – Witness Statement
[6] Vehicle Identification Number (VIN).
[7] Gross Vehicle Weight Rating (GVWR) is the total maximum weight that a vehicle is designed to carry when loaded, including the weight of the vehicle itself plus fuel, passengers, and cargo.

2.1.2. Damage Description:

For uniform description, "left" will refer to the driver's side, and "right" will refer to the passenger's side of the passenger vehicle. Damage sustained to the major vehicle operation systems will be documented in their respective sections later in this report.

The majority of the damage sustained by the passenger vehicle was from the front bumper, rearward to the firewall/dash area. The most severe damage occurred to the left of the centerline of the vehicle. The lower-front cowling, that wrapped around the front of the vehicle and made up the forward portion of the wheel wells, was found separated from the vehicle. The upper-cowling covering the top of the radiator and the two air conditioner condensers was broken. Both lower and upper cowlings had red colored transfer marks and the upper cowling contained a design imprint that matched the pattern from the rear deck of the firetruck.[8] The upper radiator mounting bracket was broken as well as the hood latch assembly. The center of the front bumper, between the frame horns, was rotated upward approximately 90-degrees from its original mounting position and there was a red-colored transfer mark just to the right of the centerline.

The hood had been crushed rearward and to the left. The hood was buckled almost in half and the trailing edge of the hood had impacted the windshield – shattering the glass. The leftThe left side of the hood displayed red-colored transfer marks and the damage appeared "square" in nature. The measurement between the creases of the "square" damage, was approximately12 inches.[9]

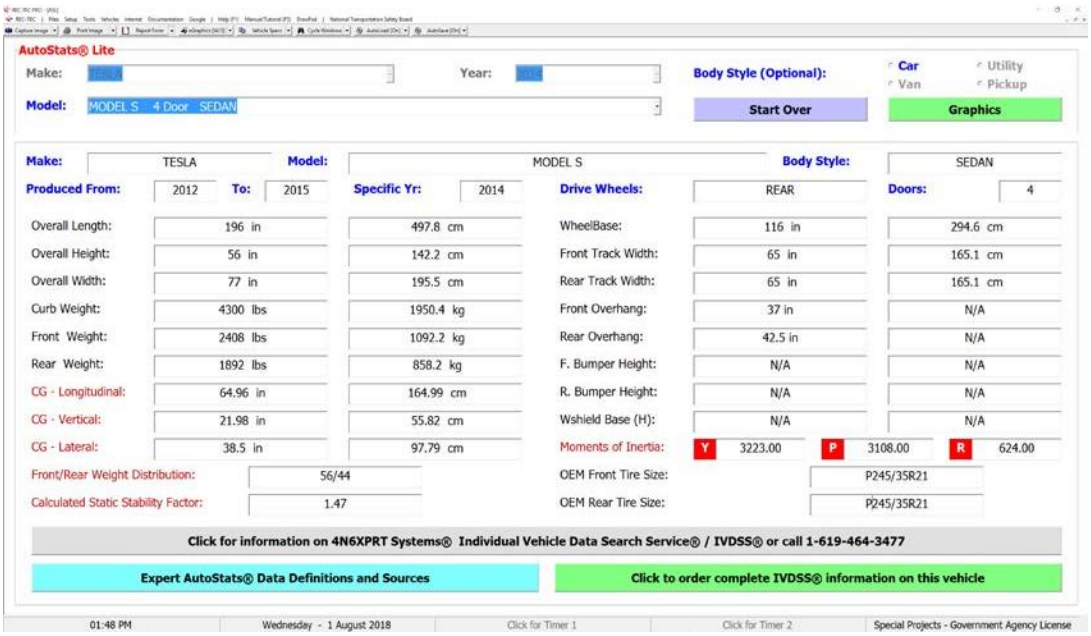
The right and left suspension turrets and crossmember were broken and had been displaced rearward into the firewall. The vehicle fuse boxes, master brake cylinder, and master brake cylinder fluid reservoir were crushed between the rearward displaced suspension turrets and crossmember and the firewall. Left-side cross brace was bent. The left side of the firewall had been displaced rearward, which in turn, displaced the dash and instrument panels rearward into the passenger compartment. The left side of the dash was in contact with the top of the steering wheel.[10]

