

INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs

ON-SITE AMBULANCE CRASH INVESTIGATION

CASE NUMBER - IN11001
LOCATION - INDIANA
VEHICLE - 2009 FORD E350 TYPE II AMBULANCE
CRASH DATE - December 2010

Submitted:

July 14, 2011



Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

DISCLAIMERS

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

Technical Report Documentation Page

1. <i>Report No.</i> IN11001		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> On-Site Ambulance Crash Investigation Vehicle - 2009 Ford E350 Type II Ambulance Location - Indiana			5. <i>Report Date:</i> July 14, 2011		
			6. <i>Performing Organization Code</i>		
7. <i>Author(s)</i> Special Crash Investigations Team #2			8. <i>Performing Organization Report No.</i>		
9. <i>Performing Organization Name and Address</i> Transportation Research Center Indiana University 501 South Madison Street, Suite 105 Bloomington, Indiana 47403-2452			10. <i>Work Unit No. (TRAIS)</i>		
			11. <i>Contract or Grant No.</i> DTNH22-07-C-00044		
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NVS-411) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003			13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: December 2010		
			14. <i>Sponsoring Agency Code</i>		
15. <i>Supplementary Notes</i> On-site side ambulance crash investigation involving a 2009 Ford E350 Type II Ambulance.					
16. <i>Abstract</i> The focus of this on-site investigation was the structural damage sustained by a 2009 Ford E350 Type II ambulance, which departed the road and impacted a tree. Additional focus was on the ejection of the front right passenger and the sources of his injuries. The ambulance was occupied by a restrained 26-year-old female driver and an unrestrained 50-year-old male front right passenger. There was no patient within the ambulance at the time of the crash. The ambulance was traveling southeast and the driver was negotiating a left curve. The vehicle departed the right side of the roadway and impacted a 64 cm (15.2 in) diameter tree. The integral structure of the right A-pillar and right front door frame separated from their mountings opening an avenue of ejection and the unrestrained front right passenger was ejected from the vehicle. The force direction on the vehicle was within the 1 o'clock sector and the impact force triggered a deployment of the driver's and front right passenger's frontal air bags. The driver was transported by ground ambulance to a hospital. The front right passenger was transported by ground ambulance to a transfer site and then transported by air ambulance to a trauma center. The driver sustained minor injuries and was treated in the emergency room and released. The front right passenger sustained fatal injuries.					
17. <i>Key Words</i> Ambulance Crash Fatal Injury			Motor Vehicle Traffic Crash Injury Severity		18. <i>Distribution Statement</i> General Public
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 31	22. <i>Price</i>	

TABLE OF CONTENTS

	<u>Page No.</u>
BACKGROUND	1
CRASH SUMMARY	2
2009 FORD TYPE II AMBULANCE	3
DESCRIPTION	3
EXTERIOR DAMAGE	4
EVENT DATA RECORDER	5
INTERIOR DAMAGE	5
MANUAL RESTRAINT SYSTEMS	6
SUPPLEMENTAL RESTRAINT SYSTEMS	7
2009 FORD TYPE II AMBULANCE OCCUPANTS	7
DRIVER DEMOGRAPHICS	7
DRIVER INJURIES	8
DRIVER KINEMATICS	8
FRONT RIGHT PASSENGER DEMOGRAPHICS	8
FRONT RIGHT PASSENGER INJURIES	9
FRONT RIGHT PASSENGER KINEMATICS	12
SCENE DIAGRAM	13
ATTACHMENT A: EVENT DATA RECORDER REPORT, 2009 FORD E350 TYPE II AMBULANCE	

INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
ON-SITE AMBULANCE CRASH INVESTIGATION
CASE NUMBER - IN11001
LOCATION - INDIANA
VEHICLE - 2009 FORD E350 TYPE II AMBULANCE
CRASH DATE - December 2010

BACKGROUND

The focus of this on-site investigation was the structural damage sustained by a 2009 Ford E350 Type II ambulance (**Figure 1**), which departed the road and impacted a tree. Additional focus was on the ejection of the front right passenger and the sources of his injuries. This crash was brought to our attention by the National Highway Traffic Safety Administration (NHTSA) on December 14, 2010 through NHTSA's Emergency Medical Services (EMS) Division. The crash occurred in December, 2010, at 1445 hours, in Indiana and was investigated by the county sheriff's department. This investigation was assigned on January 11, 2011. The ambulance and crash scene were inspected on January 14 and 26, 2011. The director of operations of the ambulance company was interviewed on January 11, 2011. The driver of the ambulance would not respond to our request for an interview.

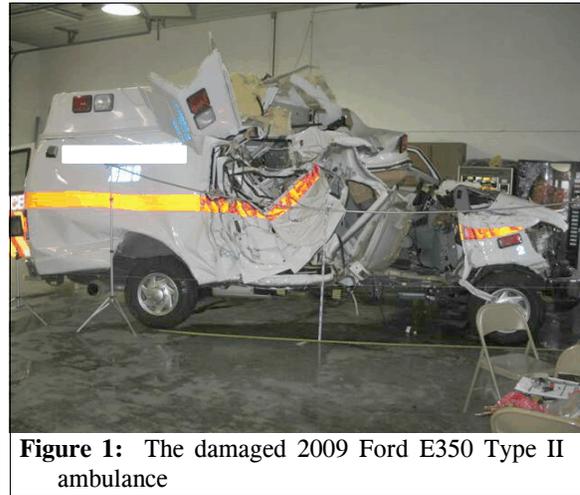


Figure 1: The damaged 2009 Ford E350 Type II ambulance

The ambulance was equipped with driver and front right passenger frontal air bags, which deployed in this crash. The vehicle was manufactured as an ambulance by Wheeled Coach Industries Inc. The ambulance was occupied by a restrained 26-year-old female driver and an unrestrained 50-year-old male front right passenger. There was no patient within the ambulance at the time of the crash. The ambulance crew was responding to a non-emergency service call when it departed the road and impacted a tree. The driver was transported by ground ambulance to a hospital. The front right passenger was transported by ground ambulance to a transfer site and then transported by air ambulance to a trauma center. The driver sustained minor injuries and was treated in the emergency room and released. The front right passenger sustained a fatal injury.

The ambulance was operated by a private company that provided contract ambulance service to the rural area of a single Indiana county with an area of 603 square kilometers (375 square miles). The ambulance service had been in operation since 1995 and operated a fleet of 14 ambulances. The ambulance service provided 9-1-1 emergency response and emergency transfer of patients. The company provided its driver's with ambulance driver training that consisted of

a Certified Emergency Vehicle Operator course. The course was approximately 4 hours in length and included video instruction and behind-the-wheel instruction.

The driver of the ambulance was an Emergency Medical Technician (EMT) and full-time employee of the ambulance company. She had been an employee for approximately 2.5 years and had been an EMT and ambulance driver for the same length of time. Her total experience as an ambulance driver was also 2.5 years. Her work schedule comprised a 24 hour shift three days a week. She did not work the day prior to the crash. On the day of the crash, she began work at 0800 hours. The front right passenger of the ambulance was also an EMT. He had worked for the ambulance service for approximately 2.5 years.

