On-Site Rollover Investigation
Dynamic Science, Inc. (DSI), Case Number DS10002
2008 Ford Escape Hybrid
California
January 2010

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract

This on-site investigation focused on a 2008 Ford Escape Hybrid that was involved in a minor vehicle-to-vehicle impact and subsequent rollover. This crash occurred in January 2010 at 1505 hours in an unincorporated area of California. The crash site was the three westbound lanes of a divided interstate highway. The subject vehicle was being driven in the middle lane by a 35-year-old male. A 2008 Dodge Dakota that was being driven by a 24-year-old female was traveling ahead of the Ford in the third lane. A 1996 Peterbilt three-axle tractor was being driven by a 44-year-old male in the first lane. The Peterbilt was towing a 2008 Western 2-axle trailer. It was raining at the time of the crash. The Dodge began changing lanes to the right into the Ford's travel lane. There was no contact between the vehicles. The driver of the Ford steered to the right to avoid the Dodge and the right side of the Ford impacted the left side of the Peterbilt. The driver of the Ford steered sharply to the left, then steered back to the right, and lost control of the vehicle. The Ford began a clockwise rotation, departed the roadway on the right, and began a left side leading rollover down an embankment. The Ford rolled five quarter turns before impacting a metal fence and coming to rest on its left side. The driver sustained minor injuries and was transported to a local hospital where he was treated and released. The Ford was towed from the scene due to damage and was later declared a total loss by the insurance company. The Dodge did not sustain any damage and was driven from the scene. The Peterbilt sustained minor damage and was towed from the scene.

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BACKGROUND

Figure 1. Subject vehicle, 2008 Ford Escape Hybrid

This on-site investigation focused on a 2008 Ford Escape Hybrid that was involved in a minor vehicle-to-vehicle impact and subsequent rollover (**Figure 1**). This crash occurred in January 2010 at 1505 hours in an unincorporated area of California. The crash site was the three westbound lanes of a divided interstate highway. It was raining at the time of the crash. The subject vehicle was being driven in the middle lane by a 35-year-old male. A 2008 Dodge Dakota that was being driven by a 24-year-old female was traveling ahead of the Ford in the third lane. A 1996 Peterbilt three-axle tractor was being driven by a 44-year-old male in the first lane. The Peterbilt was pulling a 2008 Western 2-axle trailer. The Dodge began changing lanes to the right into the Ford's travel lane. There was no contact between the vehicles. The driver of the Ford steered to the right to avoid the Dodge and the right side of the Ford impacted the left side of the Peterbilt. The driver of the Ford steered sharply to the left, steered back to the right, and lost control of the vehicle. The Ford began a clockwise rotation, departed the roadway on the right, and began a left side leading rollover down an embankment. The Ford rolled five quarter turns before impacting a metal fence and coming to rest on its left side. The driver sustained minor injuries and was transported to a local hospital where he was treated and released. The Ford was towed from the scene due to damage and was later declared a total loss by the insurance company. The Dodge did not sustain any damage and was driven from the scene. The Peterbilt sustained minor damage and was towed from the scene.

This investigation was identified by a DSI investigator during a review of an automobile auction internet site. Photographs of the subject vehicle were submitted to the National Highway Traffic Safety Administration (NHTSA) and on January 20, 2010 DSI was directed to commence the investigation. The police report was not yet available but the preliminary face sheet was obtained; permission to inspect the subject vehicle was granted and the vehicle inspection took place on February 2, 2010. Permission to remove the Ford's Event Data Recorder (EDR) was obtained but later rescinded until a salvage certificate was obtained by the insurance company. The vehicle was later sold to a private party and the EDR was obtained from that party in April 2010. The EDR was submitted to NHTSA for the purpose of submitting the EDR to Ford to image the crash data. A summary of the imaged data is included in this report.