2.1.3. Vehicle Specifications:

There were no post-crash measurements taken of the Tesla. **Table 1** is a snapshot of the vehicle specifications, listed in Expert AutoStats®, for the Tesla Model S.[11]

[8] See Vehicle Photograph 1 - Design Imprint on Upper Cowling of Passenger Vehicle
[9] See Vehicle Photograph 2 - Passenger Vehicle Hood Damage
[10] See Vehicle Photograph 3 - The Left Side of the Dash in Contact with the Steering Wheel
[11] Expert AutoStats® is a commercially available database containing vehicle dimensional information for most manufactured automobiles and light trucks.

Table 1 – Specifications for the Tesla Model S



2.1.4. Driver Controls

The driver control instrument panel and gauge display were all digital. Due to the amount of damage sustained in the crash, the main instrument panel display screen, located in the media center/center stack of the passenger vehicle, could not be safely powered on with the vehicle battery.

There were three control levers attached to the left side of the steering wheel column. The upper lever was a single, multifunctional lever which operated the windshield wipers, high/low headlight beam, and turn signal indicators. The center lever controlled the position of the steering wheel, such as, forward and backward and up and down. The lower lever controlled the operation of the Traffic-Aware Cruise Control and Autosteer functions of the vehicle, such as increasing or decreasing the following distance from the vehicle in front and increasing and decreasing the speed of the vehicle.

There was a single lever attached to the right side of the steering column which operated the transmission and electronic parking brake.

The steering wheel had three spokes, two with operational buttons. The buttons located on the left spoke of the steering wheel could be used to change radio stations, control volume, and navigate the left side of the instrument panel. The buttons located on the right spoke of the steering wheel could be used to operate cell phone applications, to navigate the right side of the instrument panel, and voice commands.

2.1.5. Airbags and Seatbelt

The driver supplemental restraint system deployed during the sequence of the crash. The driver's knee bolster airbag and frontal airbag both deployed during the sequence of the crash. The

driver's seating position was equipped with a Type 2 (three-point, continuous loop lap/shoulder) occupant restraint system. The driver's seatbelt was locked in the extended position. There were burn marks located on the seatbelt at the B pillar belt guide. There was no deformation on the latch plate. The buckle and latch plate securely locked together.

2.1.6. Event Data Recorder

The passenger vehicle was not equipped with an Event Data Recorder. The Tesla was equipped with an Air bag Control Module, however; this control module did not have an event data recorder. The center stack, which is the computer system for the vehicle was removed and sent to the NTSB Recorders lab in Washington, DC for further analysis.[12]

2.1.7. Steering

The passenger vehicle was equipped with a three spoke, multifunction steering wheel with tactile controls, mounted to a power-operated tilt and telescoping steering column. The steering wheel was connected via steering shafts to an electronic-powered steering rack. Intermediate steering shaft was separated from the upper steering shaft. The top of the left steering knuckle was displaced rearward.

2.1.8. Suspension

The front axle independent suspension system consisted of lower control arms, air springs/telescopic dampers, a stabilizer bar, and stabilizer bar connecting links. Both the right and left air spring/telescopic dampers were displaced rearward. The ball joint connecting the right-side steering knuckle to the forward, lower control arm, was broken.

The rear axle independent suspension system consisted of multiple linkages, air springs/telescopic dampers, a stabilizer bar and stabilizer bar connecting links. No damage was observed during the inspection.

2.1.9. Brake System

The passenger vehicle was equipped with a hydraulically operated, Anti-Lock Disc Braking System (ABS) with electronic brake force distribution, integrated advanced stability control, Automatic Emergency Braking (AEB) and regenerative braking. The brake calipers were a fixed type with four pistons each. The parking brake was electronically actuated and therefore, could not be operated during the inspection.

