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Special Crash Investigations: On-Site Air Bag Inflator Rupture Crash Investigation; Vehicle: 2002 Honda Civic; Location: Arizona; Crash Date: June 2018

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16. Abstract This report documents the on-site investigation of an inflator rupture of a frontal air bag module in a 2002 Honda Civic involved in a nighttime two-vehicle crash in Arizona in June 2018. The inspection documented the ruptured driver air bag inflator, the air bag, and the steering wheel/column assembly and determined the inflator did rupture. The Honda was traveling at a passenger-reported speed of 104 km/h (65 mph) and was driven by a belted 54-year-old male. The front right seat was occupied by a belted 50-year-old female. The other vehicle in this crash was a 2017 Jeep Renegade driven by an 18-year-old female. The Jeep approached and entered the intersection. It was struck on the right plane by the front plane of the Honda. Both frontal air bags in the Honda deployed and the driver sustained left side neck and face injuries attributed to the air bag inflator. He was transported to a local hospital with life-threatening injuries and died three days later. The front right passenger was transported to a local hospital where she was treated and released. Based on available evidence, it was determined that the driver's frontal air bag inflator ruptured during its Stage 1 deployment and displaced the Stage 2 inflator cap rearward toward the driver. The cap holed the air bag's fabric and struck the driver on the left side of his face and neck, resulting in fatal injuries.			
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**Special Crash Investigations
On-Site Air Bag Inflator Rupture Crash Investigation
Office of Defects Investigation
Case Number: DS19004
Vehicle: 2002 Honda Civic
Location: Arizona
Crash Date: June 2018**

BACKGROUND

This report documents the on-site investigation of an inflator rupture of a frontal air bag module in a 2002 Honda Civic (**Figure 1**). The inspection documented the ruptured driver air bag inflator, the air bag, and the steering wheel/column assembly. It was determined that the inflator did rupture. This investigation was initiated by the Office of Defects Investigation (ODI) in response to notification by an attorney. The Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration assigned the case to Dynamic Science, Inc., in March 2019. The Honda was held by the plaintiff's attorney at a private facility. The vehicle was inspected in March 2019. Parties associated with the attorney and Honda were present during the inspection. The vehicle was not supported by the Bosch Crash Data Retrieval (CDR) system.



Figure 1. The 2002 Honda Civic.

According to a CARFAX report, there were two previous owners of the vehicle, both in Arizona. The vehicle had been involved in a crash with disabling damage in May 2004. There were no reports of air bag deployments until this most recent crash. There was a manufacturer safety-related recall issued in June 2015 (NHTSA #15V-320) for the driver's air bag. According to Honda, the air bag inflator was not replaced.

This two-vehicle crash occurred in a four-leg intersection in Arizona in June 2018 at night and there were no streetlights present. The weather was clear and dry. The posted speed limit for northbound traffic was 105 km/h (65 mph). The speed limit for eastbound traffic was 72 km/h (45 mph). The eastbound approach to the intersection was controlled by a stop sign that was configured with a flashing red light on top. The Honda was traveling northbound at a passenger-reported speed of 104 km/h (65 mph) and was being driven by a belted 54-year-old male. The front right seat was occupied by a belted 50-year-old female. The other vehicle was a 2017 Jeep Renegade driven by an 18-year-old female, traveling eastbound approaching the intersection. The driver stated that she was lost and thought the eastbound roadway would take her back to an interstate highway. As the Jeep entered the intersection it was struck on the right plane by the front plane of the Honda. During this impact both frontal air bags in the Honda deployed (**Figure 2**). The Honda came to rest in the intersection facing southeast. The Jeep came to rest in the

northeast corner of the intersection facing generally north. The driver of the Honda sustained left side neck and face injuries that are being attributed to the air bag inflator. He was transported to a local hospital with life-threatening injuries. The driver was hospitalized and died three days after the crash. Medical personnel reported that the driver had sustained a lacerated carotid artery and had died due to a lack of blood to the brain. The front right passenger was transported to a local hospital, where she was treated and released. Both vehicles were towed from the scene due to damage.

