

CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD RESTRAINT SYSTEM CRASH INVESTIGATION

SCI CASE NO.: CA11001

VEHICLE: 2007 HONDA ODYSSEY EX-L

LOCATION: NORTH CAROLINA

CRASH DATE: DECEMBER 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 are 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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<p>16. Abstract This on-site investigation focused on two forward-facing convertible Child Restraint Systems (CRSs) that were in use during the multiple impact crash of a 2007 Honda Odyssey EX-L minivan. The CRSs were secured in the third row of the Honda using the vehicle's safety belts and top tether straps, and restrained twin 3-year-old females. The Honda was involved in an intersection crash with a 2004 Toyota Camry and a 2005 Pontiac Aztek. This crash was identified through a visit to a regional vehicle salvage facility on December 21, 2010. Based on the location of the impact, the severity of the damage, and the CRS usage, the case was assigned by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) for on-site investigation on January 14, 2011. The investigation was initiated on January 18, 2011 and involved the inspection and documentation of the three vehicles and the crash site, a detailed interview with the driver of the Honda, and an inspection of the CRSs in use at the time of the crash. Additionally, the Event Data Recorders (EDRs) of the Toyota and the Pontiac were imaged during the SCI inspection process.</p> <p>The Honda was initially involved in a side impact crash with the front of the Toyota. Impact forces redirected the Honda to its left, and it was subsequently involved in a frontal impact crash with the front of the Pontiac. The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, front seatback-mounted side impact air bags, and side impact Inflatable Curtain (IC) air bags. The driver's air bag, front right seatback-mounted air bag, and right IC air bag deployed during the crash sequence. The 32-year-old male driver of the Honda was transported to a regional trauma center where he was treated in the emergency department for minor severity soft tissue injuries and released the same day. The two child passengers were transported to a regional trauma center where they were also treated for minor severity soft tissue injuries and released.</p>			
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CALSPAN ON-SITE CHILD RESTRAINT SYSTEM CRASH INVESTIGATION
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VEHICLE: 2007 HONDA ODYSSEY EX-L
LOCATION: NORTH CAROLINA
CRASH DATE: DECEMBER 2010

BACKGROUND

This on-site investigation focused on two forward-facing convertible Child Restraint Systems (CRSs) that were in use during the multiple impact crash of a 2007 Honda Odyssey EX-L minivan. The CRSs were secured in the third row of the Honda using the vehicle's safety belts and top tether straps, and restrained twin 3-year-old females. The Honda was involved in an intersection crash with a 2004 Toyota Camry and a 2005 Pontiac Aztek. This crash was identified through a visit to a regional vehicle salvage facility on December 21, 2010. Based on the location of the impact, the severity of the damage, and the CRS usage, the case was assigned by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) for on-site investigation on January 14, 2011. The investigation was initiated on January 18, 2011 and involved the inspection and documentation of the three vehicles and the crash site, a detailed interview with the driver of the Honda, and an inspection of the CRSs in use at the time of the crash. Additionally, the Event Data Recorders (EDRs) of the Toyota and the Pontiac were imaged during the SCI inspection process.

The Honda was initially involved in a side impact crash with the front of the Toyota. Impact forces redirected the Honda to its left, and it was subsequently involved in a frontal impact crash with the front of the Pontiac. The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, front seatback-mounted side impact air bags, and side impact Inflatable Curtain (IC) air bags. The driver's air bag, front right seatback-mounted air bag, and right IC air bag deployed during the crash sequence. The 32-year-old male driver of the Honda was transported to a



Figure 1: Front right oblique view of the 2007 Honda Odyssey.

regional trauma center where he was treated in the emergency department for minor severity soft tissue injuries and released the same day. The two child passengers were transported to a regional trauma center where they were also treated for minor severity soft tissue injuries and released.

CRASH SUMMARY

Crash Site

This crash occurred during daylight hours within the three-leg intersection of an eight-lane roadway and a three-lane roadway in an urban setting. The environmental conditions were clear and dry at the time of the crash. The main roadway extended east/west and was configured with three eastbound lanes and four westbound lanes that were divided by a center two-way turn lane. The road was straight and had a positive 1% grade from west to east. The width of the travel lanes ranged from 3 m (9.8 ft) to 3.8 m



Figure 2: Eastbound pre-crash trajectory view of the Honda.