SUMMARY

Crash Site

The crash site was the westbound lanes of an interstate highway (**Figure 2**). The highway was configured with three lanes that were separated by dashed white lines. The concrete, rain-grooved roadway was straight, level, and was wet at the time of the crash. The roadway was bordered on the north by a 3.3 m (11.0 ft) paved concrete shoulder, a 6.7 m (22.0 ft) level area of grass, a 58 percent

descending embankment that leveled out after approximately 16.5 m (54.0 ft), and a metal fence. North of the fence there was a 1.5 m (5.0 ft) drop-off to the paved lot of a heavy vehicle repair/rental facility. The roadway was bordered on the south by a concrete shoulder and a concrete barrier. The posted speed limit was 113 km/h (70 mph).

Figure 2. Westbound approach

Pre-Crash

The Ford was traveling in the middle lane at a driver reported speed of 97-105 km/h (60-65 mph). Both of his hands were on the steering wheel and his right foot was on the accelerator. He stated in the interview that the cruise control was on. The EDR reported speed 5 seconds prior to the rollover event was 95.75 km/h (59.50 mph). An EDR record was generated due to a rollover event with a reported roll angle of -36.484 degrees. The Dodge was traveling in the adjacent left lane and was positioned slightly in front of the Ford. The Peterbilt was traveling the adjacent right lane. For undetermined reasons, the Dodge initiated a lane change to the right. The driver of the Ford reacted by braking and steering to the right. There was no contact between the vehicles.

Figure 3. Right side road departure (north)

Crash

The driver of the Ford steered to the right and the right side of the Ford impacted the left side of the Peterbilt (Event 1). The driver of the Ford steered sharply to the left, then steered back to the right, and lost control of the vehicle. The Ford began a clockwise rotation and departed the roadway on the right **(Figure 3**). The vehicle continued the rotation, crossed the level area of grass, and began traveling down the embankment. Due to the steepness of the embankment and surface irregularity the Ford began a left side leading fall-over type rollover (Event 2). The vehicle traveled approximately 60 m (197 ft) prior to the rollover event. The Ford rolled five quarter turns before impacting a metal fence (Event 3) and coming to rest on its left side straddling the fence and tipped downward into the adjacent lot (**Figure 4**).

Post-Crash

The driver remained belted in his seated position immediately after the crash. Emergency responders arrived and removed the roof glass and the driver was able to exit under his own power. He sustained abrasions and minor lacerations to his forehead and contusions along his left thigh and lower leg. He was transported by ground ambulance to a local hospital where he was treated and released. The other drivers did not report any injuries. The Ford was towed from the scene due to damage and was later declared a total loss by the insurance company. The Dodge did not sustain any damage and was driven from the scene. The Peterbilt sustained minor damage and was towed from the scene.

Figure 4. Final rest of subject vehicle looking north (police photo)

Vehicle Data - 2008 Ford Escape Hybrid

The 2008 Ford Escape hybrid sport utility vehicle was identified by the Vehicle Identification Number (VIN): 1FMCU59H78Kxxxxxx. The vehicle date of manufacture was January 2007. The vehicle mileage was 56,496 km (35,105 miles). The Ford was a gas/electric hybrid vehicle that was equipped with 2.3-liter, 4-cylinder gasoline engine, a hybrid electric motor alternator, a continuously variable transmission, 4-wheel drive, 4-wheel disc brakes, a regenerative braking system, and a tilt steering wheel. The Ford was equipped with Continental Contitrac P235/70R16 tires. The tire manufacturer's stated maximum pressure was 303 kPa (44 psi); the vehicle manufacturer's recommended cold pressure was 241 kPa (35 psi). The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire flat	6 mm (8/32 in)	No	De-beaded
LR	Unknown	6 mm (8/32 in)	No	None
RR	Tire flat	6 mm (8/32 in)	No	None
RF	179 kPa (26 psi)	5 mm (6/32 in)	No	None

The seating in the Ford was configured with front bucket seats with adjustable head restraints and rear 60/40 split bench seat with adjustable head restraints.

The head restraint for the second row middle position was missing at the time of the inspection.