CRASH SUMMARY

Crash Site: This crash occurred on a 2-lane, undivided, state highway during daylight hours and clear weather conditions. The roadway was curved and traversed in a northwest-southeast direction. The southeast-bound travel lane was 3 m (9.8 ft) in width. The northwest-bound travel lane was 3.4 m (11.2 ft) in width. The roadway pavement markings consisted of solid white edge lines and double yellow center lines. The roadway was bordered by gravel shoulders 0.5 m (1.6 ft) in width. An embankment with a negative 32% grade was located on the south side of the road. Both sides of the road were heavily wooded. The roadway surface was dry bituminous and the grade for the ambulance in the area of roadway departure was positive 7%. The speed limit was 72 km/h (45 mph). A curve warning sign with a 40 km/h (25 mph) speed advisory was located 0.22 miles northwest of the crash site. The Scene Diagram is on page 13 of this report.



Figure 2: Southeast approach of the ambulance to area of roadway departure; arrow shows impacted tree

Pre-Crash: The ambulance was traveling southeast (**Figure 2**) and the driver was negotiating a left curve. The vehicle departed the right side of the roadway in the curve. The vehicle’s Event Data Recorder (EDR) recorded 5 seconds of pre-crash data. The EDR reported the vehicle’s speed as 78.0 km/h (48.5 mph) at 5 sec prior to Algorithm Enable (AE) decelerating to 71 km/h (44.1 mph) at 0 sec. The brakes were reported as “Off” from 5 sec to 0 sec.



Figure 3: Initial contact with the tree began on the right fender of the ambulance

Crash: Following the road departure, the vehicle traveled 21 m (68.9) along a negative 11% grade

and the right side plane (**Figure 3**) impacted a 64 cm (15.2 in) diameter tree (**Figure 4**). As the impact progressed down the right side of the vehicle, the tree engaged the right A-pillar and right front door. The integral structure of the A-pillar and door frame separated from their mountings and were displaced rearward approximately 110 cm (43.3 in) opening an avenue of ejection where the unrestrained front right passenger was ejected from the vehicle. The force direction on the vehicle was within the 1 o'clock sector and the impact force triggered a deployment of the driver's and front right passenger's frontal air bags. The vehicle's EDR reported a maximum velocity change of -35.99 km/h (-22.36 mph).



Figure 4: Southeast approach of the ambulance to the impact with the tree

Post-Crash: Police, emergency medical, and rescue services responded to the crash scene. The front right passenger was transported by ground ambulance to a nearby high school and transferred to an air ambulance. The air ambulance transported him to a trauma center where he was pronounced deceased. The driver was transported by ground ambulance to a hospital where she was treated in the emergency room and released. The Ford was towed from the crash scene due to damage.

2009 FORD E350 TYPE II AMBULANCE

DESCRIPTION

The Ford was a rear-wheel drive, 4-door, super duty extended van (VIN: 1FDSS34P39Dxxxxxx) manufactured in July 2009 and was equipped with Ford's ambulance preparation package. The vehicle was manufactured as an ambulance by Wheeled Coach Industries Inc., in October 2009. The vehicle was equipped with a 6-liter, V-8 diesel engine, an automatic transmission, 4-wheel, anti-lock brakes, an EDR, driver and front right passenger dual stage frontal air bags, and a tilt steering column that was in the full-up position. The windshield glazing was AS-1 laminated. The left front, right front, and backlight glazing was AS-2 tempered. The right rear and second right rear glazing was AS-3 tempered-tinted (original). Prior to the crash, all of the glazing was either closed or fixed. The specified wheelbase was 351 cm (138 in).

The vehicle manufacturer's recommended tire size was LT245/75R16. The vehicle was equipped with tires of the recommended size. The recommended cold tire pressure for the front tires was 414 kPa (60 psi) and 552 kPa (80 psi) for the rear tires. The ambulance's tire data are presented in the table below.

<i>Position</i>	<i>Measured Pressure</i>	<i>Measured Tread Depth</i>	<i>Restricted</i>	<i>Damage</i>
LF	496 kPa (72 psi)	6 mm (8/32 in)	No	None
LR	455 kPa (66 psi)	7 mm (9/32 in)	No	None
RR	455 kPa (66 psi)	7 mm (9/32 in)	No	None
RF	510 kPa (74 psi)	6 mm (8/32 in)	No	None

The front row of the ambulance was equipped with box-mounted cloth covered seats and integral head restraints for the driver and front right passenger. The driver’s seat track was adjusted 6 cm (2.4 in) forward of the rear position and the seat back was reclined 25 degrees. The front right passenger’s seat track was located in the rear position. The seat back was displaced by intrusion and found in the slightly reclined position. The patient compartment had a typical layout with a box-mounted, rear-facing, vinyl covered seat behind the driver. The seat track was in the rear position and the seat back was fixed. A three passenger vinyl covered bench seat was located along the right side. A side entry door was located on the right side plane and there were double back doors for patient loading.

EXTERIOR DAMAGE

The ambulance sustained right side plane damage during the impact with the tree. The direct damage began 53 cm (20.9 in) forward of the right front axle and extended 350 cm (137.8 in) rearward. Since the right A-pillar and door frame were displaced from their attachments points (**Figure 5**) by the crash, one set of crush measurements was taken at the upper door level and a second set taken at the sill level in compliance with the crush measurement protocol. The maximum residual crush at the upper door level was 41 cm (16.1 in) and was located 56 cm (22 in) forward of C₃. The maximum residual crush at the sill level was 9 cm (3.5 in) at C₅. The maximum depth of the crush pocket occurred at the roof side rail (**Figure 6**) and was 70 cm (27.6 in). The height of the sill was 44 cm (17.3 in). The height of the maximum crush on the right front door was 120 cm (47.2 in). The door sill differential was 20 cm (7.9 in).

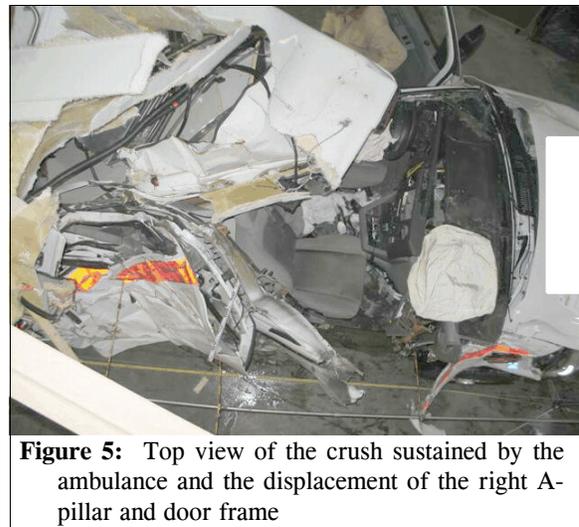


Figure 5: Top view of the crush sustained by the ambulance and the displacement of the right A-pillar and door frame

The Collision Deformation Classification (CDC) was 01RYAW4 (20 degrees). The Damage algorithm of the WinSMASH program calculated the total Delta V as 18 km/h (11.2 mph). The longitudinal and lateral velocity changes were -17 km/h (-10.6 mph) and -6 km/h (-3.7 mph), respectively. Based on the damage, the results appeared low and should be considered borderline.

The Ford's EDR was imaged using version 3.5.1 of the Bosch Crash Data Retrieval software via connection to the vehicle's diagnostic link connector. The EDR file was subsequently read and reported with version 3.8 of the software. The EDR recovered a locked frontal event and an unlocked event. The locked event was the deployment event. The frontal air bag warning lamp was reported as "Off." The safety belt status for the driver and front right passenger were reported as "Buckled." The driver's seat track position was reported as "Forward." The EDR reported a first stage deployment for the driver's and front right passenger's frontal air bags. The air bag deployment time and pretensioner actuation time were reported as 178.5 msec for the driver and front right passenger. The maximum longitudinal Delta V was reported on page 5 of the EDR report as -35.99 km/h (-22.36 mph) occurring at 250 ms following AE. The maximum lateral Delta V was reported as -8.76 km/h (-5.44 mph) occurring at 198 msec following AE. The pre-crash data was discussed on page 2 of this report. The EDR report is attached at the end of this report¹.