Damage to the brake system was isolated to the brake master cylinder, brake fluid reservoir, and brake pedal assembly. The rearward displacement of the vehicle body components, described in the *Damage Description* of this report, caused the rearward displacement of the brake master cylinder into the passenger compartment. The brake fluid reservoir was found to have separated from the master cylinder and was laying upside down at the base of the windshield. The reservoir was approximately half full of fluid. The two brake lines that came from the master cylinder and go the ABS module were crimped with the forward brake line having been stripped from the

[12] See Recorder Specialist Report for additional information

threaded port. The brake pedal was prevented from moving due to the distortion of the firewall which was in contact with the rear of brake pedal lever.

Due to the damage sustained to the brake master cylinder, reservoir, and with the brake pedal being prevented from moving, a functional check of the brake system was not done. However; the tires and wheels were removed, and an inspection of the brake system's mechanical components were conducted. The measurements for the brake linings and rotors, taken during inspection, are recorded in **Table 2**.

Table 2. Tesla Brake Measurements (all measurements in inches)

Brake Location	Front Axle		Rear Axle	
	Left	Right	Left	Right
Brake Type	Disc	Disc	Disc	Disc
Measured Lining Thickness	Inboard: .112	Inboard: .112	Inboard: .115	Inboard: .113
	Outboard: .112	Outboard: .112	Outboard: .115	Outboard: .113
Measured Rotor Thickness	1.265	1.264	1.125	1.134
Manufacturer's Specification – Minimum Rotor Thickness	1.18 inches	1.18 inches	1.02 inches	1.02 inches

2.1.10. Tires and Wheels

According to the VIN plate, mounted on the lower portion of the "B" pillar in the driver's door opening, the passenger vehicle was specified to be equipped with P245/35R21 tires, mounted on 21x8.5 J rims.[13] The tires were specified to be inflated to 42 psi for both axles. **Table 3** includes the tire and wheel information documented at the time of inspection.

Tread depth measurements were taken from the outboard tire shoulder, to the inboard tire shoulder in three separate locations within the major tread grooves of each tire. The measurements are documented in **Table 3**. All tread depths measured were in excess of the minimum tread depth regulation for passenger vehicle tires; 2/32 of an inch for all axles.[14]

[13] Hereafter referenced as wheel.
[14] Measured in two adjacent tread grooves at any location on the tire (49 CFR 570.9(a).

Table 3. Passenger Vehicle Tire Information

Front Axle	Left	Right
Make	CONTINENTAL	CONTINENTAL
Model	EXTREME CONTACT	EXTREME CONTACT
DOT #	HW4R 3VX 3015	HW4R 3VX 0516
Size	245/35ZR21	245/35ZR21
Load Rating	1,565 lbs @ 51 psi	1,565 lbs @ 51 psi
Tread Plies	1 Rayon, 2 steel, 2 Polyamide	1 Rayon, 2 steel, 2 Polyamide
Sidewall Plies	2 Rayon	2 Rayon
Pressure	DEFLATED	39 psi
Tread Depth	5/32, 6/32, 6/32, 0/32 inch	6/32, 5/32, 5/32, 4/32 inch
Rear Axle	**Left**	**Right**
Make	CONTINENTAL	CONTINENTAL
Model	EXTREME CONTACT	EXTREME CONTACT
DOT #	HW4R 3VX 0717	HW4R 3VX 0717
Size	245/35ZR21	245/35ZR21
Load Rating	1,565 lbs @ 51 psi	1,565 lbs @ 51 psi
Tread Plies	1 Rayon, 2 Steel, 2 Polyamide	1 Rayon, 2 Steel, 2 Polyamide
Sidewall Plies	2 Rayon	2 Rayon
Pressure	37 psi	38 psi
Tread Depth	6/32, 6/32, 6/32, 4/32 inch	6/32, 6/32, 6/32, 5/32 inch

All four tires were mounted on 21x8.5 alloy wheels held in place with five lug nuts each. A clock face reference (1:00 – 12:00) was used to describe locations on each tire and wheel. The valve stem was used as the 12:00 position. Tire and wheel damage observed during the inspection is described below.