Vehicle Damage

The Ford sustained direct and induced damage to the right side from the impact with the Peterbilt (**Figure 5**). The damage began 26.0 cm (10.2 in) aft of the rear axle, extended forward 287.0 cm (112.9 in), and ended just forward of the front axle. Within this area of damage, forward of the rear axle, there was a 26.0 cm (16.1 in) x 30.0 cm (18.6 in) hole in the sheet metal that had been caused by contact with one of the Peterbilt's left side wheels/hubs. The Field L measurement was identical to the direct damage measurement. Six crush measurements were taken at the lower door level as follows: C_1 = 0 cm, C_2 = 0 cm, C_3 = 3.0 cm (1.2 in), C_4 = 2.0 cm (1.2 in), C_5 = 1.0 cm (0.4 in), C_6 = 0 cm. The maximum crush was located at the window frame level above C_4 and measured 10.0 cm (3.9 in). The Door Sill Differential (DSD) was located 139.0 cm (54.7 in) forward of the rear axle and measured 7.0 cm (2.8 in). The Collision Deformation Classification (CDC) for Event 1 was 05RDES2.

Figure 5. Right side damage, 2008 Ford Escape

Figure 6. Maximum vertical crush, 2008 Ford Escape

The Ford sustained damage to the left side, right side, front, and roof during the rollover event (**Figure 6**). The direct damage to the top of the vehicle extended laterally from roof side rail to roof side rail and measured 122.0 cm (48.0 in). The damage extended from the hood rearward 374.0 cm (147.2 in). The maximum vertical crush measured 13.0 cm (5.1 in) and was located 71.0 cm (27.9 in) rearward of the windshield header and 8.0 cm (3.1 in) inboard of the right roof side rail. Both roof racks were deformed. A 46.0 cm (19.1 in) wide by 42.0 cm (16.5 in) high section of the rear bumper fascia was displaced from the vehicle. The CDC for Event 2 was 00TDDO2.

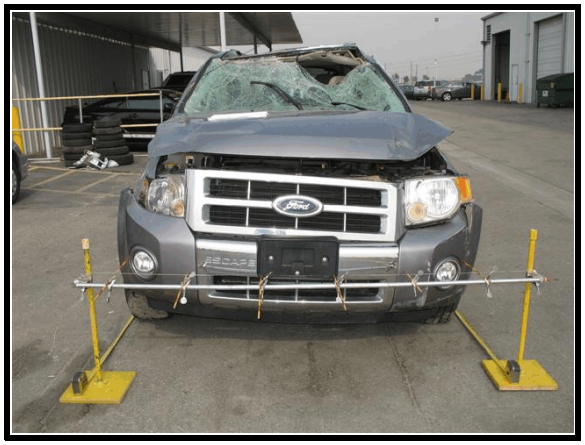


Figure 7. Frontal damage, 2008 Ford Escape

The Ford sustained minor front end damage from the impact with the fence (**Figure 7**). The vehicle also possibly contacted a set of large tires that were stacked in the lot of the repair company. The direct damage began at the left front bumper corner and extended 36.0 cm (14.1 in) to the right. Six crush

measurements were taken at the bumper level as follows: C_1 = 0 cm, C_2 = 2.0 cm (0.8 in), C_3 = 0 cm, C_4 = 0 cm, C_5 = 1.0 cm (0.4 in), C_6 = 0 cm. The CDC for Event 3 was 00FDEW1. The entire front end of the vehicle was included in the CDC because the vehicle penetrated the fence.

Interior Damage

The Ford sustained moderate interior damage as a result of intrusions, occupant loading, and occupant contacts. Vertical intrusion was located in the front row at the right A-pillar, right/middle/left windshield header, and right roof side rail. Lateral intrusion was located in the front row at the rear upper quadrant of the front right door, forward upper quadrant of the left front door, and left and right A-pillars. Vertical intrusion was located in the second row across the entire roof. Evidence of occupant loading and contacts were documented to the driver's safety belt, the safety belt latch plate, left lower instrument panel (**Figure 8**), left upper door panel, (**Figure 9**) left seat-mounted side air bag, and left inflatable curtain (IC) air bag.

Figure 8. Lower instrument panel contact

Figure 9. Left door contact

The right front door was jammed shut; the remaining doors and the rear hatch remained closed and operational. All the glazing was either fixed or closed. The windshield was cracked and in place. The left front, right front, and roof glazing was disintegrated.

