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Special Crash Investigations: On-Site Air Bag Non-Deployment Investigation; Vehicle: 2011 Honda Pilot; Location: Louisiana; Crash Date: April 2019

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15. Supplementary Notes

Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

16. Abstract

This report documents the investigation of an air bag non-deployment in a 2011 Honda Pilot involved in a crash with a 2019 Freightliner single-unit truck. The two-vehicle crash occurred in the morning in April 2019 on a two-way, undivided, east/west roadway in Louisiana. The Honda was traveling westbound, an unidentified non-contact vehicle was traveling eastbound, and the Freightliner was following behind the non-contact vehicle. The non-contact vehicle crossed the centerline, entering the westbound lane and causing the Honda to depart the roadway on the right edge in avoidance. The Honda then re-entered the roadway, crossing the centerline and entering the eastbound lane, where its front plane struck the left plane of the Freightliner. The Honda was driven by a belted 42-year-old female who sustained police-reported "B" (non-incapacitating) severity injuries. The driver's frontal air bag and the right inflatable curtain (IC) air bag deployed. The SCI vehicle inspection was completed in June 2019 with representatives from American Honda Motor Company present. During the inspection, the OEM acknowledged the non-deployment of the left IC air bag but did not express an opinion to SCI regarding the non-deployment. The Honda was not supported by the Bosch Crash Data Retrieval (CDR) tool, and the OEM imaged the vehicle's air bag control module and obtained a report in hexadecimal format it converted for interpretation. According to the Honda owner's manual, IC air bags will deploy in a moderate to severe side crash (struck side only), or both IC air bags will deploy in a rollover. Given the crash configuration, EDR data, and parameters outlined in the owner's manual, the investigation determined that the Honda's supplemental restraint system functioned as intended. The OEM conducted an independent investigation and concluded that the EDR captured a frontal collision event with a slight bias to the left (driver's) side of the vehicle. They indicated in their report that the SRS front-crash algorithm may allow for a single-side curtain deployment. Their conclusion appears to support SCI's assessment.

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Background

This report documents the investigation of an air bag non-deployment in a 2011 Honda Pilot (Figure 1) involved in a crash with a 2019 Freightliner single unit truck. This investigation was initiated by the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration in response to a notification received by the Office of Defects Investigation (ODI) stating that the left inflatable curtain (IC) air bag did not deploy during a crash in which the Honda's left-front door and frame sustained crush damage and intruded into the occupant compartment. The Honda was driven by a belted 42-year-old female who sustained police-reported "B" (non-incapacitating) severity injuries. The driver's frontal air bag and the right IC air bag did deploy, and the driver's seat belt pretensioner actuated. The investigation was intended to determine why the right IC deployed and the left did not, and to document the driver's injuries and their sources. The investigation revealed no evidence of air bag malfunction, and the vehicle's supplemental restraint system (SRS) appeared to have functioned as intended.

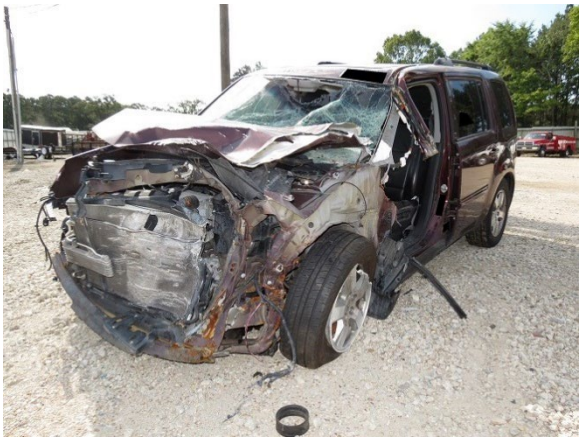


Figure 1. The 2011 Honda Pilot

The case was assigned to Dynamic Science, Inc., in May 2019. The SCI vehicle inspection was completed in June 2019 with representatives from American Honda Motor Company present. The Honda was not supported by the Bosch Crash Data Retrieval (CDR) tool; the OEM imaged the vehicle's air bag control module and obtained a report in hexadecimal format it converted for interpretation. The OEM conducted an independent investigation and concluded that the EDR captured a frontal collision event with a slight bias to the left (driver's) side of the vehicle. It indicated in its report that the SRS front crash algorithm may allow for a single IC air bag deployment. According to the Honda owner's manual, frontal air bags will deploy in a moderate to severe front crash. The manual does not state specific parameters for crash severity. The

manual stated that seat-mounted side air bags will deploy in a moderate to severe side crash, and that the IC air bag will deploy in a moderate to severe side crash (struck side only) or both IC air bags in the case of a rollover. The right plane of the Honda revealed no evidence of contact or crush damage. The vehicle did not overturn during the crash.

