



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

**SURVIVAL FACTORS GROUP CHAIRMAN'S
FACTUAL REPORT**

A. CRASH INFORMATION

Location: 14000 block U.S. 441, Delray Beach, Palm Beach County, Florida
Vehicle 1: 2019 International truck-tractor in combination with a 2008 Vanguard semi-trailer
Operator 1: FirstFleet, Inc., Murfreesboro, Tennessee
Vehicle 2: 2018 Tesla Model 3
Operator 2: Private operator
Date: March 1, 2019
Time: Approximately 6:17 a.m. (local time)
NTSB #: **HWY19FH008**

B. SURVIVAL FACTORS GROUP

Sheryl Harley, Survival Factors Investigator, Group Chairman
NTSB Office of Highway Safety
490 L'Enfant Plaza East, S.W., Washington, DC 20594

C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. DETAILS OF THE SURVIVAL FACTORS INVESTIGATION

The Survival Factors investigation focused on the survivability issues related to the Tesla Model 3 and the crash with the combination vehicle. The issues examined in this investigation include occupant protection, crashworthiness, vehicle operation and the survivability of the crash. The investigation also examined the emergency response regarding the timeliness, efficiency and effectiveness of that response. Lastly, the investigation focused on the training of the first responders regarding the operation of electric-powered vehicles and emergency incidents.

1. SURVIVABILITY FACTORS

1.1. Occupant Protection

The Tesla Model 3 was purchased by the driver in December 2018. The vehicle comes equipped with adjustable front seats with three-point inertia reel seat belts. The inertia reel seatbelts automatically tensioned to allow the occupants to move comfortably during normal driving conditions. Hard acceleration, braking, cornering or impact will cause the seatbelt reel to automatically lock. In addition to seatbelts, the vehicle is equipped with four types of airbags. Advanced front airbags are provided for both the driver and front seat passenger. Knee bags are provided for the front seat passengers and work in conjunction with the front airbags. Seat-mounted side airbags in the front seat protect the passengers' pelvis and chest area. Curtain airbags help to protect the passenger head when a severe side impact occurs, or the vehicle rolls over. In a collision, in addition to the deployment of the airbags, the Model 3's doors will unlock, the hazard warning lights will turn on along with the interior lights. Lastly, the high voltage connection for the electric battery is automatically disabled.

1.2. Crashworthiness

During the crash, the passenger vehicle struck the left side of the semi-trailer approximately 17 feet, 6 inches from the end of the trailer. As the vehicle under-rode the trailer, the glass roof was sheared off, along with the side curtain airbags that were attached to the "A" pillar near the headliner. Components from the vehicle's roof were recovered from both the exterior as well as the interior of the semi-trailer. After the vehicle detected the collision level event, the transmission automatically shifted into neutral, the hazard warning lights activated and began flashing and the vehicle coasted to a stop approximately 1600 feet from the point of impact. Extensive cosmetic damage was incurred by the vehicle in the crash. However, most of the vehicle's systems were still functional and no damage was sustained to the lithium-ion batteries. **Figure 1** shows the Tesla in the tow yard with extensive damage to the roof.



Figure 1: Photograph showing the Tesla Model 3 with extensive roof damage

1.3. Survivability

Most of the damage to the Model 3 was isolated to the roof, windshield and surfaces above the height of the 3 feet 6 inches on the vehicle. This corresponds to the height of the semi-trailer at the point where the vehicle under-rod it. Despite the severity of the impact which “woke up” the “Restraint Control Module”, the airbags did not deploy. A post-crash examination of the vehicle found that the 50-year-old driver was still properly restrained by his lap-shoulder seatbelt. The attachment point, for the seatbelt assembly located on the “B” Pillar, was damaged during the crash but did not affect the securement of the driver. The driver sustained fatal blunt force traumatic injuries to the head consistent with contact with both the vehicle’s roof structure and the semi-trailer. Due to the dynamics of the collision, the crash was not survivable.

2. EMERGENCY RESPONSE

Palm Beach County Florida encompasses approximately 2,383 square miles with a population of 1,471,150; making it the third most populous and the second largest county (by land mass) in the state of Florida. The eastern third of the county is urban while the western and central regions are suburban and rural.

2.1. Law Enforcement Response

The Palm Beach County Sheriff’s Office (PBSO) is the largest law enforcement agency in Palm Beach County, Florida with approximately 1,500 sworn officers and another 2,500-member support staff. PBSO provides police services to the 680,000 residents in the county unincorporated areas and another 120, 000 in smaller cities and towns. PBSO is divided into three regional police bureaus; north, south and western. Delray Beach is in the south regional bureau.