Manual Restraints

The front row seating positions were equipped with 3-point manual lap and shoulder belts with sliding latch plates, adjustable D-ring anchorage assemblies, and buckle/retractor pretensioners. The driver's safety belt had an Emergency Locking Retractor (ELR) and the front right passenger's safety belt had a switchable ELR/Automatic Locking Retractor (ALR).

The driver's safety belt D-ring anchorage was set in the full-up position. The latch plate was scratched indicating historical usage. The retractor pretensioner actuated and the safety belt was locked in place. The buckle stalk was compressed 2.0 cm (0.8 in). There were areas of loading and scuffing to the safety belt webbing (**Figure 10**).

Figure 10. Scuff to driver's safety belt

The first area measured 5.0 cm (2.0 in) wide and was located 115.0 cm (45.2 in) from the stop button. The second was located 49.0 cm (19.3) from the stop button and measured 12.0 cm (4.7 in) in length.

The front right and second row outboard safety belt latch plates showed evidence of historical usage and the safety belt components were otherwise unremarkable. The second row center safety belts did not show indications of usage.

Supplemental Restraint Systems

This vehicle's Supplemental Restraint System (SRS) included a Restraint Control Module (RCM), driver and passenger frontal air bags, seat-mounted side air bags for the front row, rollover/side impact IC air bags, and safety belt pretensioners for the front row. The Ford was a Certified Advanced 208-Compliant (CAC) vehicle and was equipped with advanced frontal air bags. The multi-stage air bags were certified by the manufacturer to be compliant with the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The driver's air bag was located within the steering wheel hub and the front right passenger air bag was located within the middle of the right instrument panel. During the crash, the left and right IC air bags and the driver's side seat-mounted side air bag deployed (**Figure 11**).

Figure 11. Left IC air bag, interior view

The left and right IC air bags deployed from modules in roof rails above the front and second rows. The IC air bags measured 150.0 cm (59.0 in) in length and 53.0 cm (20.9 in) in height. The bottom edge of the air bag was located 10.0 cm (3.9 in) below the side window frame. The air bags were configured without vent ports or internal tethers. The front of the air bag was attached to the A-pillar by a 40.0 cm (15.7 in) tether; the rear was attached to the C-pillar by a 9.0 cm (3.5 in) tether.

The tether that attached the left IC air bag to the A-pillar had been cut, presumably by rescue personnel. On the inboard panel there were several areas of scuffing and dirt. A 4.0 cm (1.6 in) long scuff was located 35.0 cm (13.8 in) from the leading edge and 8.0 cm (3.1 in) from the cladding. Along the leading edge, there was an area of grease and dirt that measured 20.0 x 53.0 cm (7.9 x 20.9 in). There was 6.0 x 5.0 cm (2.4 x 1.9 in) area of dirt near the B-pillar. On the outboard panel there was an area of grease along the leading edge. There was also a 17.0 cm (6.7 in) long diagonal cut that was located 20.0 cm (7.9 in) from the leading edge at the top of the cut and 6.0 cm (2.4 in) at the bottom of the cut.

The tethers attached to the right IC air bag were intact. On the inboard panel there was an area of dirt that was located 40.0 cm (15.7 in) from the leading edge and was 53.0 cm (20.9 in) high.

On the outboard panel, there was a 5.0 x 5.0 cm (1.9 x 1.9 in) scuff located 20.0 cm (7.9 in) from the leading edge and 25.0 cm (9.8 in) below the cladding, a small cut that was located 15.0 cm (5.9 in) from the leading edge and 8.0 cm (3.1 in) from the cladding, and a area of grease at the leading edge. There was a 30.0 x 35.0 cm (11.8 x 13.8 in) area of window not covered.

The driver's seat-mounted side air bag deployed from the seat back (**Figure 12**). The air bag was semi-circular in shape and measured 28.0 cm (11.0 in) in width and 32.0 cm (12.6 in) in length. There was a 5.0 x 5.0 x 5.0 cm (2.0 x 2.0 x 2.0 in) triangular shaped fabric transfer on the inboard panel.