(12.5 ft). **Figure 2** depicts the eastbound trajectory view of the Honda. Concrete curbs bordered both sides of the road and measured 16 cm (6.3 in) in height. These barrier curbs transitioned to and from mountable curbs for parking lot access. Asphalt and concrete parking lots extended outboard of the curb line in this urban area. A three-lane, undivided, north/south roadway intersected the main roadway from the south. The southbound lane was 4.4 m (14.4 ft) in width. The two northbound lanes were designated as a left-turn lane and a right-turn lane, respectively. The left turn lane measured 3 m (9.8 ft) in width and the right turn lane measured 3.7 m (12.1 ft) in width. Consistent with the main roadway, the intersecting roadway was bordered by 16 cm (6.3 in) concrete curbs that transitioned to mountable curbs where necessary to accommodate the parking lot access. The intersecting roadway had a level grade. Access to the main roadway was controlled by a stop sign for the northbound traffic. The speed limit on both roadways was 72 km/h (45 mph). A Scene Diagram is included at the end of this technical report.

Pre-crash

The unrestrained 32-year-old male driver of the Honda was operating his vehicle eastbound in lane number three of the main roadway traveling at a driver-reported speed of 81 km/h (50 mph). The Toyota, operated by a 62-year-old female driver, was northbound approaching the intersection. The Toyota stopped at the intersection with the main roadway and then accelerated forward initiating a left turn directly into the path of the Honda. The EDR within the Toyota did not record pre-crash data parameters. Coincident to these vehicle movements, a 68-year-old female driver was operating the Pontiac westbound on the main roadway in lane four. The Pontiac was traveling at an EDR reported speed of 60 km/h (37 mph) approximately five seconds prior to Algorithm Enable (AE).

Crash

The front plane of the Toyota impacted the forward aspect of the Honda's right plane. The direction of force was within the 1 o'clock sector for the Honda and within the 10 o'clock sector for the Toyota. The Honda was deflected to its left by the initial impact and continued eastward due to its momentum. This resulted in continuous engagement of the Toyota's frontal structures with the right plane of the Honda. The vehicles separated with an increasing left deflection of the Honda and a clockwise (CW) rotation of the Toyota. The front right seatback and IC air bags in the Honda, as well as the frontal air bags in the Toyota, deployed as a result of the impact.

The Honda maintained its forward trajectory as it traveled across the center turn lane and entered the inboard westbound lane, directly in the path of the Pontiac. The front plane of the Pontiac subsequently impacted the right center aspect of the Honda's frontal plane. Corresponding directions of force for this impact were in the 12 o'clock sector for the Pontiac and the 1 o'clock sector for the Honda. The force of the impact caused the deployment of the driver's frontal air bag in both the Honda and the Pontiac.

There was no physical evidence at the scene to pinpoint the exact locations of the impacts or the final rest location of any of the vehicles. A local business owner reported that he overheard the crash and observed the vehicles in their final rest locations. This bystander reported that the Honda was facing north, straddling the turn lane and westbound inboard lane. The Toyota was facing north, straddling the center turn lane. The Pontiac was facing west in the number three westbound lane.

Post-Crash

The driver of the Honda retrieved his cellular phone and called the 9-1-1 emergency response system. He then called his wife and informed her of the crash. Due to his injuries, he was unable to reach and assist the children in the rear of the Honda. Police, fire, emergency medical, and recovery personnel responded to the crash site. The driver of the Honda was removed from the vehicle due to perceived serious injuries and transported to a regional trauma center. He was treated in the emergency department for soft tissue injuries and lower extremity pain and released the same day. The third row child passengers exited the vehicle with some assistance, transported to a regional trauma center, and treated in the emergency department for minor soft tissue injuries. All three vehicles were towed from the scene due to disabling damage and were later transferred to a regional vehicle salvage facility, where they were inspected for this SCI investigation.