SUMMARY

Crash Site

This crash occurred in the four-leg intersection of a State highway and a cross-over street. The northbound approach consisted of a left-turn lane, two through lanes, and a right-turn lane (**Figure 3**). Northbound traffic was separated by a wide, grass-covered median. The asphalt roadway was straight and had a positive 1 percent grade. The posted speed limit for northbound traffic was 104 km/h (65 mph). The eastbound approach consisted of an eastbound through lane, a left-turn lane, and a westbound through lane (**Figure 4**). This roadway spanned the width of the grass covered median and was level. The speed limit for eastbound traffic was 72 km/h (45 mph). The eastbound approach to the intersection was controlled by a stop sign that was configured with a flashing red light on top. It was dark at the time of the crash, and there were no streetlights present. The weather at the nearest reporting station was 23 °C (75 °F), 27 percent humidity, and winds variable at 8 km/h (5 mph). A crash diagram is attached at the end of this technical report.

Pre-Crash

The Honda was driven by a belted 54-year-old male and was traveling northbound at approximately 107 km /h (66.5 mph)¹ approaching



Figure 2. Frontal air bag deployments, the 2002 Honda Civic (police image).



Figure 3. Northbound approach for 2002 Honda Civic.



Figure 4. Eastbound approach for the 2017 Jeep Renegade.

¹ Speed based on conservation of linear momentum formula with departure speed based on police-reported final rest positions.

the intersection. The front row right seat was occupied by a belted 50-year-old female. The Jeep was driven by an 18-year-old female and was traveling eastbound approaching the intersection. The driver stated that she was lost and thought the eastbound roadway would take her back to an interstate highway. Based on an estimated impact speed, it does not appear that the driver of the Jeep stopped at the intersection. A witness traveling behind the Honda indicated that he did not see any brake lights from the Honda.

Crash

As the Jeep entered the intersection, it was struck in the right plane by the Honda (Event 1). The “missing vehicle” algorithm of the WinSMASH program calculated a total delta V of 50 km/h (31 mph) for the Honda. The longitudinal and lateral components were -47 km/h (-29 mph) and 17 km/h (11 mph), respectively. The collision fit the model and the results appear reasonable. The WinSMASH program calculated a total delta V of 35 km/h (22 mph) for the Jeep. The longitudinal and lateral components were -12 km/h (-7 mph) and -33 km/h (-21 mph), respectively. The results appear borderline. The Honda was displaced in a northeast direction and came to rest in the intersection facing south (**Figure 5**). The Jeep was displaced in a northeast direction, entered the right shoulder of the westbound lane, and struck a stop sign pole (Event 2) before coming to rest facing northwest next to the pole (**Figure 6**).

Post-Crash

The driver of the Honda sustained serious left side neck and face injuries. He was removed from the vehicle by police officers who began CPR. EMS arrived on scene at 2040 hours. They located him outside of his vehicle and noted that he had no palpable pulse and was not breathing. He had a Glasgow Coma Scale score (GCS) of 3 at 2045 hours. He was treated on scene and EMS began cardiac arrest protocol. The ambulance transport record indicated that the patient’s breath was being mechanically assisted and the GCS was incomplete. He was transported from the scene code three to a local trauma center at approximately 2108 hours. He was hospitalized for three days before passing away. The front right passenger was ambulatory and had a GCS score of 15 upon EMS arrival. She complained of pain to her chest and left ankle. She was transported from the scene to a local hospital in a non-emergency mode. Both vehicles were towed from the scene due to damage.