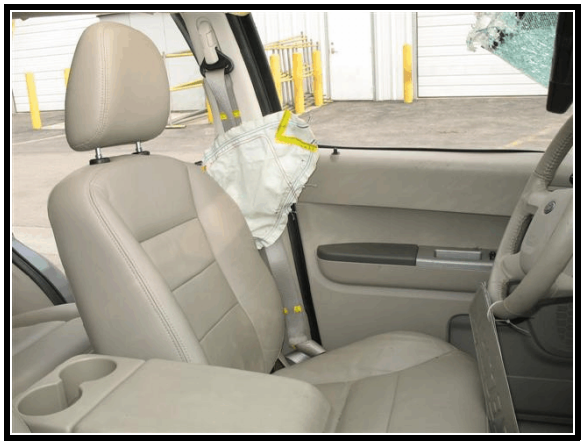


Figure 12. Seat-mounted side air bag

Event Data Recorder (EDR)

The restraint control module (RCM) analysis reported the following. Two events were recorded, a rollover event with air bag deployments and a frontal event without a deployment. Based on the key-on times, the time between the rollover event and the front event was 0.08 minutes or 4.8 seconds. Based on RCM minutes of operation, the time between the two events was 0.09 minutes or 5.4 seconds. The RCM minutes of operation has a resolution of +/-5 seconds. Based on the times, the front event came after the rollover event and was probably related to the impact with the metal fence.

Event Data Record 1

- A rollover event was recorded.
- The driver's retractor pretensioner fire time was ≥ 255 milliseconds (ms).
- The driver's pretensioner fire time was ≥ 255 ms.
- The left IC air bag deployment time was ≥ 255 ms.
- The right IC air bag deployment time was ≥ 255 ms.
- The roll rate at the time of deployment was -89.5 degrees per second.
- The roll angle at the time of deployment was -36.484 degrees
- There was 74.17 minutes from key-on until rollover algorithm wakeup.

Event Data Record 2

- The RCM recorded a front event without deployment.
- There was 74.25 minutes from key-on until algorithm wakeup.

Pre-Crash Data from Event Data Record 1

- The driver seat belt status was buckled and the seat track position was rearward.
- The passenger seat belt status was unbuckled. The seat track position was not reported.

- The passenger occupant classification was “Empty”.
- The vehicle speed was 95.75 km/h (59.50 mph) at 5 seconds prior to the event and was 11.46 km/h (8.36 mph) at 1 second prior to the event.
- The brake pedal was reported as not being depressed at 5 seconds prior to the event.
- At 4 seconds prior the brake pedal was reported as being depressed and then was reported as not being depressed from 3 to 1 seconds.

Pre-Crash Data from Event Data Record 2

- The driver seat belt status was buckled and the seat track position was rearward.
- The passenger seat belt status was unbuckled. The seat track position was not reported.
- The passenger occupant classification was Empty at seconds 5 through 2 and was Indeterminate at second 1.
- The vehicle speed was 88.22 km/h (54.82 mph) at 5 seconds prior to the event and was 11.10 km/h (6.9 mph) at 1 second prior to the event.
- The RCM recorded a -5.23 km/h (-3.25 mph) Delta-V at approximately 80 ms.

Hybrid System - 2008 Ford Escape

The Ford was specifically designed as a hybrid power train vehicle. The hybrid system consisted of a gasoline engine and an electric motor that when combined, produced low emissions and high fuel economy without the need to externally charge the battery system. The Ford was designed as a full hybrid vehicle, meaning that the gasoline engine and the electric motor can both operate separately, or run at the same time. The Ford was designed with a 2.3-liter, 4-cylinder gasoline engine which was linked to a 3-phase permanent magnet electric motor. An overview of the hybrid components and their locations is shown in Attachment 2.