The crash occurred during the morning hours in April 2019 on a two-way, undivided, east/west roadway in Louisiana. The Honda was traveling westbound at a driver-estimated speed of 72 km/h (45 mph), an unidentified non-contact vehicle was traveling eastbound at an unknown speed, and the Freightliner was following behind the non-contact vehicle at an unknown speed.

The non-contact vehicle crossed the centerline, entering the westbound lane and causing the Honda to depart the roadway in avoidance. The Honda then re-entered the roadway, crossed the centerline, and entered the eastbound lane, where the front plane of the Honda struck the left plane of the Freightliner. The Freightliner then overturned onto its right plane. The Honda came to rest near the area of impact, and the non-contact vehicle stopped briefly then fled the scene.

Both drivers were transported by ambulance to a local hospital, and both vehicles were towed due to damage.

Summary

Crash Site

The crash site was located on a two-way, undivided, east/west roadway in Louisiana (Figure 2). The surface was paved with asphalt in traveled and polished condition. The lanes measured 3.4 m (11.1 ft) in width and were separated by double yellow-painted stripes and bordered by solid white-painted fog lines in poor/worn condition. The roadsides consisted of grass-covered ground and drainage ditches. The roadway was straight and level. Driveways were present on the north and south sides of the roadway. The speed limit was 72 km/h (45 mph). Conditions at the time of the crash were daylight, clear, and dry. A crash diagram is included at the end of this report.

Figure 2. Crash site looking west

Pre-Crash

The Honda was traveling westbound at a driver-estimated speed of 72 km/h (45 mph). An unidentified non-contact vehicle was traveling eastbound at an unknown speed, and the Freightliner was traveling eastbound behind the non-contact vehicle eastbound at an unknown speed. The non-contact vehicle crossed the centerline, entering the westbound lane causing the Honda to partially depart the roadway on the right edge in avoidance. During the departure, the Honda driver observed a signpost in her path requiring another avoidance maneuver, so she steered left returning to the roadway. The driver lost control of the vehicle, crossed the centerline, and entered the eastbound lane. She did not recall steering or braking in avoidance of the Freightliner.

Crash

The front plane of the Honda struck the left plane of the Freightliner in an angled front to side crash (Event 1). The police report indicated that the area of impact to the Freightliner was on the left plane of the cab. At impact, the Honda driver's seat belt pretensioner actuated and the driver's frontal air bag deployed (1st and 2nd stages). Additionally, the vehicle's right IC air bag deployed. According to the OEM's analysis of the Honda's EDR report, the front collision data appeared normal, with a slight bias toward the driver's side of the vehicle. The Honda traveled in a post-impact, westbound path and came to rest on the roadway approximately 6 m (20 ft) west of the POI for Event 1. The Freightliner subsequently overturned onto its right side (Event 2) and

came to rest on the roadside approximately 12 m (40 ft) east of the POI for Event 1. The non-contact vehicle stopped briefly before fleeing the scene.

For the Honda in Event 1, the barrier algorithm of the WinSMASH calculated a total delta V of 16 km/h (10 mph), a longitudinal delta V of -10 km/h (-6 mph), a lateral delta V of -12 km/h (-8 mph), and a barrier equivalent speed (BES) of 16 km/h (10 mph). The WinSMASH results are included in this report for informational purposes. The results appear low, and the Freightliner was out of scope for the WinSMASH precluding a reconstruction. According to the OEM, the EDR-reported total delta V was 42.0 km/h (26.1 mph). Longitudinal and lateral velocity changes were not reported.