2.2. Fire/Rescue and EMS Response

The Palm Beach County Fire and Rescue Services (PBCFR) is one of the largest fire departments in the state of Florida. PBCFR provides fire and EMS services and dispatch capabilities for the 19 cities and unincorporated areas within Palm Beach County. The fire department is divided into 8 battalions that include 49 stations. Battalion 4 includes the area of Delray Beach and Boynton Beach.

On the day of the crash, three units were dispatched from various stations in the fourth and fifth battalion. The units included Engine 42 (E-42); Ladder 47 (L-47) and Rescue 54 (R-54) along with Battalion Chief 42 (BC-42). Units from station 42 responded from the south and arrived at the Tesla’s final rest location first. L-47, coming from the north; traveled southbound on US 441 and arrived at the location where the combination vehicle was still parked in the intersection. R-54, from the fifth battalion, arrived on the scene but was immediately placed back into service by BC-42.

2.3. Emergency Response Timeline

The emergency response timeline, listed in the **Table 1** below, was obtained from the PBSO Incident Detail report.¹

Table 1. Emergency Response Timeline

TIME	EVENT
6:16:57	Crash is captured on security camera of agricultural facility
6:22:50	911 call received by PBSO Call taker
6:24:05	911 call received by PBC Fire Communications
6:24:10	Call details sent to PBSO dispatcher
6:24:37	PBC Fire Rescue units dispatched
6:25:13	First PBSO unit dispatched
6:32:43	First PBC Fire Rescue units on scene
6:34:04	First PBSO unit arrives on the scene

2.4. The Vehicle and the Emergency Operation

The Tesla Model 3, in this crash, was being operated by a “key card”. To operate the vehicle, the driver would approach the car and tap the key card against the reader located on the “B” Pillar, on the driver’s side. The key card operates off a “Bluetooth” system and using RFID (radio frequency identification) signals, the card authenticates the cell phone synced to the vehicle. Both the “authenticated” phone and the key card must be present within proximity of the vehicle for the Model 3 to operate. Once entry into the vehicle has been gained, the driver powers on the touchscreen and can operate all the controls. The driver depresses the brake pedal, to power on the vehicle to drive. To power the vehicle off, the driver must shift into “Park” and then exits the vehicle with both the authenticated phone and the key card. A second option to power off the vehicle is by shifting into park and waiting 15 minutes. The car will power off regardless if someone is in the driver’s seat. The third way to power off the vehicle requires familiarization with the vehicle’s touch screen operations and command functions or access to the owner’s manual to obtain the required instructions.²

¹ See Survival Factors Attachment-Emergency response 911 CAD Detail report

² See Vehicle Factors Attachment-Model 3 Owner’s Manual

The emergency responders were unfamiliar with the operation of the Model 3 and did not know how to power off the vehicle. Despite the driver's cellphone being ejected from the vehicle during the crash, the car remained powered up because the key card was still inside of the vehicle. **Figure 2** shows the location of the driver's cellphone and its proximity to the Tesla post-crash.

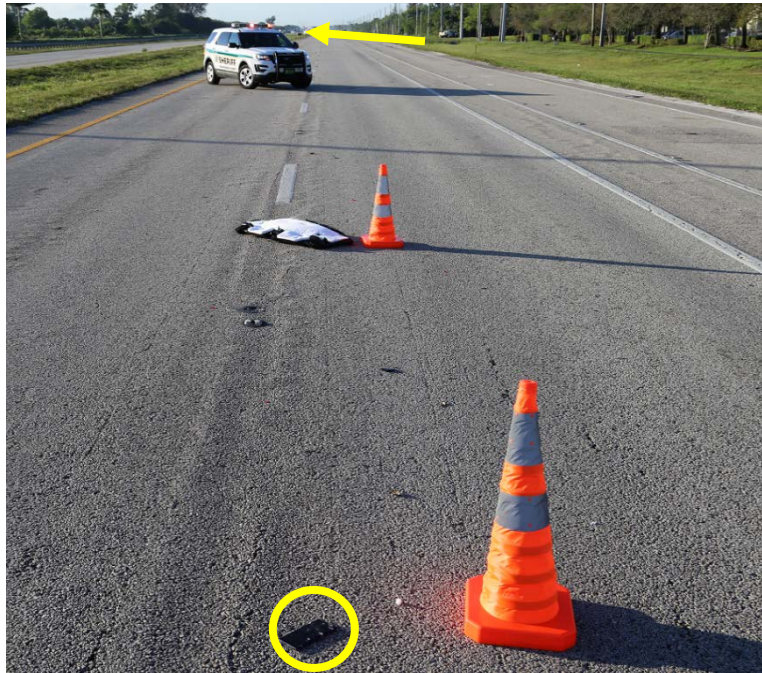


Figure 2: Photograph showing the driver's cellphone, circled in yellow, that was ejected from the car. The yellow arrow indicates the location of the Tesla at final rest. (PBSO)

During the post-crash examination of the Tesla Model 3 at the tow yard, a fire department identification tag was observed in the engine compartment. Tesla installed these tags, on their newer model cars, to assist first responders with locating the designated place to cut the power cable in the event of an emergency. The Palm Beach County Fire Department personnel, on the scene, were unaware of the presence of this tag and no attempt was made to disconnect the power to the vehicle. **Figure 3** shows the tag still attached to the power cable in the engine compartment of the crash vehicle.