2007 HONDA ODYSSEY

Description

The 2007 Honda Odyssey EX-L minivan was manufactured in February 2007 and identified by the Vehicle Identification Number (VIN): 5FNRL38747Bxxxxxx. The front-wheel drive Honda was powered by a 3.5-liter, V6 gasoline engine linked to a five-speed automatic transmission. It was equipped with Electronic Stability Control (ESC) and traction control. The braking system consisted of power-assisted front and rear disc brakes with four-wheel antilock and electronic brakeforce distribution. The Honda was also equipped with an indirect Tire Pressure Monitoring System (TPMS). The driver stated in the interview that the TPMS indicator light was not illuminated prior to the crash. The Honda was equipped with Michelin Radial XSE tires on the front positions and Bridgestone Turanza EL-42 tires on the rear. All tires were size P235/65R16, which matched the vehicle manufacturer's recommended tire size, and were mounted on 16-inch OEM alloy wheels. The vehicle manufacturer's recommended cold tire pressure was 241 kPa (35 PSI), front and rear. Specific tire data at the time of the SCI inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Restriction	Damage
LF	207 kPa (30 PSI)	3 mm (4/32 in)	No	None
LR	214 kPa (31 PSI)	7 mm (9/32 in)	No	None
RR	152 kPa (22 PSI)	6 mm (8/32 in)	No	None
RF	Flat	5 mm (6/32 in)	Yes	Wheel rim deformed, cut in sidewall

The interior of the Honda was configured with leather-surfaced, seven passenger seating (2/2/3). The front bucket seats were separated by a center console. All seating positions were equipped with height adjustable head restraints. The driver's head restraint was 2 cm (0.8 in) above the full-down position. The front right head restraint was 7 cm (2.8 in) above the full-down position, and the second row left head restraint was 4 cm (1.6 in) above the full-down position. The second row right and all three rear head restraints were in the full-down position. The powered driver's seat was located 9 cm (3.5 in) forward of the full-rear position. The driver's seat back angle was 23 degrees aft of vertical. The front right seat track was 7 cm (2.8 in) forward of the full-rear position, and the seat back angle was 22 degrees aft of vertical. The second row consisted of two captain's chairs with folding backs. Both had adjustable tracks located 4 cm (1.6 in) forward of full-rear. The left and right seat back angles measured 23 and 20 degrees aft of vertical, respectively. The third row consisted of a fixed 60/40 split three-passenger bench with folding backs. The larger (60%) portion of the seat was on the right side of the cabin.

The vehicle's safety systems consisted of 3-point lap and shoulder belts for all seven designated seating positions, front seat safety belt retractor pretensioners, CAC dual-stage frontal air bags, side impact air bags mounted in the upper outboard aspects of the front seat backs, and roof side rail-mounted side impact IC air bags that provide protection for the six outboard seating positions.

Exterior Damage

The right and frontal planes of the Honda sustained moderate severity damage as a result of the multiple event crash sequence. It should be noted that the front right corner of the vehicle was directly involved in both impacts. Therefore, the residual crush at the corner occurred from two overlapping impacts. For this reason, the planar WinSMASH analyses of the two impact events should be considered borderline. It was not possible to directly associate the magnitude of the right corner's longitudinal and lateral crush to only the impact force from that respective direction. Additionally, the stiffness values, utilized in the Event 2 (frontal) analysis, were not representative of the Honda's structure after it had been involved in the Event 1 impact.

Figure 3 is a side view depicting the damage to the right plane of the Honda. The impact resulted in deformation of the fender with continuous engagement across the right doors to the rear axle area. The direct and induced damage began 54 cm (21.3 in) aft of the right rear axle and extended forward 402 cm (158.3 in) to the front right corner. A residual crush profile measured at mid-door level produced the following results: C1 = 0 cm, C2 = 6 cm (2.4 in), C3 = 3 cm (1.2 in), C4 = 8 cm (3.1 in), C5 = 0 cm, C6 = 36 cm (14.2 in). The C5 crush measurement was located within the front wheel opening and thus was zero. The maximum crush was located at C6, the right front bumper corner. The Classification Deformation Classification (CDC) assigned to this damage pattern was 01RDEW3. The Damage Algorithm of the WinSMASH program was used to calculate the severity of the initial impact (delta-V). The total calculated delta-V for the Honda was 16 km/h (9.9 mph). Corresponding longitudinal and lateral delta-V components were -14 km/h (-8.7 mph) and -8 km/h (-5.0 mph), respectively.