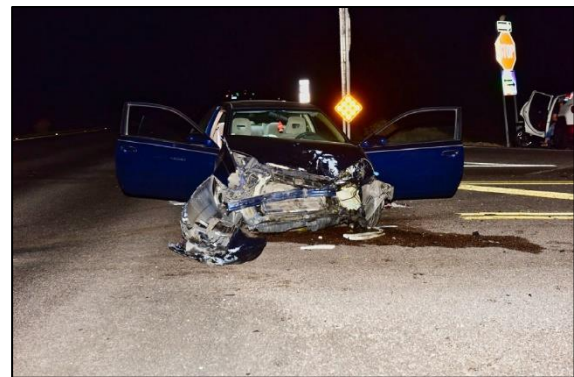


Figure 5. The 2002 Honda Civic at final rest, looking north (police image).



Figure 6. The 2017 Jeep Renegade at final rest/event 2, looking east (police image).

2002 HONDA CIVIC

Description

The Honda was a 5-passenger, 2-door coupe. The vehicle was identified by the Vehicle Identification Number (VIN) 1HGEM21962Lxxxxxx. There was no manufacturer certification placard present and the date of manufacture is not known. The vehicle was equipped with a 1.7-liter, 4-cylinder, gasoline engine, a 5-speed manual transmission, and front-wheel drive. The recommended tire size for front and rear was P185/70R14. The vehicle was equipped with Forceum Hena P205/40R17 tires on the front and Nexen 6000 P205/40R17 tires on the rear. The vehicle had 5-spoke Momo rims all around. The specific tire information was as follows:

Position	Measured Tread Depth	Restricted	Damage
LF	6 mm (8/32 in)	No	None
LR	3 mm (4/32 in)	No	None
RR	2 mm (2/32 in)	No	None
RF	6 mm (7/32 in)	Yes	None

The Honda was configured with seating for five occupants. The front row was equipped with fabric covered bucket seats with folding backs and adjustable head restraints. The driver's seat was slightly reclined and was adjusted to the full rearward track position at the time of the vehicle inspection. The position of seat track at the time of the crash is unknown.

Exterior Damage

The Honda sustained moderate front plane damage from the impact to the right side of the Jeep (**Figure 7**). The direct damage began at the left front bumper corner and extended from bumper corner to bumper corner. The backing bar had been shifted 40 cm (15.6 in) to the right. The Field L extended from bumper corner to bumper corner. Twelve measurements were taken at the bumper backing bar level by the Nikon Total Station, and the Faro Blitz program computed crush measurement in six increments as follows: $C_1 = 23$ cm (9.0 in), $C_2 = 29$ cm (11.4 in), $C_3 = 35$ cm (13.7 in), $C_4 = 30$ cm (11.8 in), $C_5 = 20$ cm (7.8 in), and $C_6 = 10.0$ cm (3.9 in). The Collision Deformation Classification (CDC) was 11FDEW2.



Figure 7. The 2002 Honda Civic.

NHTSA Recalls and Investigations

According to the Carfax report, there was a manufacturer safety-related recall issued in June 2015 (NHTSA #15V-320) for the driver's frontal air bag. According to the recall, the frontal air bag inflator, when deploying in a crash, could rupture and break apart, possibly causing serious injury or fatality. The air bag inflator was not replaced prior to this crash. Subsequent to this

crash, there was a safety-related recall issued in June 2019 (NHTSA #19V-501) for the passenger's frontal air bag. The most recent database query occurred in July 2020. According to the recall, the passenger's frontal airbag inflator may rupture when deploying during a crash. The potential for such ruptures may occur in some of the subject air bag inflators after several years of exposure to persistent conditions of high absolute humidity.

Event Data Recorder

The Honda was equipped with an air bag control module that monitored the air bag system's diagnostics and controlled its deployment. It was the understanding of parties involved in the inspection that Honda vehicles of this time frame were equipped with EDRs that had limited capabilities and did not record pre-crash data. The EDR was not supported by the Bosch Crash Data Retrieval (CDR) tool; therefore, EDR data was not available.