Figure 13. Battery location

The high-voltage battery pack consists of 50 battery modules with each module comprised of 5 Nickel Metal-Hydride (NiMH) 1.3-volt batteries welded together. The battery cells contain a base electrolyte consisting of potassium hydroxide as the dominant active ingredient. The total voltage of the battery pack is approximately 300 volts DC. The battery pack is mounted below the rear cargo floor, aft of the second row seat (**Figure 13**). The battery pack was mounted laterally in the vehicle and was concealed and protected by an aluminum cover that was bolted to the rear floor of the vehicle. The battery is electrically isolated from the rest of the vehicle when the key is OFF. When the key is turned ON, high voltage contactors inside the battery are closed to make the electricity available to the motor/generator and enable the vehicle to drive[1]. There was a orange-colored service disconnect plug located on the right side of the battery. It was in the locked position

[1]2008 Ford Escape Hybrid Owner’s Manual

at the time of the vehicle inspection.

In the event the vehicle receives a substantial physical jolt the high voltage shut-off switch shuts off power from the high voltage battery. The inertia-activated shut-off switch was located in the cargo area on the passenger side of the vehicle in the jack compartment, behind the jack access door (**Figure 14**). The switch is located behind the jack. At the time of the vehicle inspection the switch had opened and disabled the battery. The DSI investigator reset the switch and the vehicle was restarted.

Figure 14. High-voltage shut-off switch

Federal Motor Vehicle Safety Standard (FMVSS) 305, Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection is the standard applied to vehicles that use more that 48 nominal volts of electricity as propulsion and whose speed on a level paved surface is more than 40 km/h (25 mph). FMVSS No. 305 specifies performance requirements of electrolyte spillage, retention of propulsion batteries, and electrical isolation of the chassis from the high-voltage system during a crash event.[2] The standard test requirements are summarized as follows:

- Not more than 5.0 liters (1.3 gal) of electrolyte from propulsion batteries shall spill outside the passenger compartment, and none shall spill in the passenger compartment, within 30 minutes after a battery impact test.
- No propulsion battery system component located inside the passenger compartment shall move from its installed location.
- No propulsion battery system component located outside the passenger compartment shall enter the passenger compartment.
- Electrical isolation shall exist between the propulsion battery system and the vehicle electricity-conducting structure.

The Toyota was examined to assess compliance with FMVSS No. 305.

- There were no indications of electrolyte spillage from the propulsion battery either outside or inside the passenger compartment.
- There was no movement of the battery module.
- The isolation test was not conducted. Examination of the converter and associated wiring and connectors (that were accessible) revealed no evidence of electrical arcing or melting of components.

[2]U.S. Department of Transportation, 49CFR 571.305

External power was applied to the vehicle service battery and the vehicle was started. The electronic odometer and other controls were illuminated and the power door locks were activated. The center video screen on the IP displayed systems and maintenance details pertaining to the vehicle showing the vehicle running and the HV battery being charged (**Figure 15**).

Figure 15. Center IP display. Vehicle running and HV battery being charged.

Rollover

The Ford had a Static Stability Factor (SSF) of 1.17. The SSF of a vehicle is an at-rest calculation of its rollover resistance, which is based on its track width and center of gravity. The vehicle had a rollover resistance rating of 3 out of 5 stars, indicating in a single vehicle crash the vehicle has a risk of rollover between 20 and 30 percent[3]. The vehicle was equipped with anti-lock brakes and traction control.

After the initial impact, the driver lost control of the vehicle and it began a clockwise rotation. As the vehicle departed the roadway, the vehicle continued the rotation, crossed the level area of grass, and began traveling down the embankment. Due to the steepness of the embankment and surface irregularity the Ford began a left side leading fall-over type rollover. The Ford rolled 5-quarter turns before impacting a metal fence and coming to rest on its left side straddling the fence and tipped downward into the adjacent lot. The estimated distance from the trip point at the top of the embankment to final rest was 26.8 m (88.0 ft).

Vehicle Data -1996 Peterbilt Tractor-Trailer

The 1996 Peterbilt 385 6x4 tractor was identified by the VIN: 1XPGD98X0TNxxxxxx. The Peterbilt was configured with a conventional cab and a Cummins M11 661 CID diesel engine and had a gross vehicle weight between 15,969 - 21,319 kg (33,001 - 47,000 lbs). It was being driven by a 44-year-old male and was pulling a 2008 Western 2-axle trailer. The vehicle sustained minor left side damage from the impact with the Ford and was driven from the scene. It was not available for inspection.