Figure 3: Right plane damage to the Honda resulting from Events 1.

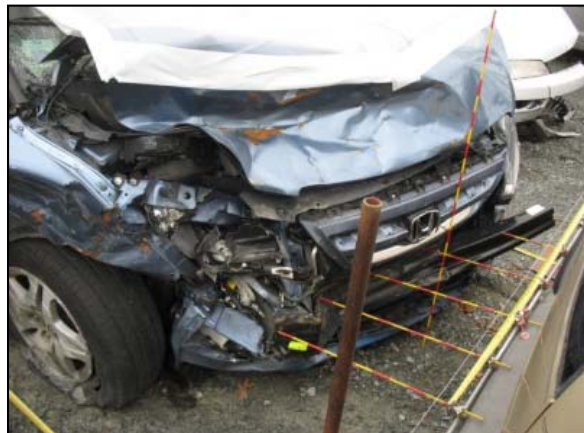


Figure 4: Right front oblique view of the Honda's frontal plane.

Figure 4 is an oblique view of the damage to the Honda's frontal plane resultant to the impact with the Pontiac (Event 2). The bumper fascia separated during the impact, exposing the reinforcement bar. The direct contact damage began 25 cm (10.0 in) left of center and extended 114 cm (44.9 in) laterally to the right corner. The damage pattern spanned the entire 178 cm (70.0 in) front end width.

A residual crush profile was documented at mid-level across the bumper reinforcement with a Field L of 105 cm (41.3 in), which produced the following measurements: C1 = 0 cm, C2 = 2 cm (0.8 in), C3 = 32 cm (12.6 in), C4 = 37 cm (14.6 in), C5 = 35 cm (13.8 in), C6 = 29 cm (11.4 in). The maximum crush on the front plane was located at C4, 11 cm (4.3 in) right of the vehicle centerline. The right wheelbase was shortened 23 cm (9.1 in). The CDC assigned to this damage pattern was 01FZEW2. The total delta-V of the Honda calculated by the WinSMASH program was 41 km/h (25.4 mph). The longitudinal and lateral delta-V components were -39 km/h (-24.2 mph) and -14 km/h (-8.7 mph), respectively.

Interior Damage

The Honda sustained moderate severity interior damage that was attributed to passenger compartment intrusion, occupant contact and air bag deployment. The lower aspect of the steering wheel rim was deformed 3 cm (1.2 in) longitudinally forward by contact from the driver's thoracic loading through the deployed air bag. The turn signal control stalk on the left side of the steering column was fractured by contact from the driver's left hand. The outboard aspect of the left knee bolster was scuffed and deformed as a result of contact by the driver's left knee. This contact was located 5-15 cm (2-5.9 in) right of the outboard edge of the instrument panel and 46-58 cm (18.1-22.8 in) above the floor. The inboard aspect of the left knee bolster, adjacent to the center stack, was scuffed and cracked as a result of contact by the driver's right knee. This contact was located 52-64 cm (20.5-25.2 in) right of the panel's outboard edge and 30-44 cm (11.8-17.3 in) above the floor. There was a spider web fracture of the windshield that included a depression that originated on the inside of the vehicle. This fracture was determined in the interview to have resulted from contact with a heavy metal coffee cup in the vehicle. The fracture site was located 40-47 cm (15.7-18.5 in) inboard of the right A-pillar and 44-52 cm (17.3-20.5 in) below the windshield header.

There was longitudinal intrusion to the right toe pan that measured 11 cm (4.3 in) resulting from the rearward displacement of components adjacent to the right front suspension. Both of the front doors, the left rear door and the rear hatch were operational post-crash. The sliding right rear door was jammed shut and forced open by the first responders. It could not be closed again due to damage to the door track. The AS-1 laminated windshield was fractured as a result of impact forces and the coffee cup contact. The AS-2 front side windows were not damaged. The AS-3 deep tint center and rear side windows, backlight and sunroof were also undamaged post-crash.