Figure 6: Front to rear view of the crush at the ambulance's right roof side rail

INTERIOR DAMAGE

The inspection of the front row revealed a scuff on the center instrument panel behind the end of the gear shift lever, probably from contact by the driver's right hand. A scuff was also present on the lower right corner of the glove box door and instrument panel, probably from contact by the front right passenger's right knee. There was no other discernable evidence of occupant contact. There was no deformation of the steering wheel or compression of the energy absorbing steering column.

The left front door remained closed and operational, while the integral structure of the right front door was displaced rearward creating an avenue of ejection for the front right passenger. The right side entry doors to the patient compartment were jammed closed. The patient compartment loading doors remained closed and operational. The right front glazing was disintegrated from impact forces and the windshield was cracked and separated from the vehicle.

The front row sustained a total 12 intrusions. The most severe intrusions in the front row occurred in the front right passenger's space where the right A-pillar and windshield header intruded longitudinally 110 cm (43.3 in) and 90 cm (35.4 in), respectively.

Patient Compartment: The patient compartment was configured with a storage cabinet on the left side that was equipped with plexiglass sliding doors. All the medical supplies had been removed

¹ Pages 18-24 of the EDR report have been deleted for confidentiality purposes.

from the cabinet. This cabinet was undamaged and the sliding doors were undamaged. A storage compartment for an oxygen cylinder was located at the right rear corner of the patient compartment. The oxygen cylinder had been removed. There was no damage to the oxygen compartment door or the two stainless steel oxygen tank securement straps. The front wall of the oxygen tank compartment was cracked and displaced rearward approximately 5 cm (2 in). The oxygen line within the compartment was undamaged. The right side entry doors to the patient compartment were heavily damaged and jammed closed and their window glazing was disintegrated.



Figure 7: Intruding components into the patient compartment

The patient compartment sustained 13 intrusions. The most severe intrusions involved the right B-pillar and the air conditioning unit compartment (**Figure 7**), which intruded longitudinally 131 cm (51.6 in) and 91 cm (35.8 in), respectively.

MANUAL RESTRAINT SYSTEMS

The front row was equipped with driver and front right passenger lap-and-shoulder safety belts, which were mounted in the B-pillars. The driver's safety belt was equipped with continuous loop belt webbing, a fixed upper anchor, a sliding latch plate, and an Emergency Locking Retractor (ELR). The front right safety belt was similarly equipped but had an ELR/Automatic Locking Retractor (ALR). Both safety belts were equipped with retractor-mounted pretensioners, which actuated during the crash.

The inspection of the driver's safety belt assembly revealed historic usage scratches on the latch plate. There were no load marks on the latch plate belt guide. The D-ring belt guide was made of metal and showed no discernable evidence of loading. The belt webbing appeared slightly stretched consistent with loading by the driver during the crash. The evidence suggested that the driver was restrained in this crash.

The right B-pillar was displaced rearward into the patient compartment from the damage and the front right passenger's safety belt was found jammed in the retracted position. There were no load marks or damage to the belt webbing or buckle assembly suggesting that the belt was buckled at the time of the crash. Had the safety belt been buckled, the belt webbing probably would have been significantly stretched or broken and the buckle assembly damaged as the B-pillar was displaced rearward during the crash. The undamaged condition of the safety belt assembly suggested that the front right passenger was unrestrained at the time of the crash.

In the patient compartment, the EMT seat was equipped with a lap-and-shoulder safety belt with a sliding latch plate and an ELR/ALR. There were three lap safety belts on the bench seat

equipped with ALRs and sewn latch plates. Three safety belt buckles were also located on the vertical front surface of the box on which the bench seat was located. They were for securing a patient in the supine position on the bench seat. The patient compartment was unoccupied at the time of the crash.

SUPPLEMENTAL RESTRAINT SYSTEMS

The Ford was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger frontal air bags, a driver seat position sensor, safety belt buckle switch sensors, retractor-mounted pretensioners and a front right passenger presence sensor. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The frontal air bag satellite sensor was located on the center radiator support. The driver's and front right passenger's frontal air bags deployed in this crash.

The driver's air bag was located within the steering wheel hub. The air bag module cover was a three-flap configuration constructed of pliable vinyl. The top flap was 14.5 cm (5.7 in) in width and 8 cm (3.4 in) in height. Each bottom flap was 6.5 cm (2.6 in) in width and 8 cm (3.4 inches) in height. The cover flaps opened at the designated tear points and were undamaged. The deployed air bag was 50 cm (19.7 in) in diameter and had two 2.5 cm (1.0 in) vent ports on the back of the air bag at the 11 and 1 o'clock positions. The air bag had no internal tethers. Inspection of the air bag revealed no damage and no discernable evidence of occupant contact.

The front right passenger's frontal air bag was located within the middle of the right instrument panel. The air bag module cover was a two-flap configuration constructed of pliable vinyl. Each flap was 23 cm (9.1 in) in width. The top flap was 6.5 cm (2.6 in) in height, while the bottom flap was 6 cm (2.4 in) in height. The cover flaps opened at the designated tear points and were undamaged. The deployed air bag was 37 cm (14.6 in) in width and 56 cm (22 in) in height. There was a single vent port located on the right side of the air bag that was 5 cm (2 in) in diameter. The air bag had no internal tethers. Inspection of the air bag revealed no discernable evidence of occupant contact. There were several large areas of water and oil stains. There were also several small holes in the air bag with melted edges. The holes were probably caused by flying glass particles.

2009 FORD E350 TYPE II AMBULANCE OCCUPANTS

DRIVER DEMOGRAPHICS

Age/Sex:	26 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Box mounted
Seat Track Position:	6 cm (2.4 in) forward of rear position
Manual Restraint Usage:	Lap-and-shoulder
Usage Source:	Vehicle inspection

Driver Demographics (Continued)

IN11001

Air Bags: Frontal, deployed
 Alcohol/Drug Involvement: Police reported blood test given, results unknown
 Egress from Vehicle: Removed by EMS
 Transport from Scene: Ground ambulance
 Medical Treatment: Treated in emergency room and released

DRIVER INJURIES

IN11001

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Abrasions, small, right dorsal hand and right thumb, not further specified	710202.1,1	Air bag, driver's	Probable
2	Contusion right hand, not further specified	710402.1,1	Center instrument panel	Certain

Source: Emergency Room Records.