Figure 3: Photograph of the fire department tag on the power cable inside of the car's engine compartment.

2.5. Fire/Rescue Training

The Palm Beach County Fire Rescue Services (PBCFR) uses an online platform to conduct training and recurrent certification of its personnel. Target Solutions is a nationally recognized “Online Training Management System for Public Safety” used by fire rescue agencies across the country. Target Solutions provides easily accessible training on current emergency responder topics and serves as a record management system to track first responders training and certification. Through Target Solutions, PBCFR has provided its personnel with training regarding fire suppression and issues related to lithium ion batteries found in electric-powered vehicles. Several training modules over the past year have been dedicated to this topic.

Additional specialized training is provided to personnel assigned to the PBCFR Special Operations Division (SOD). These firefighters attend advanced training courses in several areas; to include handling emergencies involving electric-powered vehicles. Additional resources, such as the Tesla mobile app that provides first responders with important information about electric-powered vehicles, is more likely to be available to and used by SOD personnel rather than regular station personnel.

2.6. First Responder Interviews

An interview was conducted at Station 42 with the first responders from PBCFR on March 1, 2019. The discussion included the rescue operation and issues encountered, related to the vehicle and training provided to personnel regarding operations involving electric-powered vehicles.

BC-42, the duty command officer on the day of the crash, reported that the call was dispatched at about 6:10 a.m. The chief spoke to the dispatcher and requested L-47's response to the call to provide additional support.

The overall fire department's response included an engine company, a truck company, the battalion chief and an ambulance from the Fifth Battalion in Boca Raton, Florida.

BC-42 reported that the fire department units had arrived moments after the arrival of the first law enforcement officer. L-47, which is housed at Station 47 to the north, arrived and checked on the driver of the commercial truck. He advised that he quickly assessed the driver of the Tesla and determined that his injuries were incompatible with life and placed R-54 back in service as soon as the unit arrived on the scene. The chief conducted a complete scene survey to determine the presence of any other victims or hazards. As he approached the commercial vehicle, he was advised by a firefighter from L-47 that a cellphone had been found in the roadway. The cellphone had been located between the truck and the final rest position of the Tesla. The firefighter reported that the phone had begun to ring and that he had picked the phone up off the ground. A number was displayed on the cellphone along with the name "Tesla". The firefighter advised that he did not answer the call. BC-42 ordered him to put the phone back where he found it. BC-42 cleared all the units except L-47 which remained on the scene to assist the sheriff's deputies with traffic control.

The emergency responders advised that this was the first exposure to a Tesla Model 3. They were unaware that the vehicle was operated by a keycard and that the conventional dashboard board display and ignition system was not present. The firefighters were unfamiliar with the touch screen operation or the procedures required to power off the vehicle. The keycard was located some time afterwards on the driver. Since the undercarriage of the car and the battery compartment were undamaged and presented no hazard and no obvious method of "shutting down" (powering off) the vehicle was found, the decision was made to leave the car "running". This decision was to prevent needless expose of emergency responders to electrical hazards associated with the high voltage lithium-ion batteries. The operation of the key card and the touch screen was also unfamiliar to the law enforcement officers at the scene.³

The NTSB investigator questioned the first responders regarding other incidents involving electric-powered vehicles. In the most recent incident, that occurred approximately one year before this crash, another Tesla was involved in a serious collision. Despite the deployment of the airbag, the firefighters advised that the door handles remained "flushed" with the side of the car and could not be used to access the interior of the vehicle or the victims. Despite the severity of the impact, the passengers were able to self-extricate and no entrapment occurred. A representative for Tesla reported that their vehicles are engineered, in the event of the deployment of the airbags, to "present" the door handles and unlock the car doors to provide access to the interior of the vehicle. In this prior crash, that occurred in Palm Beach County, as well as other incidents, the door handles did not "present" and the car doors remained locked. This issue was not a factor in the Delray Beach crash.

³ See Survival Factors Attachment- First Responder interviews

E. DOCKET MATERIAL

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

LIST OF ATTACHMENTS

Survival Factors Attachment- Emergency Response 911 CAD detail reports

Survival Factors Attachment- Emergency Responder Interviews

END OF REPORT

Sheryl Harley
Survival Factors Group Chairman