Interior Damage

The inspection of the interior did not reveal any damage. There was no deformation of the steering wheel rim or compression of the column. There were no deformations to any of the seats. All the doors remained closed and operational. There was no glazing damage or any intrusion.

Manual Restraint Systems

The front row was equipped with driver and front right passenger lap and shoulder seat belts. The driver's belt was equipped with continuous loop belt webbing, a sliding latch plate, an emergency locking retractor (ELR), and a fixed upper anchor. The driver and the front right passenger were restrained by the seat belts based on the observations of the SCI vehicle inspection. The driver seat belt webbing was cut immediately below the D-ring by first responders during the on-scene activities to remove the driver from the vehicle. The cut length of the webbing was lying on the driver seat cushion at inspection and was blood-soaked. There was loading evidence located



Figure 8. Driver's frontal air bag, the 2002 Honda Civic.



Figure 9. Driver's air bag, the 2002 Honda Civic.



Figure 10. Components found inside the air bag, the 2002 Honda Civic.

on the front right passenger seat belt. Both front row seat belt pretensioners actuated.

Supplemental Restraint Systems

The Honda was equipped with dual-stage frontal air bags for the driver and front right passenger positions. As a result of the front-to-side impact with the Jeep, both frontal air bags deployed. The air bag system was controlled by a sensing and diagnostic module. The module was located on the forward aspect of the center tunnel forward of the transmission shifter. Two external sensors were mounted to the outboard forward aspects of the front frame rails.

The driver's air bag deployed from an H-configuration module cover located in the hub of the steering wheel rim (**Figure 8**). The air bag was circular and measured 46 x 43 cm (18.1 x 16.9 in) in diameter in its deflated state (**Figure 9**). The air bag was configured with rear panel vent ports and was tethered. The air bag inflator ruptured during the air bag deployment. The air bag face was holed at the 12 and 6 o'clock positions. The upper hole was measured 7 x 4 cm (2.7 x 1.5 in). There was an area of melting adjacent to this hole. The lower hole measured 6 x 4 cm (2.3 x 1.7 in).

The passenger's frontal air bag deployed from the top of the instrument panel. The air bag measured 46 x 44 cm (18.1 x 17.3 in) and was configured with two vent ports. There was no indication of occupant contact and the air bag was not damaged.

Air Bag Inflator Rupture Discussion

The driver's air bag inflator was manufactured by Takata in 2002 and appeared to be original to this vehicle, per Honda. At the time of the inspection, the bottom portion of the module was still attached to the vehicle. The top of the module and other pieces were found in the vehicle by a relative of the driver and placed in a bag. The module was unbolted from the steering wheel and further torn down for inspection. Multiple fragments were recovered from in the air bag (**Figure 10**). The back of the inflator housing was damaged with three of the four attachment bolts torn (**Figures 11-12**).

The Stage 2 cap, both squibs, and a metal fragment were found in the vehicle (**Figures 13-15**). The top surface of the cap was labeled JBAN3806745. It weighed 318 grams (11.2 ounces). The metal fragment weighed 4 grams (0.1 ounces) and each initiator weighed 10.9 grams (0.38



Figure 11. Back view of ruptured inflator housing, the 2002 Honda Civic.



Figure 12. Interior surface of the ruptured inflator housing, the 2002 Honda Civic.

ounces). Based on available evidence, it was determined that the driver's frontal air bag inflator ruptured during its Stage 1 deployment and displaced the Stage 2 inflator cap rearward toward the driver. The cap holed the air bag's fabric and struck the driver on the left side of his face and neck resulting in fatal injuries.



Figure 13. Stage 2 inflator cap, the 2002 Honda Civic.



Figure 14. Inflator metal fragment, the 2002 Honda Civic.



Figure 15. Inflator squibs, the 2002 Honda Civic.