DRIVER KINEMATICS

The impact with the tree displaced the driver forward and to the right opposite the 1 o'clock direction of force and she loaded the safety belt. Her right hand contacted the deploying frontal air bag and left portion of the center instrument panel. She sustained abrasions on the dorsal surface of the right hand and right thumb from the air bag and a contusion on the right hand from the center instrument panel.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 50 years/male
 Height: 193 cm (76 in)
 Weight: 171 kg (377 lbs)
 Eyewear: Unknown
 Seat Type: Box-mounted bucket seat
 Seat Track Position: Rear position
 Manual Restraint Usage: None
 Usage Source: Vehicle inspection
 Air Bags: Frontal, deployed
 Alcohol/Drug Involvement: None
 Egress from Vehicle: Ejected during crash
 Transport from Scene: Ground ambulance to transfer site, then air ambulance to hospital
 Medical Treatment: Pronounced deceased at hospital 83 minutes post-crash

FRONT RIGHT PASSENGER INJURIES

IN11001

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Laceration (transection) of upper cervical spinal cord with complete atlanto-occipital disarticulation with upward protruding dislocated atlas at the foramen magnum with subarachnoid hemorrhage and subdural hemorrhage surrounding the brainstem	640274.6,6	A-pillar, right	Probable
2	Hemorrhages, subdural, bilateral, up to 10 ml over occipital lobes (poles)	140654.4,3	A-pillar, right	Probable
3 4	Hemorrhage, subarachnoid, over cortical convolutions, predominantly in temporal and occipital regions	140693.2,1 140693.2,2	A-pillar, right	Probable
5 6	Hemorrhages, subdural and subarachnoid, cover cerebellum	140438.3,6 140466.2,6	A-pillar, right	Probable
7	Hemorrhage, subarachnoid, in hippocampus, not further specified	140693.2,9	A-pillar, right	Probable
8	Hemorrhage, intraventricular of brain, not further specified	140678.2,9	A-pillar, right	Probable
9	Laceration (partial avulsion) of right atrium from root of inferior vena cava	421804.3,4	Right front door panel, forward upper quadrant	Probable
10	Laceration, superficial, anterior epicardium of right ventricle	441010.3,4	Right front door panel, forward upper quadrant	Probable
11	Lacerations, small, subendocardium of right atrium	441010.3,4	Right front door panel, forward upper quadrant	Probable
12	Laceration anterior pericardial sac, not further specified	441602.2,4	Right front door panel, forward upper quadrant	Probable
13	Fractured ribs: left-1 st to 3 rd , laterally, 3 rd to 6 th , anterolaterally; right-1 st to 5 th , posteriorly, 2 nd to 10 th , laterally, 1 st , 2 nd , and 9 th anterolaterally	450203.3,3	Right front door panel, forward upper quadrant	Probable
14	Hemopneumothorax with copious amount of blood returned after left chest tube inserted; 200 ml right; 1,500 ml left	442206.4,3	Right front door panel, forward upper quadrant	Probable
15	Contusions, multifocal, upper, middle, and lower lobes of right lung	441408.3,1	Right front door panel, forward upper quadrant	Probable
16	Laceration, subpleural, right lower lobe of lung	441431.3,1	Right front door panel, forward upper quadrant	Probable
17	Lacerations, superficial, hilar region of lungs, bilaterally	441450.4,3	Right front door panel, forward upper quadrant	Probable

Front Right Passenger Injuries (Continued)

IN11001

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
18	Fractured sternum between 3 rd and 4 th ribs	450804.2,4	Right front door panel, forward upper quadrant	Probable
19	Lacerations, multifocal, anterior and posterior surfaces of liver, not further specified	541820.2,1	Right front door panel, forward upper quadrant	Probable
20	Dislocation distal right clavicle (acromioclavicular joint), not further specified	770730.2,1	Right front door panel, forward upper quadrant	Probable
21 22	Fracture, displaced (dislocating) right distal humerus, not further specified, with associated contusion on right humeral area, 17.8 x 25.4 cm (7.0 x 10.0 in)	751331.2,1 710402.1,1	Right front door panel, forward upper quadrant	Probable
23	Laceration (avulsion) iliopsoas musculature overlying right sacral ala	810600.1,1	Right front door panel, forward lower quadrant (indirect)	Probable
24	Contusion (subgaleal hemorrhage) over left parietal-temporal region	110402.1,2	A-pillar, right	Probable
25 26	Abrasions (dicing type), multiple, with underlying contusion over face including: right lower forehead, left forehead just below hairline, left outer eyebrow, right temple, right zygomatic region, right mandibular face, right bridge of nose, upper and lower lips, and submental chin area	210202.1,0 210402.1,0	Noncontact injury: flying glass, right front glazing	Probable
27	Laceration, curvilinear, right forehead to out right eyebrow	210602.1,7	A-pillar, right	Probable
28	Laceration, superficial, outer corner of right eye	210602.1,1	A-pillar, right	Probable
29	Contusion (petechial showers) right mid-chest, 10.2 x 3.0 cm (4.0 x 1.2 in)	410402.1,4	Right front door panel, forward upper quadrant	Probable
30	Contusion, superior abdomen, not further specified	510402.1,7	Right front door panel, forward upper quadrant	Probable
31 32	Abrasions, multiple, irregular, linear scratch type, up to 22.9 cm (9.0 in), embedded in a contusive area, 40.6 x 27.9 cm (16 x 11 in), on right abdomen extending to outer right hip	510202.1,1 510402.1,1	Right front door panel, forward lower quadrant	Probable

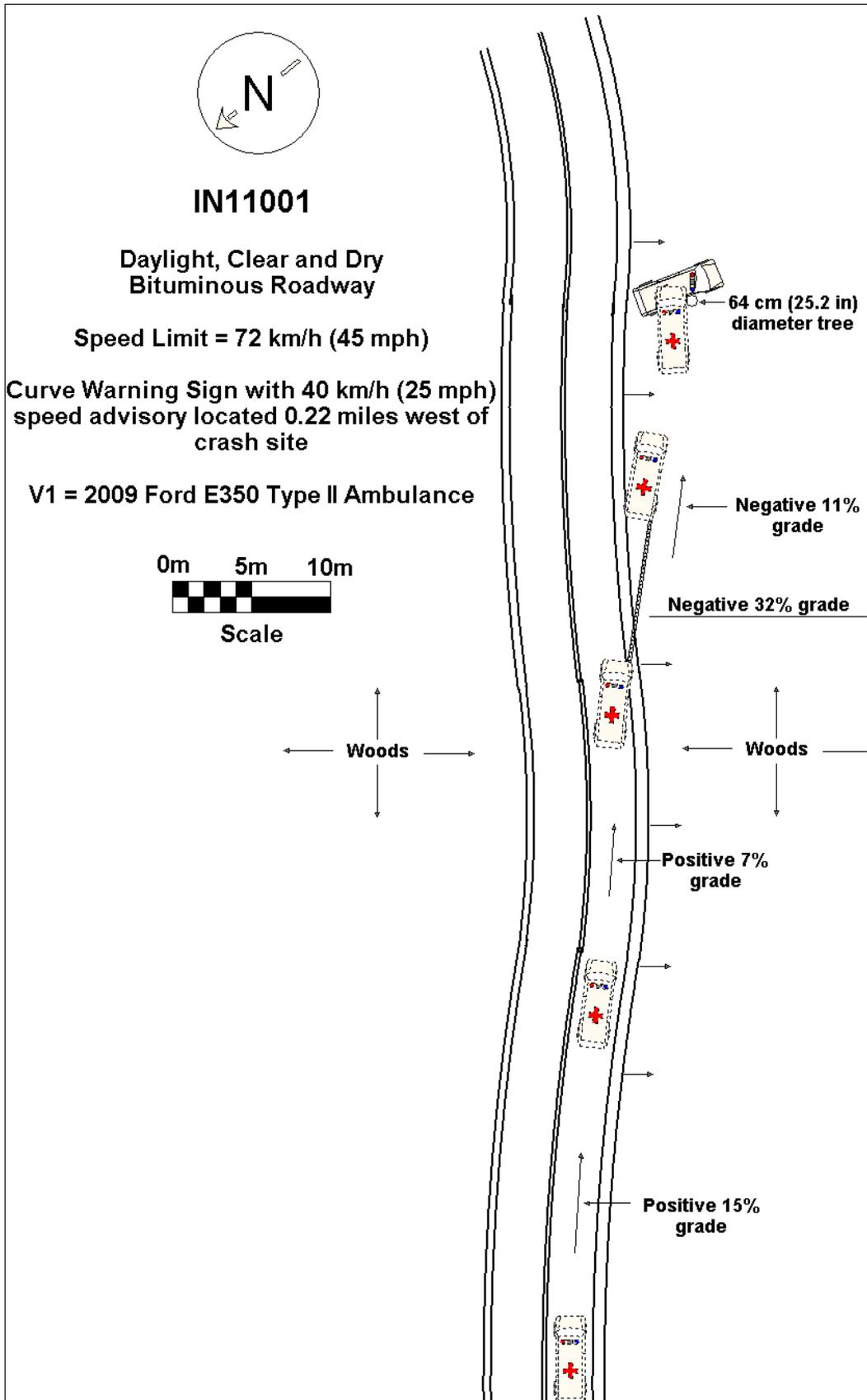
Front Right Passenger Injuries (Continued)