[3] www.safercar.gov

Occupant Demographics

Driver

Age/Sex:	35/Male
Height:	188 cm (74 in)
Weight:	104 kg (230 lbs)
Seat track position:	Full rearward
Manual restraint use:	Lap and shoulder belt
Type of medical treatment:	Transported and released

Occupant Kinematics

Driver Kinematics

The driver of the Ford was seated in an upright posture and was restrained by the lap and shoulder safety belt. The seat was adjusted to the rear-most track position and the seat back was slightly reclined. He was actively steering with both hands. His right foot was on the accelerator and the left was on the floor. As the Dodge began to change lanes, the driver of the Ford braked and steered to the right. The right side of the Ford impacted the Peterbilt in a side-swiping configuration and there was little driver movement. The driver then steered to the left, started losing control of the vehicle, and then steered back to the right. The Ford began a clockwise rotation and the driver was displaced to the left. As the Ford tripped and began to roll, the driver's safety belt pretensioner actuated and the side IC air bags deployed. The driver likely contacted the left IC air bag but there were no resultant injuries. The vehicle rolled five quarter-turns and came to rest on its left side. The driver remained belted in his seated position immediately after the crash. He sustained an abrasion to the forehead due to flying glass and contusions to his left lower leg and thigh due to contact with the left door and left instrument panel. Emergency responders arrived and removed the roof glass and the driver was able to exit under his own power. He was transported by ground ambulance to a local hospital where he was treated and released.