Front Axle – Left:

- The inboard wheel flange was abraded from approximately the 3:00 to 5:00 positions, approximately 7 ½-inches in chord length.[15]
- The inboard wheel flange sustained a radial collapse from approximately the 8:45 to10:00 positions, approximately 8 ¾-inches in chord length.
- The inboard tire sidewall sustained a 1-inch by ½-inch slice at the 3:15 position.
- The inboard tire side sidewall was missing a ¾-inch by 5/8-inch piece of rubber at the 4:00 position.
- The tire tread sustained a cut which was 9 ½-inches in length and exposed the steel cords.
- The inboard major tread grove was worn below 2/32-inch

[15] Chord length is a line that links two points on a circle or a curve

Front Axle – Right:

- Three quarters of the outboard wheel flange was abraded.
- The inboard tire sidewall at the 7:45 position, approximately 1 ½-inches in length.

Rear Axle – Left:

- The outboard wheel flange was abraded 360-degrees.

Rear Axle – Right:

- The outboard wheel flange was abraded from the 1:00 to 1:15 positions, approximately 2 ½-inches in chord length.

2.1.11. Maintenance History

Eighteen maintenance records were obtained from the owner of the passenger vehicle. A review of the records was conducted and indicates that routine maintenance and miscellaneous warranty repairs were performed.

2.1.12. Vehicle Automation Technology

The 2014 Tesla model S was equipped with an advanced driver assistance system; Autopilot. According to Tesla, at the time of the crash the crash vehicle was operating Hardware Version 1 and was running firmware version 17.50.97-3bd9f6d082U (SX). The firmware was installed using wireless connectivity on December 28, 2017, about 25 days prior to the crash. The technology provided the following safety features:

- Traffic Aware Cruise Control
- Autosteer
- Automatic Emergency Braking
- Forward Collision Warning
- Lane Departure Warning
- Side Collision Warning
- Automatic High Beam Headlights

The systems which are relevant to the operation of the vehicle in this crash are described further in the sections below. [16]

2.1.12.1. Traffic Aware Cruise Control

Traffic Aware Cruise Control (TACC) is a comfort and convenience feature in which, when activated, vehicle speed and following distance are maintained using data from radar and camera systems. Although a driver may enter settings to determine following distance, the system may adjust following distances according to changes in speed. TACC interreacts with other driver assist technology systems; Forward Collision Warning and Automatic Emergency Braking (AEB).

The Tesla Owner's Manual describes, in detail, parameters for safe operation utilizing the Autopilot system. The manual warns the driver that TACC is not a collision warning or avoidance

[16] Factual Report Attachment – Tesla Model S Software Release Notes v6.1

system. Drivers are instructed to always be prepared to take corrective action. Additionally, the manual warns that TACC may not detect stationary vehicles especially when vehicle speed is over 50 mph or a vehicle traveling ahead moves out of the path of travel. The accuracy of the system can be degraded by roadway topography, weather conditions, glare from sunlight or headlights, or the obstruction or interference of sensors.

TACC braking is insufficient to stop a vehicle in an emergency situation; its braking limit is up to 0.5 G. When the system identifies the need for braking in excess of the system limit, an audible brake capacity warning alert is given. In order for autonomous braking to occur, the AEB system must be engaged.

2.1.12.2. Autosteer

Autosteer is a comfort and convenience feature which steers the vehicle within a lane of travel. Autosteer can only be activated after TACC has been engaged and cannot be used alone. must be used in conjunction with TACC. The system uses information from the radar and camera systems to keep the vehicle to the center of its travel lane.