IN11001

Injury Number	Injury	AIS 2005/08	Injury Source	Confidence Level
	Contusion, 5.1 x 4.4 cm (2.0 x 1.75 in) outer and anterior right hip—separate from contusive area above			
33 34	Abraded contusion, linear, 12.1 x 1.0 cm (4.75 x 0.4 in) right superolateral back	410202.1,7 410402.1,7	Ground	Probable
35	Abrasions, superficial, linear scratch type, right inferolateral back and right buttock, up to 27.9 cm (11 in)	410202.1,8	Ground	Probable
36 37	Abraded contusion right forearm with dicing type abrasions back of right hand and outer right forearm	710202.1,1 710402.1,1	Noncontact injury: flying glass, right front glazing	Probable
38 39	Abraded contusions left outer upper arm, 3.0 x 0.6 cm (1.2 x 0.25 in) and contusion, 4.4 x 1.3 cm (1.75 x 0.5 in), outer upper arm, not further specified	710202.1,2 710402.1,2	Front right windshield's glazing	Probable
40	Abrasions (dicing type) left hand and left outer 5 th finger	710202.1,2	Noncontact injury: flying glass, right front glazing	Probable
41	Abrasions with underlying contusions posterolateral right thigh and outer right thigh and shin	810202.1,1 810402.1,1	Right front door panel, forward lower quadrant	Probable
42	Abraded contusions, 2 parallel, left posterolateral upper thigh superiorly, 8.3 x 0.6 cm (3.25 x 0.25 in) and 7.6 x 0.6 cm (3.0 x 0.25 in) inferiorly—separated by cutaneous sparing; left lateral thigh, separately	810202.1,2 810402.1,2	Ground	Probable
43	Contusion, 1.9 x 1.9 (0.75 x 0.75 in) inferolateral left gluteal cleft	810402.1,2	Ground	Probable
44 45	Abrasion and contusion right lateral ankle, not further specified	810202.1,1 810402.1,1	Right front door panel, forward lower quadrant	Probable

Source(s): Autopsy Records and Emergency Room Records. The vast majority of lesions are attributed to the autopsy, but Injury Numbers 1, 14, and 24 came from a combination of Autopsy and ER records.

The impact with the tree displaced the unrestrained front right passenger forward and to the right opposite the 01 o'clock direction of force. The impact displaced the integral structure of the right A-pillar and door rearward approximately 110 cm (43.3 in) through the front right passenger's occupant space. The passenger's head contacted the intruding A-pillar causing a laceration of the upper cervical spinal cord, bilateral subdural hemorrhages, subarachnoid hemorrhage, and intraventricular hemorrhage in the hippocampus. His chest contacted the forward upper quadrant of the right front door causing lacerations of the right atrium, anterior epicardium of the right ventricle, subendocardium of the right atrium, and pericardial sac. The door contact also caused multiple rib fractures with hemopneumothorax, contusions and lacerations of the lungs, a fractured sternum, lacerations of the liver, dislocated right clavicle, and a fractured and dislocated right humerus. The displacement of the integral structure of the right A-pillar and right front door created an avenue for ejection and the unrestrained front right passenger was ejected from the vehicle. He sustained abrasions on the right back, buttock, and left thigh from contacting the ground.



Attachment A
Event Data Recorder Report
2009 Ford E350 Type II Ambulance

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	1FDSS34P39D*****
User	
Case Number	
EDR Data Imaging Date	01/14/2011
Crash Date	
Filename	09FORD_E350_11001.CDRX
Saved on	Friday, January 14 2011 at 14:32:11
Collected with CDR version	Crash Data Retrieval Tool 3.5.1
Reported with CDR version	Crash Data Retrieval Tool 3.8
EDR Device Type	airbag control module
ACM Adapter Detected During Download	No
Event(s) recovered	locked frontal event unlocked event

Comments

No comments entered.

Data Limitations

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a subpoena or search warrant, as indicated by the CDR tool user on Friday, January 14 2011 at 14:32:11.

Restraints Control Module Recorded Crash Events:

Deployment Events cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device, the RCM must be replaced. The data from events which did not qualify as deployable events can be overwritten by subsequent events. The RCM can store up to two deployment events.

Airbag Module Data Limitations:

- Restraints Control Module Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced from the point of algorithm wake up. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately five seconds prior to algorithm wake up. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the RCM memory or if it has been interrupted and not fully written.
- If power to the Airbag Module is lost during a crash event, all or part of the crash record may not be recorded.
- For 2011 Ford Mustangs, the Steering Wheel Angle parameter indicates the change in steering wheel angle from the previously recorded sample value and does not represent the actual steering wheel position.

Airbag Module Data Sources:

- Event recorded data are collected either INTERNALLY or EXTERNALLY to the RCM.
 - INTERNAL DATA is measured, calculated, and stored internally, sensors external to the RCM include the following:
 - > The Driver and Passenger Belt Switch Circuits are wired directly to the RCM.
 - > The Driver's Seat Track Position Switch Circuit is wired directly to the RCM.
 - > The Side Impact Sensors (if equipped) are located on the side of vehicle and are wired directly to the RCM.
 - > The Occupant Classification Sensor is located in the front passenger seat and transmits data directly to the RCM on high-speed CAN bus.
 - > Front Impact Sensors (right and left) are located at the front of vehicle and are wire directly to the RCM.
 - EXTERNAL DATA recorded by the RCM are data collected from the vehicle communication network from various sources such as Powertrain Control Module, Brake Module, etc.