Post-Crash

The Honda driver sustained a self-reported loss of consciousness for approximately 5 minutes. Witnesses came to her aid while she remained seated in the vehicle. Fire department and EMS personnel were notified within 1 minute of the crash and arrived 18 minutes after the crash. The driver's door was jammed shut, and they removed it from the vehicle prior to removing the driver. At 36 minutes after the crash, the driver was transported by ambulance, arriving at a local hospital 58 minutes after the crash, where she was treated for police-reported "B" (non-incapacitating) severity injuries and released later that day. The driver of the Freightliner sustained police-reported "B" (non-incapacitating) severity injuries and was transported to a local hospital. Both vehicles were towed due to damage.

2011 Honda Pilot

Description

The 2011 Honda Pilot was a 4-door SUV identified by the vehicle identification number (VIN) 5FNYF3H63BBxxxxxx. The owner-estimated odometer reading at the time of the crash was 280,000 km (174,000 mi). The vehicle had three rows to seat seven occupants. The vehicle had a 6-cylinder, 3.5-liter gasoline engine; front-wheel drive; hydraulic brakes; antilock brakes; electronic stability control; daytime running lights; and tilt/telescoping steering column functionality. The manufacturer recommended P245/65R17 tires for the front and rear. The Honda had Michelin Phantom A/P tires of the recommended size manufactured in late 2018. The front row had two bucket seats and adjustable head restraints. The driver's seat track was set between middle to full-back, and the seat back was reclined slightly.

Vehicle History

According to statements made by the driver's spouse during an interview with SCI, the vehicle was purchased new by the driver. A prior reported damage was caused by a non-deployment rear-end crash resulting in minor to moderate damage in 2016. Later that year, the passenger's frontal air bag inflator was replaced in response to a recall. No other crashes or air bag-related service was reported until this crash.

The last reported service record listed an odometer reading of 273,834 km (170,153 mi).

Exterior Damage

The Honda had moderate severity crush to the front plane in the impact with the Freightliner (Figure 3). The front-bumper fascia was missing, and the bumper-backing bar was used to measure crush to the front plane. Direct damage began from the front-left bumper corner and extended 88 cm (34.6 in) to the right. The Field L extended from bumper corner to bumper corner and measured 125 cm (49.2 in). Fifteen measurements were taken at bumper level using the Nikon total station. The Honda sustained the above bumper crush. Direct damage was distributed across the left and middle aspects of the upper radiator support and hood. The Field L measured 75 cm (29.5 in) in length. Ten crush measurements were taken at the upper radiator support and crush averaging was used to calculate crush as follows: C1 = 18 cm (7.1 in), C2 = 21 cm (8.3 in), C3 = 19 cm (7.5 in), C4 = 12 cm (4.7 in), C5 = 3 cm (1.2 in), and C6 = 0 cm. Maximum crush at bumper level measured 10 cm (3.9 in) at 20 cm (7.9 in) right of the front-left bumper corner. The left- and right-frame rails as well as the bumper-backing bar were shifted downward to ground level. The principal direction of force (PDOF) was 50 degrees, and the collision deformation classification (CDC) for the Honda in Event 1 was 02FYEW2.

Figure 3. Front-plane damage, the 2011 Honda Pilot

Air Bag Non-Deployment Discussion

According to the Honda owner's manual, frontal air bags will deploy and seat belt pretensioners will actuate in a moderate to severe front crash. The seat-mounted side air bags will deploy in a moderate to severe side crash. The SRS will deploy an IC air bag in a moderate to severe side crash (struck side only) or both IC air bags in the case of a rollover. The manual does not state specific parameters for crash severity. According to the OEM, the SRS front crash algorithm can allow for single-side curtain air bag deployment. For a frontal crash where an IC air bag deploys, it is unknown if this is expected on the side where the most severe damage occurs.

This crash included a frontal crash of moderate severity with a 2 o'clock direction of force. The driver's frontal air bag deployed and the driver's seat belt pretensioner actuated, and the right IC air bag deployed. The EDR data indicated the frontal air bag deployed in two stages. The right IC air bag likely deployed as a result of the lateral velocity changes that occurred at impact with the Freightliner. Using an observed 50° direction of force, the barrier algorithm of the WinSMASH calculated a lateral delta V of -12 km/h (-8 mph). Given the parameters for air bag deployment as stated in the owner's manual, lateral velocity change calculated in the WinSMASH, and the OEM's analysis of the EDR data, it appears the SRS performed as intended.