The operator's manual instructs drivers to keep hands positioned loosely on the steering wheel while the feature is engaged. While engaged, a sensor detects when a driver's hands are not on the steering wheel; a warning occurs. If the system does not detect the driver's hands on the steering wheel for a prolonged period, the system will disengage. Factors such as, vehicle speed, the presence of a vehicle ahead, and lateral acceleration determine the timing of when warning notifications are given and when autosteer will disengage. Before autosteer disengages, a visual warning is displayed to the driver which reads, "Hold Steering Wheel". If the vehicle still does not detect driver steering input, a second waring is displayed which reads, "To Maintain Set Speed Place Hands On Steering Wheel". The vehicle then begins to decelerate until it stops.

In addition to circumstances which may cause TACC to disengage, there are several conditions which may cause autosteer to disengage. When a driver applies torque to the steering wheel beyond an established threshold, autosteer will disengage however, TACC will remain active. Additionally, if the system is unable to detect lane markings, autosteer will disengage.

Autosteer interacts with Traffic Aware Cruise Control, Automatic Emergency Braking, and Forward Collision Warning.

2.1.12.3. Automatic Emergency Braking

Automatic Emergency Braking (AEB) is an active crash avoidance system which automatically applies brakes when the system determines that a frontal collision is eminent when vehicle speed is between 5 mph and 85 mph. The system is designed to prevent or lessen the severity of a forward collision by stopping or reducing speed. The system uses information from the vehicle radar and camera systems to identify hazards in the vehicle's path of travel.

When activated, the system is capable of making a full force braking application. An emergency brake application will continue until the hazard is no longer detected, the vehicle speed has been reduced by 25 mph or stops, or the driver provides steering or acceleration input. If during an AEB response a driver makes less than a full braking application, the AEB will remain

engaged until the cycle has completed. The performance of the system can be influence by road geometry, weather conditions, glaring light, and electronic interference or visible obstruction.

2.1.12.4. Forward Collision Warning

Forward Collision Warning is a passive crash avoidance system which provides a visual and auditory warning of a potential forward moving crash when vehicle speed is between 5 mph and 58mph. The system utilized data from the radar and camera systems to identify objects in the vehicle's path of travel. Delivery of warnings is determined by several factors. Distance between the vehicle and objects, and their relative velocities are used to determine the time required for a driver to avoid a crash by braking or evasive steering. The performance of the system can be influence by road geometry, weather conditions, glaring light, and electronic interference or visible obstruction.

2.1.13. Driver Assistance Systems Data

Although Tesla was equipped with an Air bag Control Module, the control module did not have an event data recorder; a download of pre-crash information was not possible as with standard passenger vehicles. Data containing information about the operation of the 2014 Tesla in the moments leading up to the crash was downloaded wirelessly by the vehicle manufacturer. Upon request, Tesla shared the information with NTSB investigators. The information describes the operation and performance of the driver assistance systems as well as the driver's interaction.

2.1.13.1. Autopilot

The duration of the crash trip was about 66 minutes. Throughout the crash trip, the autopilot was engaged for a total of 29 minutes. When the crash occurred, autopilot was active and had been engaged for 13 minutes, 48 seconds.

2.1.13.2. Auto Steer

Data from the crash trip shows that for the majority of the time in which autopilot engaged, the driver did not have his hands on the wheel. In the final segment leading up to the crash, the driver had his hands off the wheel 12 minutes, 57 seconds. A "place hands on the wheel" alert was given four times in the final segment. Immediately after each alert was given, the driver placed his hands on the wheel. The last alert was given about 9 minutes into the segment. About driver placed his hands on the wheel for the last time in the segment. When the crash occurred, the driver has his hands off the wheel for a

Vehicle 2 – 2006 Seagrave Firetruck

The firetruck, which was located at the Culver City Corporation Yard in Culver City, CA., was examined on January 24, 2018. The examination was limited to damage description, lighting, photographs, and a review of the maintenance records.