Manual Restraint Systems

The Honda was equipped with 3-point lap and shoulder belts for the seven designated seating positions. All belt systems utilized continuous loop webbing and sliding latch plates. The front and second row upper D-rings were height adjustable. All four height adjustments were in the full-down position at the time of the SCI inspection. The driver's belt retracted onto an Emergency Locking Retractor (ELR); all other belts retracted onto switchable ELR/Automatic

Locking Retractors (ALRs). Both front belts utilized retractor pretensioners which did not actuate during the crash. The driver's belt was not in use at the time of the crash. The front right passenger's seat, the second row right seat, and the third row center seat were not occupied at the time of the crash. The second row left safety belt and the outboard third row belts were used to install the CRSs. The second row CRS was not occupied at the time of the crash.

The driver's safety belt, latch plate and upper D-ring contained no crash related evidence. There was evidence of use on the third row outboard safety belts. This evidence consisted of imprinting and scuff marks on the belt webbing consistent with the CRS installation. On the rear right belt this evidence extended from 26-85 cm (10.2 -33.5 in) above the lower anchor. On the rear left belt this evidence extended from 24-92 cm (9.4-36.2 in) above the lower anchor. The second row seats and the center position of the third row bench were equipped with the lower anchors and top tether anchors of the Lower Anchors And Tethers for CHildren (LATCH) system. The outboard positions of the third row were only equipped with top tether anchors. At the time of the crash, the (occupied) third row CRS's were installed utilizing the vehicle's safety belts and the top tether anchors. Additionally, each CRS had one end of its respective LATCH belt attached to the lower anchor bar of the center seat.

Supplemental Restraint Systems

The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual-stage driver and front passenger air bags, front seat track positioning sensors, front seat retractor pretensioners, safety belt buckle switches and a front right occupant weight sensor. The manufacturer of the Honda certified that this vehicle was compliant to the advanced air bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) Number 208. The driver's frontal air bag deployed during this crash sequence. The front right passenger's air bag was suppressed, as the front right seat was not occupied.

The driver reported that the Honda's frontal air bag had been replaced due to a previous frontal deployment crash. The driver's air bag was concealed within an H-configuration module mounted to the center hub of the four-spoke steering wheel. The upper flap was 15 cm (5.9 in) in width at the tear seam and 8 cm (3.1 in) in height. The lower flap tapered from 15 cm (5.9 in) in width at the tear seam to 10 cm (3.9 in) in width at the lower aspect, and was 9 cm (3.5 in) in height. The driver's air bag measured 56 cm (22 in) in diameter in its deflated state. It was vented by two vent ports on the upper rear aspect of the air bag at the 10 and 2 o'clock positions. There were two internal tethers that attached to a 9 cm (3.5 in) circular tether seam at the center of the face of the air bag. The front view of the driver's air bag is depicted in **Figure 5**.



Figure 5: View of the Honda's driver air bag.

There was a scuff mark on the face of the air bag attributed to the driver's chest. This scuff mark extended vertically 8 cm (3.1 in) above the horizontal centerline of the air bag to a point 1 cm (0.4 in) below the horizontal centerline. It extended laterally 16-22 cm (6.3-8.7 in) right of the vertical centerline of the air bag. There was an imprint from contact with the lower aspect of the steering wheel rim on the lower rear aspect of the air bag. This imprint was attributed to the driver's abdominal loading of the steering wheel rim through the air bag. It was located 5 cm (2 in) above the lower edge of the air bag and measured 4 cm (1.6 in) in height and 16 cm (6.3 in) in width, following the curvature of the steering wheel rim.

The Honda was equipped with side impact air bags located in the upper outboard aspects of the two front seats. The front right air bag deployed from a 26 cm (10.2 in) vertical tear seam in the outboard side of the front right seat back. The air bag was 28 cm (11 in) in height and 31 cm (12.2 in) in width. The side air bag was vented by one circular vent port at the forward 9 o'clock position. There was no damage or crash related evidence on the side air bag. The front left side impact air bag did not deploy in this crash.