System Status at Time of Retrieval

VIN as programmed into RCM at factory	1FDSS34P39D*****
Current VIN from PCM	1FDSS34P39D*****
Ignition cycle, download (first record)	2,951
Ignition cycle, download (second record)	2,951
Restraints Control Module Part Number	9C24-14B321-BJ
Restraints Control Module Serial Number	701305240000000
Restraints Control Module Software Part Number (Version)	9L34-14C028-AN
Left/Center Frontal Restraints Sensor Serial Number	0C33998A
Left Side Restraint Sensor 1 Serial Number	00000000
Left Side Restraint Sensor 2 Serial Number	00000000
Right Frontal Restraints Sensor Serial Number	00000000
Right Side Restraint Sensor 1 Serial Number	00000000
Right Side Restraints Sensor 2 Serial Number	00000000

System Status at Event (First Record)

Recording Status	Locked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	3,869,480
Key-on Timer at event time zero (seconds)	220
Vehicle voltage at time zero (Volts)	14.094
Energy Reserve Mode entered during event (Y/N)	No

Faults Present at Start of Event (First Record)

No Faults Recorded

Deployment Data (First Record)

Frontal airbag deployment, time to first stage deployment, driver (msec)	178.5
Pretensioner (buckle) deployment, time to fire, driver (msec)	178.5
Frontal airbag deployment, time to first stage deployment, front passenger (msec)	178.5
Pretensioner (buckle) deployment, time to fire, right front passenger (msec)	178.5
Maximum delta-V, longitudinal (MPH [km/h])	-22.36 [-35.99]
Time, maximum delta-V longitudinal (msec)	250
Maximum delta-V, lateral (MPH [km/h])	-5.44 [-8.76]
Time, maximum delta-V lateral (msec)	198
Left or center front, satellite Sensor discriminating deployment	Yes
Left or center, front satellite Sensor safing	Yes
RCM, front sensor discriminating deployment	Yes
RCM, front sensor safing	Yes

Pre-Crash Data -1 sec (First Record)

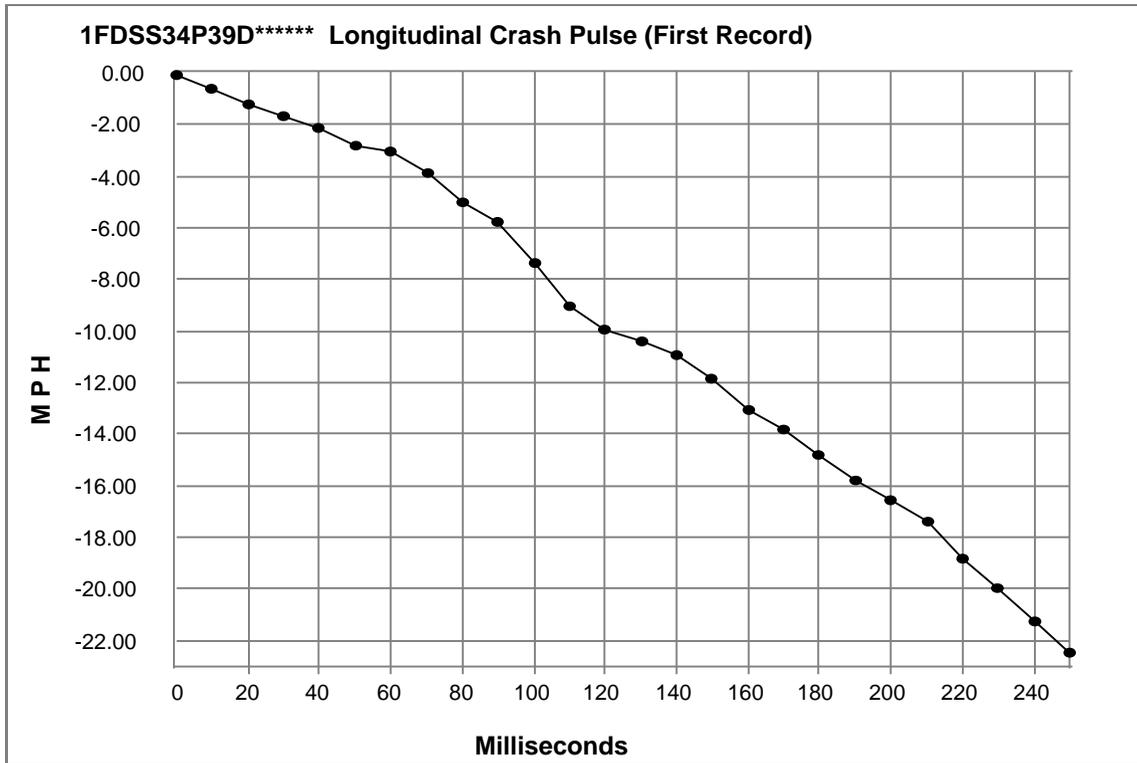
Ignition cycle, crash	2,950
Frontal air bag warning lamp, on/off	Off
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$04]
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Forward
Safety belt status, front passenger	Passenger Buckled
Brake Telltale	Off
ABS Telltale	Off
Stability Control Telltale	Off
Speed Control Telltale	Off
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off
HEV Hazard Telltale	Off

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine rpm	ABS activity (engaged, non-engaged)	Stability control (engaged, non-engaged)	Traction Control via Brakes (engaged, non-engaged)	Traction Control via Engine (engaged, non-engaged)
- 5.0	48.5 [78.0]	62	Off	2,300	non-engaged	non-engaged	non-engaged	non-engaged
- 4.5	48.5 [78.0]	62	Off	2,200	non-engaged	non-engaged	non-engaged	non-engaged
- 4.0	48.5 [78.0]	68	Off	2,300	non-engaged	non-engaged	non-engaged	non-engaged
- 3.5	47.8 [77.0]	73	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 3.0	47.2 [76.0]	71	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 2.5	47.2 [76.0]	62	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 2.0	46.6 [75.0]	59	Off	2,500	non-engaged	non-engaged	non-engaged	non-engaged
- 1.5	46.0 [74.0]	51	Off	2,500	non-engaged	non-engaged	non-engaged	non-engaged
- 1.0	46.0 [74.0]	40	Off	2,400	non-engaged	non-engaged	non-engaged	non-engaged
- 0.5	45.4 [73.0]	24	Off	2,200	non-engaged	non-engaged	non-engaged	non-engaged
0.0	44.1 [71.0]	10	Off	1,700	non-engaged	non-engaged	non-engaged	non-engaged