2002 HONDA CIVIC OCCUPANTS

Driver Demographics

Age/sex:	54 years/male
Height:	179 cm (70 in)
Weight:	93 kg (205 lbs)
Eyewear:	Unknown
Seat type:	Bucket with folding back
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder used
Usage source:	Vehicle inspection
Alcohol/drug data:	None
Egress from vehicle:	Removed by police due to serious injuries
Transport from scene:	Ambulance
Type of medical treatment:	Hospitalized for three days before dying

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Left cerebral ischemic infarct - [evolved over time]	140676.3	Ruptured air bag inflator	Certain
2	Laryngeal fracture	340208.3	Ruptured air bag inflator	Certain
3	11 cm laceration, left anterolateral side of neck	310604.2	Ruptured air bag inflator	Certain
4 5	Injuries to internal and external jugular vein	320899.1 320699.1	Ruptured air bag inflator	Certain
6	Left carotid artery contusion	320499.2	Ruptured air bag inflator	Certain
7	C3 transverse process fracture	650220.1	Ruptured air bag inflator	Certain
8	Left mandibular fracture	250600.1	Ruptured air bag inflator	Certain

Source: autopsy report.

Driver Kinematics

The 54-year-old male driver was seated in an unknown posture with the seat adjusted to an unknown track position. He was restrained by the vehicle's 3-point lap and shoulder seat belt. As the Honda traveled northbound approaching the intersection, the Jeep traveling eastbound crossed its path. There were no indications that the driver of the Honda took any evasive actions. The front plane of the Honda struck the right plane of the Jeep. The severity of the crash resulted in the deployment of the Honda's frontal air bag system and actuation of the seat belt pretensioner. During deployment, the air bag inflator ruptured and a portion of the inflator penetrated through the air bag fabric and struck the left aspect of the driver's neck and face. This resulted in injuries that eventually became fatal. The driver was removed from the vehicle by the police and transported by ambulance to a hospital, where he died three days later.

Front Row Right Occupant Demographics

Age/sex:	50 years/female
Height:	Unknown
Weight:	79 kg (174 lbs)
Eyewear:	Unknown
Seat type:	Bucket with folding back
Seat track position:	Unknown

Manual restraint usage:	Lap and shoulder used
Usage source:	Vehicle inspection
Alcohol/drug data:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Ambulance
Type of medical treatment:	Treated and released

Front Row Right Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Seat belt contusions to chest	410402.1	Shoulder belt	Certain
	Swelling to left ankle	Not codeable		

Source: EMS report.

Front Row Right Occupant Kinematics

The 50-year-old female front right occupant was seated in an unknown posture with the seat adjusted to an unknown track position. She was restrained by the vehicle's lap and shoulder seat belt. As the front of the Honda struck the right plane of the Jeep, the passenger frontal air bag deployed and the seat belt pretensioner actuated. She loaded the seat belt. She sustained minor injuries. She was able to exit the vehicle under her own power and was then transported by ambulance to a hospital for examination.



Figure 16. The 2017 Jeep Renegade, right plane damage (police image).

2017 JEEP RENEGADE

Description

The 2017 Jeep Renegade was identified by the VIN ZACCJBCB2HPxxxxxx. The Jeep was a 4-door SUV equipped with a 2.4-liter, 4-cylinder, gasoline engine and all-wheel drive.

Exterior Damage

The Jeep sustained moderate damage to the right plane from the impact with the Honda (**Figure 16**). The direct contact began near the B-pillar and extended to the front right bumper corner. The front right axle was displaced. The CDC for this impact was 02RYEW2. The vehicle sustained moderate damage to the front plane from the