Direct damage was present on the front plane, induced damage was present in the front and passenger sectors of the left plane, and the right plane did not sustain sheet metal deformation. The driver notification received by ODI stated the driver's door and frame intruded into the occupant compartment and while in a state of unconsciousness her head was in close proximity to those components. The driver's concern was that the left IC air bag did not deploy to provide head protection from the damage and intrusion. The left front door was removed during post-crash efforts and was not available for inspection.

During the vehicle inspection, SCI observed the left- and right-front air bag sensors on the damaged front plane, and they appeared to be unremarkable. The left-side impact sensor at the B-pillar (Figure 4) appeared to be unremarkable. The non-deployed left IC air bag (Figure 5) located in the roof side rail was exposed and appeared unremarkable. During the inspection, the OEM acknowledged the non-deployment of the left IC air bag but did not express an opinion to SCI regarding the non-deployment. The Honda's EDR report contained additional air bag deployment data discussed in the following section.

Figure 4. Left-side air bag sensor, the 2011 Honda Pilot

Figure 5. Non-deployed left IC air bag, the 2011 Honda Pilot

Event Data Recorder

The Honda had an SRS including an electronic control unit (ECU) that had EDR capability to store crash events. The Honda was not supported by the Bosch CDR tool; the OEM imaged the vehicle's air bag control module and obtained a report in hexadecimal format it converted for interpretation. The OEM conducted an independent investigation and concluded that the EDR captured a frontal collision event with a slight bias to the left (driver's) side of the vehicle. The vehicle inspection revealed an observed 50° direction of force for the Honda. The OEM indicated in its report that the SRS front-crash algorithm can allow for a single-side curtain deployment, but it did not specify why the right IC was chosen to deploy over the left IC in this

crash. The OEM report included the following conclusions, based on their interpretation of the EDR vehicle status data:

- No faults were detected in the air bag system prior to or at the time of the crash.
- A frontal crash event was recorded.[1]
- Left, right, and rear collision was g-trigger only (no safing, no deployment).[2]
- Driver seat belt was detected as buckled, and driver position was detected as far (not near).
- Passenger seat belt was detected as unbuckled, and passenger seat was detected as empty.

The OEM concluded the following, based on its interpretation of the EDR event data.

Time from g-trigger to left front crash sensor safing	-4 msec (safing occurred 4 msec prior to g-trigger)
Time from g-trigger to right front crash sensor safing	4 msec (safing occurred 4 msec after g-trigger)
Time from T0 to driver pretensioner deploy command	20 msec
Time from T0 to driver front air bag first stage deploy command	21 msec
Time from driver front air bag first stage to second stage deploy command	30 msec
Delta V from T0 to driver pretensioner deploy command	3.31 km/h (2.06 mph)
Delta V from T0 to driver front air bag first stage deploy command	3.31 km/h (2.06 mph)
Delta V from T0 to 250 msec later	42.0 km/h (26.1 mph)

NHTSA Recalls and Investigations

A search last queried in May 2022 using the vehicle's VIN revealed no open recalls for the Honda. The search revealed 11 past recalls involving the driver's and passenger's frontal air bags (9), seat belts (1) and suspension (1). The vehicle owner indicated during the interview that the passenger's air bag was serviced or replaced in response to a recall and that all other air bags were original to the vehicle. No recalls existed for IC air bags.

[1] This was a deployment event.
[2] A g-trigger level event engages crash recording only. No deployment is commanded. A subsequent deployment level event should overwrite any g-trigger event data.

Interior Damage

The Honda's interior sustained damage caused by impact forces, air bag deployments, and occupant contacts. The windshield was fractured by hood contact, and the left-front window was disintegrated. The left-front door was jammed shut and removed by responders. The driver's frontal and right IC air bags deployed, and the driver's seat belt pretensioner actuated. The driver's seat belt revealed scuff marks caused by loading. The front row was reduced by the longitudinal intrusion of the left instrument panel 4 cm (1.6 in), and by the vertical intrusion of the roof side rail 5 cm (2.0 in) and left windshield header 4cm (1.6 in).