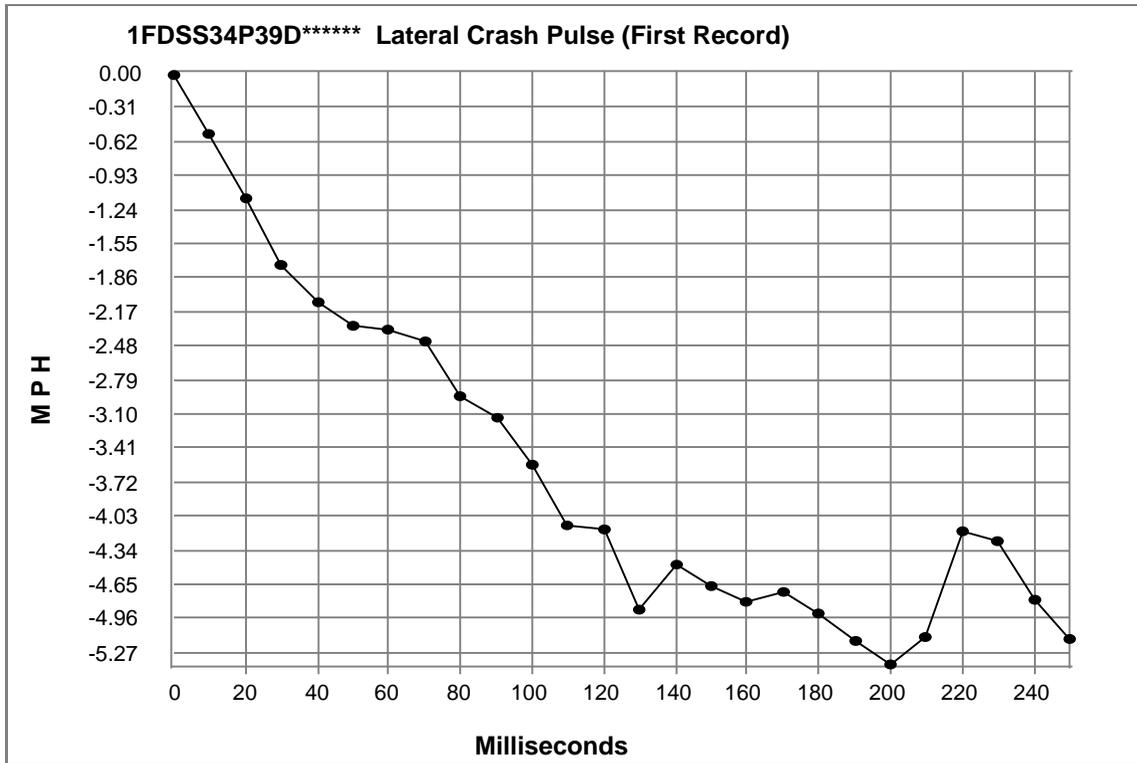
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Times (sec)	Steering Wheel Angle (degrees)
- 5.0	Invalid
- 4.9	Invalid
- 4.8	Invalid
- 4.7	Invalid
- 4.6	Invalid
- 4.5	Invalid
- 4.4	Invalid
- 4.3	Invalid
- 4.2	Invalid
- 4.1	Invalid
- 4.0	Invalid
- 3.9	Invalid
- 3.8	Invalid
- 3.7	Invalid
- 3.6	Invalid
- 3.5	Invalid
- 3.4	Invalid
- 3.3	Invalid
- 3.2	Invalid
- 3.1	Invalid
- 3.0	Invalid
- 2.9	Invalid
- 2.8	Invalid
- 2.7	Invalid
- 2.6	Invalid
- 2.5	Invalid
- 2.4	Invalid
- 2.3	Invalid
- 2.2	Invalid
- 2.1	Invalid
- 2.0	Invalid
- 1.9	Invalid
- 1.8	Invalid
- 1.7	Invalid
- 1.6	Invalid
- 1.5	Invalid
- 1.4	Invalid
- 1.3	Invalid
- 1.2	Invalid
- 1.1	Invalid
- 1.0	Invalid
- 0.9	Invalid
- 0.8	Invalid
- 0.7	Invalid
- 0.6	Invalid
- 0.5	Invalid
- 0.4	Invalid
- 0.3	Invalid
- 0.2	Invalid
- 0.1	Invalid
0.0	Invalid



Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
0	-0.05	-0.08
10	-0.60	-0.96
20	-1.25	-2.01
30	-1.65	-2.65
40	-2.14	-3.45
50	-2.84	-4.57
60	-3.07	-4.94
70	-3.90	-6.28
80	-4.99	-8.04
90	-5.79	-9.31
100	-7.35	-11.83
110	-9.07	-14.60
120	-9.95	-16.02
130	-10.43	-16.79
140	-10.90	-17.55
150	-11.84	-19.05
160	-13.06	-21.02
170	-13.78	-22.18
180	-14.83	-23.86
190	-15.77	-25.38
200	-16.54	-26.61
210	-17.40	-28.00
220	-18.79	-30.24
230	-19.95	-32.10
240	-21.22	-34.15
250	-22.45	-36.14



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
0	-0.02	-0.03
10	-0.56	-0.90
20	-1.14	-1.83
30	-1.74	-2.81
40	-2.09	-3.37
50	-2.30	-3.69
60	-2.34	-3.77
70	-2.44	-3.92
80	-2.94	-4.73
90	-3.14	-5.05
100	-3.57	-5.74
110	-4.11	-6.62
120	-4.16	-6.69
130	-4.88	-7.85
140	-4.48	-7.21
150	-4.68	-7.53
160	-4.81	-7.73
170	-4.73	-7.61
180	-4.91	-7.90
190	-5.17	-8.32
200	-5.38	-8.65
210	-5.14	-8.27
220	-4.16	-6.70
230	-4.26	-6.85
240	-4.80	-7.72
250	-5.16	-8.30

System Status at Event (Second Record)

Recording Status	Unlocked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	2
Time from event 1 to 2 (msec)	200
Lifetime Operating Timer at event time zero (seconds)	3,869,480
Key-on Timer at event time zero (seconds)	220
Vehicle voltage at time zero (Volts)	13.851
Energy Reserve Mode entered during event (Y/N)	No

Faults Present at Start of Event (Second Record)

B1193-00

Deployment Data (Second Record)

Maximum delta-V, longitudinal (MPH [km/h])	-10.09 [-16.24]
Time, maximum delta-V longitudinal (msec)	126
Maximum delta-V, lateral (MPH [km/h])	3.83 [6.16]
Time, maximum delta-V lateral (msec)	126

Pre-Crash Data -1 sec (Second Record)

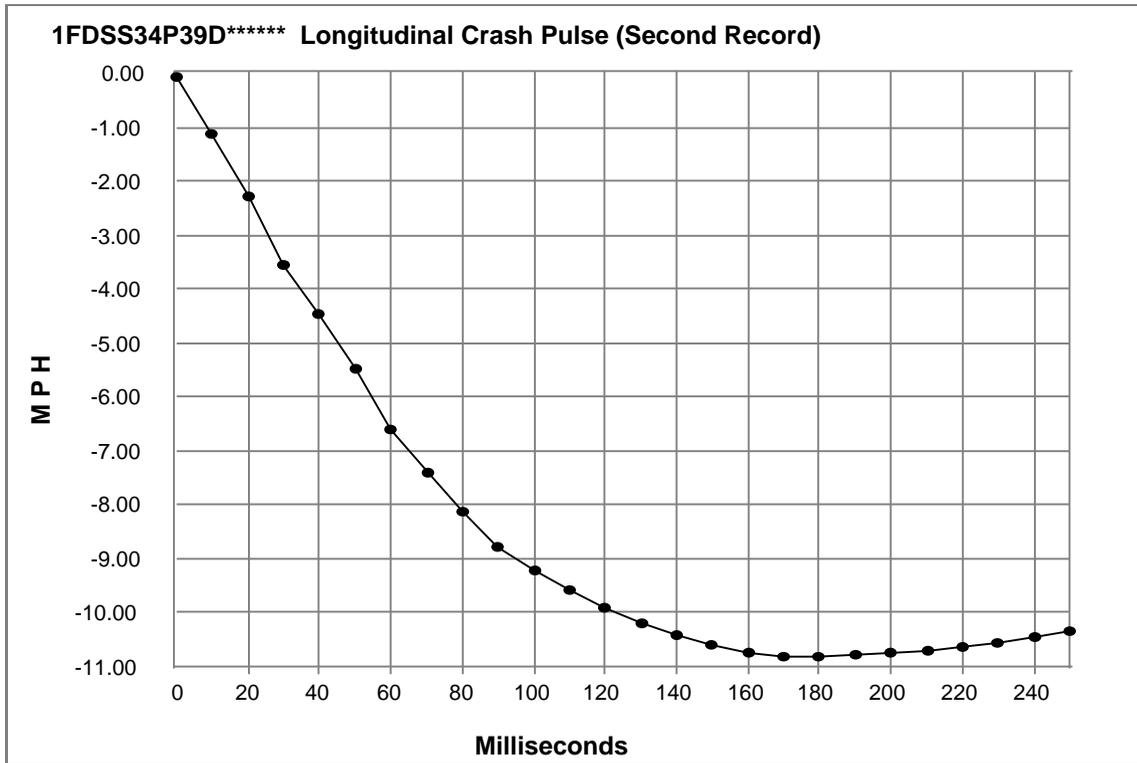
Ignition cycle, crash	2,950
Frontal air bag warning lamp, on/off	On
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$04]
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Forward
Safety belt status, front passenger	Passenger Buckled
Brake Telltale	Off
ABS Telltale	Off
Stability Control Telltale	Off
Speed Control Telltale	Off
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off
HEV Hazard Telltale	Off