2.1.14. General Information:

Make/Model:	2006 Seagrave Fire APP. / TB50DA Firetruck
VIN:	1F9EW28T86CST2130
Company Unit #:	3730
Date of Manufacture:	November 2006
Mileage:	86,593
GVWR:	44,000 lbs.
GAWR (front axle):	20,000 lbs.
GAWR (rear axle):	24,000 lbs.
Scaled Weight:[17]	37,100 lbs.

2.1.15. Damage Description

The crash damage sustained by the firetruck was contained to the left rear of the vehicle, see **Figure 1**. There were numerous gouges, scrapes, and black transfers (green marks), originating at the left-rear corner and extended forward approximately 40-inches along the two left-rear side equipment compartment doors. There was an arched-shaped scrape that apexes the bottom of the door handle on the second-to-last compartment door. The metal trim located on the bottom of the rearmost compartment was damaged and displaced forward. The lower portion of the left-rear corner sustained moderate crush damage.

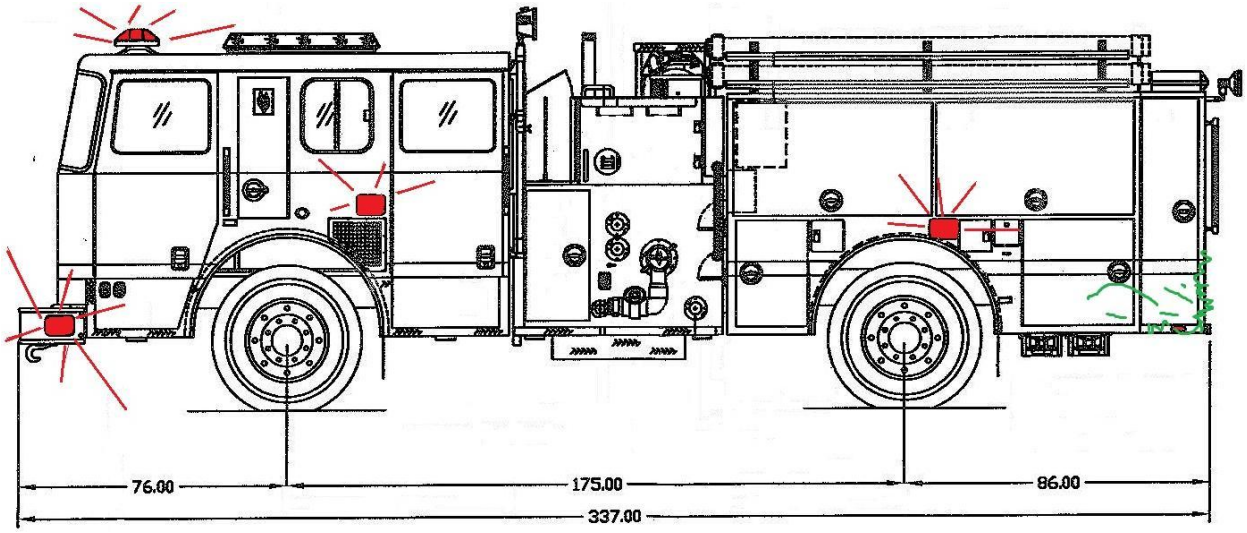


Figure 1: The Left Side of the Fire Truck

The rear of the fire truck sustained crash damage as well. Most of the damage was located to the left of center of the vehicle; see **Figure 2**. The lower portion of the equipment compartment door, the left of the rear deck, sustained impact damage. The left-lower, red, Light Emitting Diode (LED), lens was crushed. The rear deck, which was 72-inches wide, sustained crash damage from the left to the right, approximately 50-inches in width. The left side of the rear deck was distorted in an upward arch – preventing the rear compartment doors from opening. The three red LED

[17] The scaled weight is what the firetruck weighed at the time of inspection via certified scales

identification lights mounted to the rear deck, were displaced forward beneath the rear deck. The green outline in **Figure 2** illustrates the area of damage.