The Honda was also equipped with roof side rail-mounted side impact Inflatable Curtain (IC) air bags. The right IC air bag deployed from the right roof side rail. It measured 246 cm (96.9 in) in length and 48 cm (18.9 in), 42 cm (16.5 in) and 39 cm (15.4 in) in height at the front, second, and third rows respectively. Vertically, the IC extended below the belt line at each outboard seating position. The right IC provided protection from the D-pillar forward to a location 20 cm (7.9 in) aft of the A-pillar. The open area between the right IC and A-pillar measured 20 cm (7.9 in) in length, 18 cm (7.1 in) in height at the A-pillar and 33 cm (13 in) in height at the forward edge of the IC. The right IC was tethered to the A-pillar by a webbing strap 14 cm (5.5 in) in length. The IC was labeled with the identifying nomenclature: *ID-6082110C SI/PA 6.6*. The right IC is depicted in **Figures 6 and 7**. It was free from damage or occupant contact evidence. The left IC did not deploy in this crash sequence.



Figure 6: View of the Honda's right IC at front and second row seating positions.



Figure 7: View of the Honda's right IC at second and third row seating positions.

Child Restraint Systems

There were two identical Evenflo Express Vision CRS's installed in the outboard seating positions of the third row bench seat. The model 3292198 L1 CRS's were manufactured on March 14, 2008. They were purchased new by the driver and his wife in the fall of 2008. A stamp in the plastic shell of the CRS's advised to not use the seats after December 2014. These forward facing seats could be used with the internal 5-point harness or as a booster seat with the 5-point harness removed. The 5-point harness was installed in both seats and was in use at the time of the crash. Per the manufacturer's placards, the Evenflo Express Vision seats could accommodate a child weighing between 9 and 18 kg (20 and 40 lbs) with a height of 74-109 cm (29-43 in) when the 5-point harness was in use. As a belt-positioning booster, the CRS could accommodate a child weighing between 13.6 and 45.3 kg (30 and 100 lb) with a height less than 137 cm (54 in). The CRS was designed as a plastic shell covered by a padded fabric cover and was equipped with LATCH lower anchor attachment straps and a top tether strap. Both CRS's were inspected for cracks and other crash related damage beneath the fabric cover. Neither seat was found to be damaged. Based on the reported height and weight of the twin female occupants, the CRS's were an appropriate selection for use.

Figure 8 depicts the third row right CRS as it was found installed in the vehicle. This CRS was installed using the lap and shoulder portion of the Honda's safety belt. The belt was routed through the forward facing belt path slots on the rear of the CRS. Prior to the crash during the CRS installation, the belt had been fully extended to place the retractor in the ALR mode. The webbing was then back-fed into the retractor to install the CRS. This seat position was not equipped with LATCH lower anchors; however, the inboard LATCH hook of the CRS was attached to the right



Figure 8: Rear right CRS, as found installed in the Honda.

lower anchor of the center seating position. The LATCH belt was then tightened against the small strap that was used to retain the LATCH belt with the CRS. The outboard CRS LATCH hook was left unattached. The top tether was routed over the head restraint and down to the attachment point on the rear aspect of the seat. During the SCI inspection, it was observed that the longitudinal and lateral movement of the CRS (measured at the belt path) was 6 cm (2.4 in) and 9 cm (3.5 in), respectively. The internal 5-point harness was installed in the middle slot of three vertical options.

Figure 9 depicts the rear left CRS as it was found installed in the vehicle. The third row left CRS was also installed using the vehicle's lap and shoulder belt with its retractor switched to the ALR mode. The safety belt was routed through the forward facing belt path on the rear of the CRS. In a manner similar to that of the right CRS, the inboard LATCH hook of this CRS was connected to the left lower anchor of the center seating position and tightened. The top tether was routed over the head restraint and attached to the top tether anchor point of the rear left seat. The longitudinal and lateral movement of the CRS measured 8 cm (3.1 in) in each direction.



Figure 9: Rear left CRS, as found installed in the Honda.

An unoccupied CRS was present in the vehicle's second row at the time of the SCI inspection. Based on the inspection and the imprints to the second row left seat cushion, it was installed in the forward-facing mode using the vehicle's safety belt. This seat was a Cosco/Dorel Scenera model #22-120-WAL manufactured December 28, 2005. It was a convertible seat with the 5-point harness in the top of four available height adjustment slots. This seat was not occupied at the time of the crash.