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Second Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine rpm	ABS activity (engaged, non-engaged)	Stability control (engaged, non-engaged)	Traction Control via Brakes (engaged, non-engaged)	Traction Control via Engine (engaged, non-engaged)
- 5.0	48.5 [78.0]	62	Off	2,200	non-engaged	non-engaged	non-engaged	non-engaged
- 4.5	48.5 [78.0]	68	Off	2,300	non-engaged	non-engaged	non-engaged	non-engaged
- 4.0	47.8 [77.0]	73	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 3.5	47.2 [76.0]	71	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 3.0	47.2 [76.0]	62	Off	2,600	non-engaged	non-engaged	non-engaged	non-engaged
- 2.5	46.6 [75.0]	59	Off	2,500	non-engaged	non-engaged	non-engaged	non-engaged
- 2.0	46.0 [74.0]	51	Off	2,500	non-engaged	non-engaged	non-engaged	non-engaged
- 1.5	46.0 [74.0]	40	Off	2,400	non-engaged	non-engaged	non-engaged	non-engaged
- 1.0	45.4 [73.0]	24	Off	2,200	non-engaged	non-engaged	non-engaged	non-engaged
- 0.5	44.1 [71.0]	10	Off	1,700	non-engaged	non-engaged	non-engaged	non-engaged
0.0	44.7 [72.0]	60	Off	2,000	engaged	non-engaged	non-engaged	non-engaged

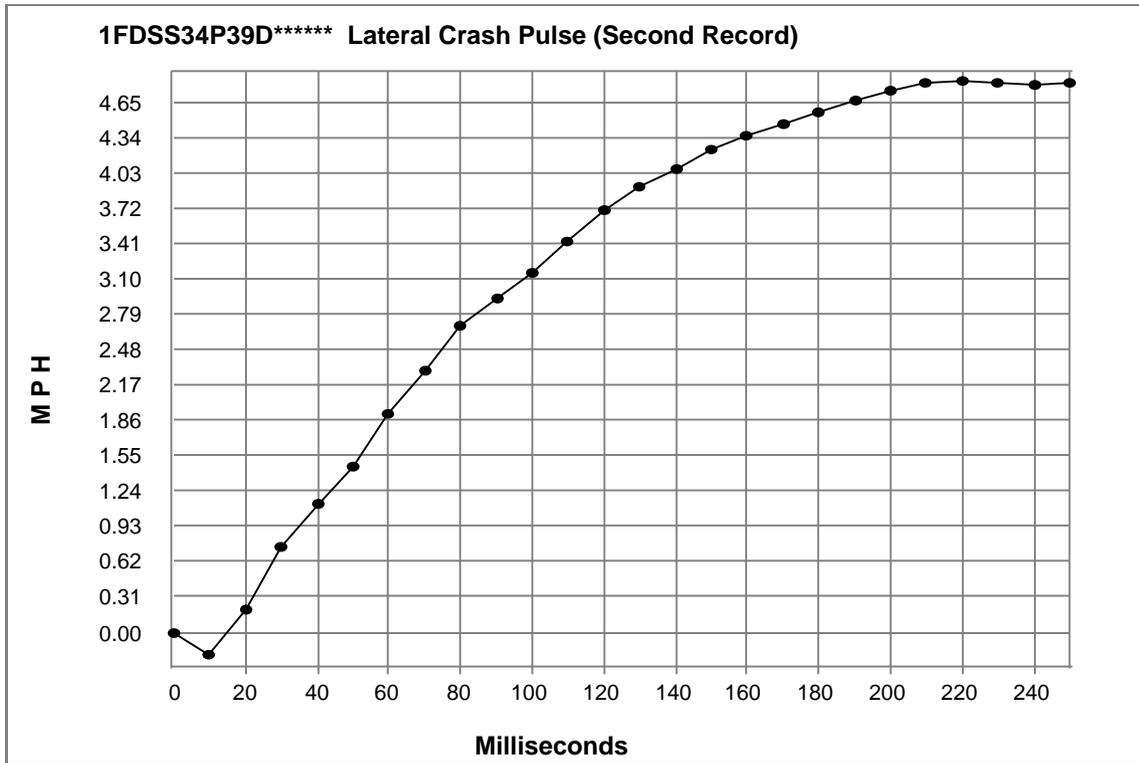
Pre-Crash Data -5 to 0 sec [10 samples/sec] (Second Record)

Times (sec)	Steering Wheel Angle (degrees)
- 5.0	Invalid
- 4.9	Invalid
- 4.8	Invalid
- 4.7	Invalid
- 4.6	Invalid
- 4.5	Invalid
- 4.4	Invalid
- 4.3	Invalid
- 4.2	Invalid
- 4.1	Invalid
- 4.0	Invalid
- 3.9	Invalid
- 3.8	Invalid
- 3.7	Invalid
- 3.6	Invalid
- 3.5	Invalid
- 3.4	Invalid
- 3.3	Invalid
- 3.2	Invalid
- 3.1	Invalid
- 3.0	Invalid
- 2.9	Invalid
- 2.8	Invalid
- 2.7	Invalid
- 2.6	Invalid
- 2.5	Invalid
- 2.4	Invalid
- 2.3	Invalid
- 2.2	Invalid
- 2.1	Invalid
- 2.0	Invalid
- 1.9	Invalid
- 1.8	Invalid
- 1.7	Invalid
- 1.6	Invalid
- 1.5	Invalid
- 1.4	Invalid
- 1.3	Invalid
- 1.2	Invalid
- 1.1	Invalid
- 1.0	Invalid
- 0.9	Invalid
- 0.8	Invalid
- 0.7	Invalid
- 0.6	Invalid
- 0.5	Invalid
- 0.4	Invalid
- 0.3	Invalid
- 0.2	Invalid
- 0.1	Invalid
0.0	Invalid



Longitudinal Crash Pulse (Second Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
0	-0.09	-0.14
10	-1.12	-1.80
20	-2.30	-3.71
30	-3.55	-5.71
40	-4.48	-7.21
50	-5.50	-8.85
60	-6.62	-10.66
70	-7.42	-11.94
80	-8.13	-13.09
90	-8.78	-14.13
100	-9.22	-14.85
110	-9.58	-15.42
120	-9.89	-15.92
130	-10.19	-16.40
140	-10.41	-16.75
150	-10.59	-17.05
160	-10.74	-17.28
170	-10.84	-17.44
180	-10.84	-17.44
190	-10.78	-17.36
200	-10.75	-17.30
210	-10.71	-17.23
220	-10.65	-17.13
230	-10.58	-17.02
240	-10.47	-16.85
250	-10.35	-16.66



Lateral Crash Pulse (Second Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
0	-0.01	-0.01
10	-0.21	-0.33
20	0.20	0.32
30	0.75	1.20
40	1.13	1.82
50	1.46	2.34
60	1.92	3.09
70	2.30	3.70
80	2.68	4.31
90	2.93	4.72
100	3.15	5.07
110	3.43	5.52
120	3.69	5.95
130	3.90	6.28
140	4.06	6.54
150	4.23	6.81
160	4.36	7.01
170	4.46	7.17
180	4.56	7.34
190	4.66	7.50
200	4.75	7.64
210	4.82	7.75
220	4.83	7.77
230	4.82	7.76
240	4.80	7.73
250	4.81	7.74