Manual Restraint Systems

The Honda had three-point continuous lap and shoulder seat belts for the driver. The belt had a retractor pretensioner that actuated during the crash. The driver was belted at the time of the crash, and the seat belt was locked in the used position. The belt revealed scuff marks to the webbing at 45 cm (17.7 in) above the stop button.

Supplemental Restraint Systems

The Honda had advanced frontal air bags and seat-mounted side impact air bags for the driver and the front-right occupant as well as combination side impact/roll-sensing IC air bags for both rows. The driver's frontal air bag (Figure 6) and the right IC air bag (Figure 7) deployed, and the driver's seat belt pretensioner actuated at impact with the Freightliner.

Figure 6. Deployed driver's frontal air bag, the 2011 Honda Pilot

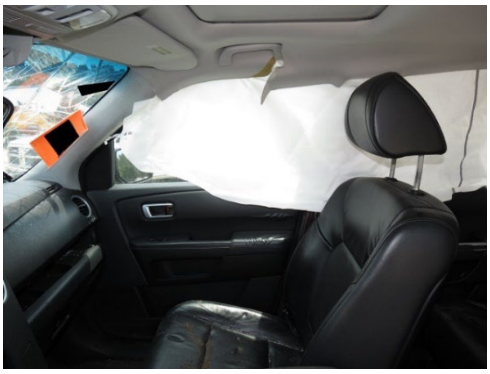


Figure 7. Deployed right IC air bag, the 2011 Honda Pilot

2011 Honda Pilot Occupant

Driver Demographics

Age/sex:	42 years/female
Height:	175 cm (69 in)
Weight:	107 kg (235 lb)
Eyewear:	None
Seat type:	Bucket with adjustable head restraint
Seat track position:	Middle to full-back
Manual restraint usage:	Lap and shoulder belt used
Usage source:	Vehicle inspection, EDR report
Air bags:	Frontal air bag deployed, seat-mounted side impact, and IC air bags not deployed
Alcohol/drug data:	None
Egress from vehicle:	Removed due to perceived serious injury
Transport from scene:	Ambulance to a hospital
Type of medical treatment:	Treated and released; sought follow-up treatment later

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Contusion, left abdomen	510402.1	Lap seat belt	Certain
2	Abrasion, left shoulder	710202.1	Shoulder seat belt	Certain
3	Abrasions, left forearm	710202.1	Left door panel, unknown quadrant	Probable
4	Contusion, left forearm	710402.1	Steering wheel rim	Probable
5	Abrasions, minor lacerations, bilateral hands	710202.1	Flying glass	Probable
6	Contusion, left knee	810402.1	Lower Left IP	Probable

Source: medical records, driver photos.

Driver Kinematics

The belted 42-year-old female driver was seated in a normal upright posture. While actively steering, she departed the roadway on the right edge in avoidance of a non-contact vehicle. The driver returned to the roadway and crossed into the oncoming lane. At impact with the Freightliner, the driver's seat belt pretensioner actuated and the driver's frontal air bag deployed. The driver was displaced forward and right in response to the 2 o'clock direction of force. She loaded the seat belt, causing scuff marks to the webbing and abrasions to her left shoulder and a contusion to her left abdomen. She likely loaded the deployed frontal air bag with her face, head, and chest. Her medial left forearm likely contacted the steering wheel rim, causing a contusion,

and her dorsal left forearm likely contacted the left-door panel, causing an abrasion. Her hands were contacted by flying glass that caused abrasions and minor lacerations. Her left knee contacted the lower left instrument panel, causing a contusion. The driver self-reported an unconfirmed loss of consciousness that lasted approximately 5 minutes.

The Honda came to rest in an upright orientation, and the driver remained held in her seated position by the pretensioned seat belt. She required assistance from responders who removed the front-left door and then removed her from the vehicle. She was transported by ambulance to a local hospital, where she was treated and released. The driver sought follow-up treatment later to remove a glass fragment from her finger. She sought rehabilitative therapy for the injury to her left knee. The driver missed approximately 10 days from work due to injury and related pain.

2019 Freightliner M2 106

Description

The 2019 Freightliner M2 106 was a medium-duty, commercial, 3-axle, straight-unit truck with rear-wheel drive and a gross vehicle weight rating (GVWR) greater than 15,000 kg (33,000 lb). It was equipped with a 6-cylinder, 9.0-liter diesel engine and air brakes.