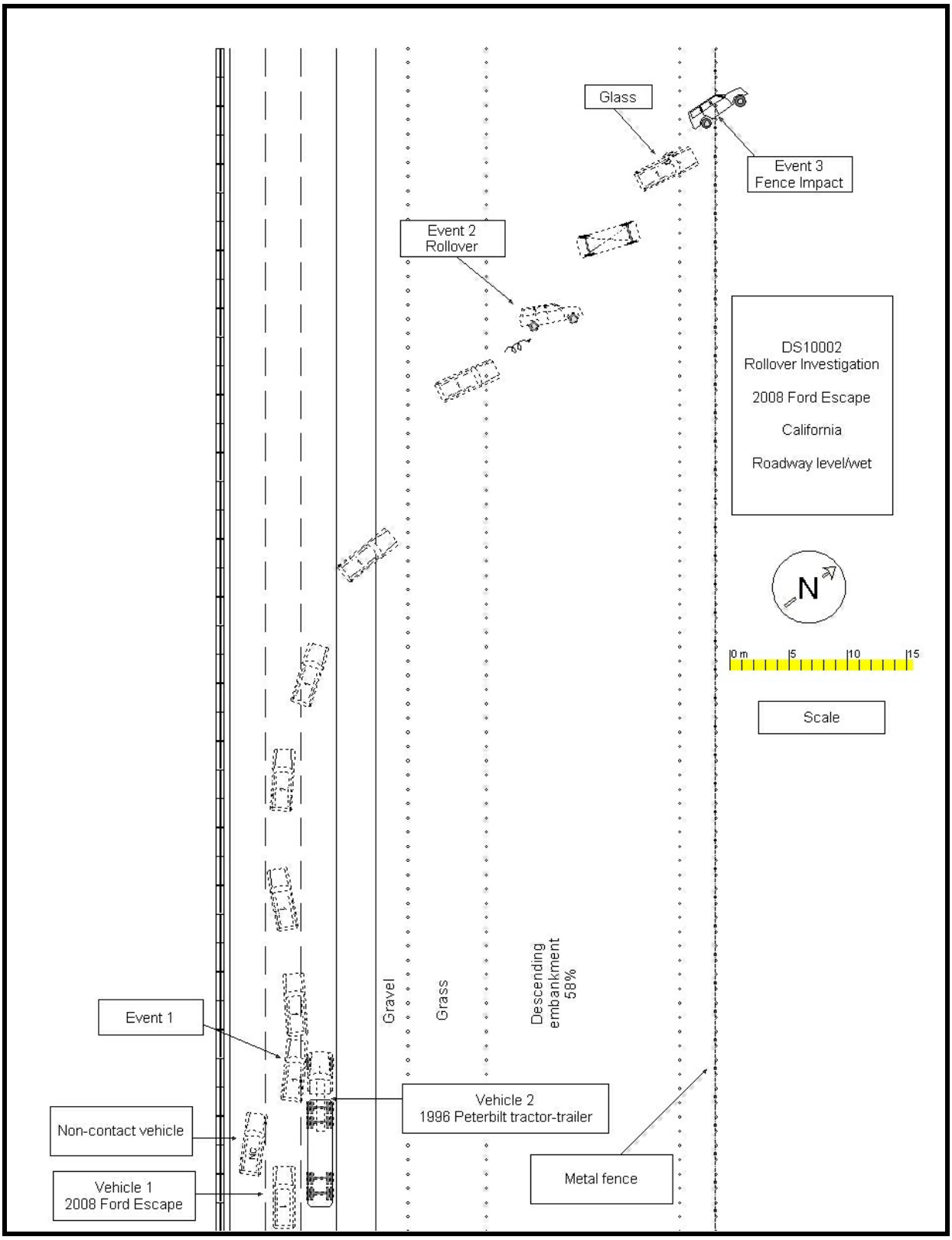
Occupant Injuries

Driver: Injuries obtained from interview.

Injury	Injury Severity (AIS 2005)	Injury Source	Confidence Level
Abrasion, forehead	210202.1,7	Flying glass	Probable
Contusion, left thigh	810402.1,2	Door panel - Forward lower quadrant	Probable

Injury	Injury Severity (AIS 2005)	Injury Source	Confidence Level
Contusion, left lower leg	810402.1,2	Left instrument panel	Certain

Attachment 1. Scene Diagram



Attachment 2. Hybrid Component Location and Identification[4]

HYBRID COMPONENT LOCATION AND IDENTIFICATION

This chart provides the location, description and basic function of the Hybrid system components. Refer to the Hybrid Component Location illustration on the following page.

	COMPONENT	LOCATION / DESCRIPTION	FUNCTION
1	High-Voltage Shut-Off Switch	• Located in the jack stowage compartment, passenger side in the cargo area.	Disconnects high-voltage battery in the event of a collision.
2	High-Voltage Service Disconnect Switch	• Located on top of the high-voltage battery, passenger side in the cargo area under carpet. • Orange in color with molded plastic handle, about 100 mm (4 inch) in diameter.	Provides means to disconnect high-voltage battery for safely servicing vehicle.
3	High-Voltage Battery — 300+ Volts	• Located in the cargo area under carpet. • Sealed nickel-metal hydride.	Provides high-voltage storage (300+ V) for vehicle propulsion requirements.
4	High-Voltage Wiring	• Runs along underside of vehicles cab floor from high-voltage battery to electronically controlled continuously variable transaxle (eCVT) then to DC-to-DC converter. • All high-voltage wiring has orange-colored insulation.	Provides physical path for high-voltage circuitry.
5	12-Volt Battery	• Located under the hood on driver side of the vehicle. • Typical automotive 6-cell lead/acid design.	Provides 12-volt power for vehicle accessories.
6	Electronically Controlled Continuously Variable Transaxle (eCVT)	• Transverse-mounted design similar to the non-Hybrid Escape/Mariner vehicles. • Contains the traction motor, generator motor and Hybrid electronics.	Provides delivery of power to wheels for vehicle propulsion, generates electricity to recharge the batteries during braking and coasting, and contains certain Hybrid electronics.
7	DC/DC Converter	• Located under the hood on the passenger side forward of the strut tower.	Provides 12 volts of power to charge the 12-volt battery and run vehicle accessories.
8	Fuel Shut-Off Inertia Switch	• Located behind the flip-up panel in the passenger front foot well.	Disables power supply to the gasoline fuel pump and the HV shut-off switch in the event of a collision.

NOTE: All high-voltage wires and harnesses are wrapped in orange-colored insulation.

[4]Escape Hybrid/Mariner Hybrid Emergency Response Guide

Hybrid Component Location