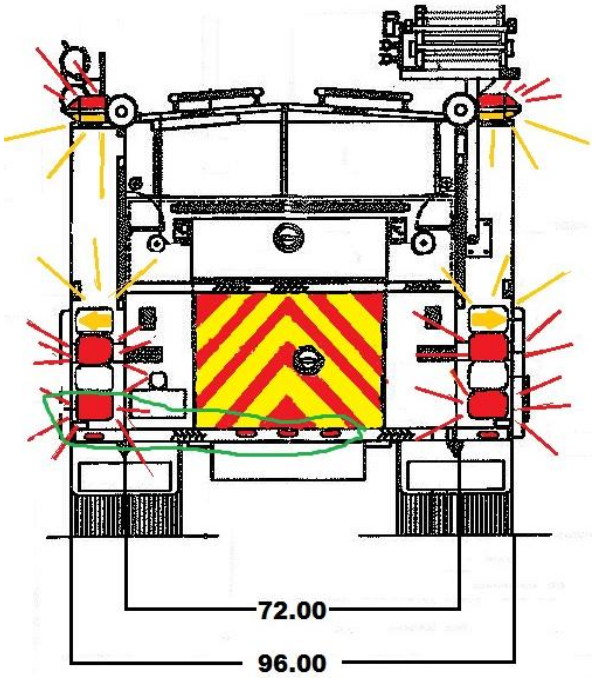


Figure 2: The Rear of the Fire truck

2.1.16. Emergency Vehicle Lighting

Emergency vehicles have multiple flashing lights, with varying colors and patterns, which are used to warn motorist of the presence or approach of an emergency vehicle. Emergency lights in general are used to protect emergency personnel by making their presence or the presence of hazardous conditions more conspicuous to nearby vehicle operators. In certain circumstances, emergency lights may be used in conjunction with a siren.

The exterior lights of the fire truck were inspected for functionality. All of the lights were observed to be functional, including the broken light assembly on the left. In **Figures 1 and 2** above, the emergency lights which would be activated are indicated. The red and yellow markings on the rear compartment doors are comprised of reflective tape.

2.1.17. Maintenance History

Inspection and maintenance records for the fire truck were obtained from the Culver City Fire Department. The records contained routine inspection and preventative maintenance operations and did not indicate any recurring maintenance issues.

3. Highway Factors

The crash occurred in the southbound HOV lane of I-405 about 1000 feet south of Washington Boulevard. In the vicinity of the crash, I-405 is a controlled access highway composed of 8 inches of Portland Cement Concrete (PCC). The travel lanes consists of twelve lanes; six northbound and six southbound. The north and southbound lanes of travel are divided by a concrete barrier. The posted speed limit was 65 mph. The extreme left lane in each direction is a dedicated HOV lane. The left edge of the southbound HOV lane is delineated by a solid painted yellow line and bordered by a paved shoulder. The right edge of the HOV lanes is delineated by a solid painted white line and bordered by five through lanes of travel. The southbound HOV lane is separated from the through lanes by two solid double yellow lines. Each of the through lanes of travel are delineated by painted broken white lines; the right edge of the southbound lanes are bordered by a paved shoulder.

3.1. Traffic Conditions

In an interview with NTSB investigators, the Tesla driver stated that while traveling on I-405, traffic conditions were heavy. While using active cruise control he had the vehicle speed set at 65 mph and believes that the vehicle was traveling close to that speed. However, data from the Tesla active cruise control indicates that in the moments leading up to the crash the vehicle traveled from 4-24 mph. The most recent completed Average Daily Traffic Count (ADT) on I 405 was measured to be 327,000 vehicles per day.[18]

E. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

Factual Report Attachment - 2014 Tesla Driver Interview Transcript

Factual Report Attachment – 2014 Tesla Driver's Cellphone Records

Factual Report Attachment – Witness Statement

Factual Report Attachment - Tesla Model S Software Release Notes v6.1

Factual Report Attachment - 2016 Interstate 405 Average Daily Traffic Count

END OF REPORT

Kenneth J. Bragg

Senior Human Performance Investigator

[18] Factual Report Attachment – 2016 Interstate 405 Average Daily Traffic Count.