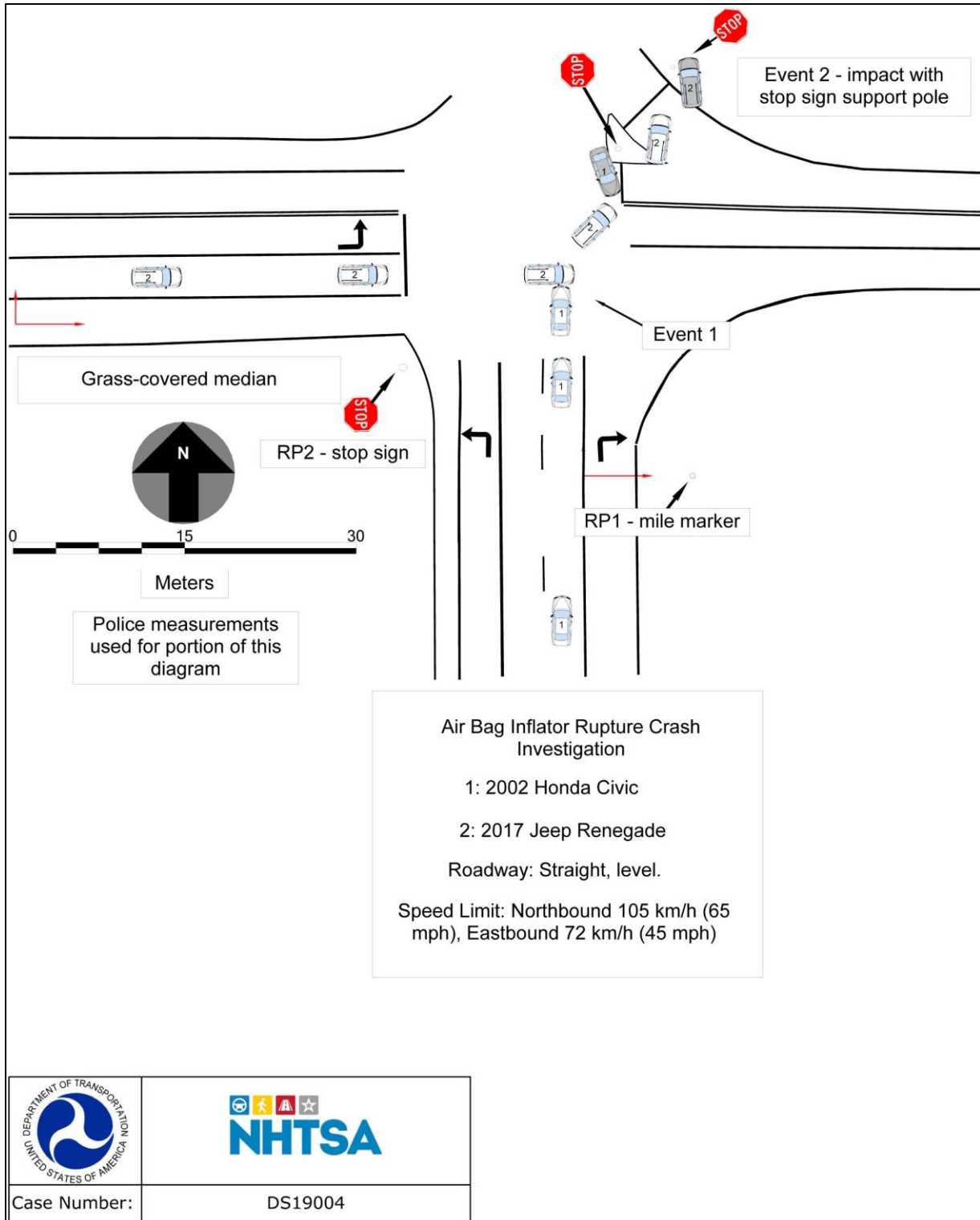
Figure 17. The 2017 Jeep Renegade, frontal damage (police image).

impact with the stop sign support pole (**Figure 17**). The damage began at the front left bumper corner. The CDC was 12FLEE2.

Occupant Data

The 18-year-old female driver of the Jeep was police-reported as restrained by the manual seat belt system. The report indicated that the frontal air bag deployed. The police indicated that she was able to exit the vehicle under her own power and was not injured.

CRASH DIAGRAM



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