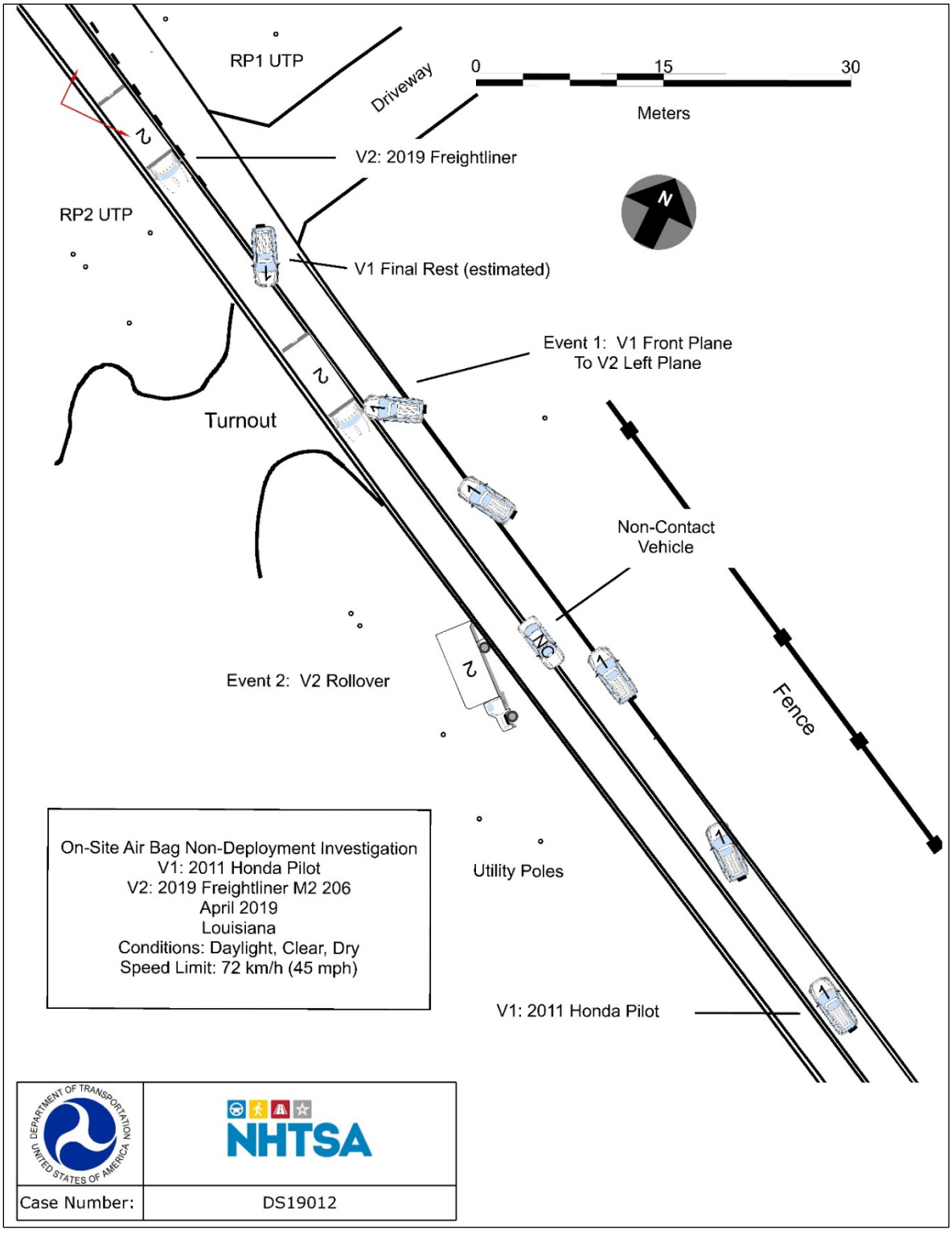
Exterior Damage

The Freightliner sustained disabling damage to the left and right planes caused by the Event 1 impact with the Honda and the Event 2 rollover.

Occupant Data

Data for this occupant were obtained from the police report. The belted 49-year-old male driver had unspecified, non-incapacitating/moderate severity injuries and was transported by ambulance to a local hospital. The duration of his treatment was unknown.

Crash Diagram



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