2007 HONDA ODYSSEY OCCUPANTS

Driver Demographics

Age/Sex:	32 years / Male
Height:	188 cm (74 in)
Weight:	100 kg (220 lb)
Eyewear:	None
Seat Type:	Bucket
Seat Track Position:	Mid-to-rear track, 9 cm (3.5 in) forward of full-rear
Manual Restraint Usage:	None
Usage Source:	Vehicle Inspection
Air Bags:	Frontal deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Exited due to perceived serious injuries
Transport from Scene:	Ground ambulance
Medical Treatment:	Treated in ER and released the same day

Driver Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	2.5 cm (1 in) laceration on chin	210602.1,8	Driver's frontal air bag	Certain
2	20 cm (8 in) high contusion extending across abdomen	510402.1,4	Loaded steering wheel rim through the air bag	Certain
3	15 cm (6 in) contusion on front of right knee	810402.1,1	Knee bolster	Certain
4	Right hip partial dislocation/ligament damage	Not codeable	Knee bolster	Certain
5	Lower back muscle pain	Not codeable	Impact forces	Certain

Source = Medical records; Interview

Driver Kinematics

The 32-year-old male driver of the Honda was seated in a mid-to-rear track position 9 cm (3.5 in) forward of full-rear. He was not restrained by the available manual 3-point lap and shoulder belt system. The driver stated in the interview that he did not have time to initiate an avoidance maneuver prior to the initial impact.

At impact, the driver initiated a forward and right trajectory within the front left seating position in response to the 1 o'clock direction of the impact force. The driver maintained his position within the front left occupant space by bracing and did not contact any interior components. As the crash sequence progressed, the front plane of the Honda impacted the front plane of the Pontiac. The force of this impact resulted in the deployment of the driver air bag. The driver responded to this (higher severity) frontal impact with a forward trajectory. The driver contacted and loaded the deployed air bag with his face and chest. This loading resulted in a chin laceration. The driver loaded through the inflated air bag and engaged the steering wheel rim with his abdomen. This resulted in the abdominal contusion and the lower back pain. The steering wheel loading was evidenced by the deformation of the lower half of the rim. The driver's knees contacted the knee bolster evidenced by the scuffed and fractured bolster panel. The bolster panel loading resulted in the right knee contusion. The driver complained of a right hip injury with associated pain during his interview; however, the hip injury was not verified upon a review of the medical records. The driver then rebounded off the steering assembly and came to rest on the front left seat, against the left B-pillar and door.

The driver was able to open the front left door but could not exit the vehicle due to the hip pain. He retrieved his cellular phone and called 9-1-1. After reporting the crash to emergency responders, he called his wife and informed her of the crash and that he was unable to reach the children in the rear seat, but could hear them both crying. Due to experiencing back and hip pain, the driver was removed from the vehicle and transported by EMS to a regional trauma center. He was treated in the emergency department and released the same day.

Third Row Left Occupant Demographics

Age/Sex: 3 years / Female
 Height: 91 cm (36 in) (reported by interview)
 Weight: 16.3 kg (35.9 lb) (reported by medical records)
 Eyewear: None
 Seat Type: CRS secured to a split bench with folding back
 Seat Track Position: Not adjustable
 Manual Restraint Usage: Lap and shoulder used to install CRS, 5-point harness in CRS
 Usage Source: Vehicle Inspection
 Air Bags: None deployed
 Alcohol/Drug Involvement: None
 Egress from Vehicle: Exited with some assistance
 Transport from Scene: Ground ambulance
 Medical Treatment: Treated in ER and released the same day

Third Row Left Occupant Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	“Dark” contusion 5 cm (2 in) wide and 15 cm (6 in) long on front of right shoulder	710402.1,1	CRS 5-point harness webbing	Certain
2	“Dark” contusion 5 cm (2 in) wide and 15 cm (6 in) long on front of left shoulder	710402.1,2	CRS 5-point harness webbing	Certain
3	8 cm (3 in) abrasion on front of left shoulder	710202.1,2	CRS 5-point harness webbing	Certain

Source = Medical records; Interview (surrogate)

Third Row Left Occupant Kinematics

The 3-year-old female rear left occupant was restrained by the 5-point harness system in an Evenflo Express Vision forward facing CRS. The forward-facing CRS had been installed in the third row right seat using the vehicle safety belt and the top tether strap. Only the right (inboard) LATCH hook was in use and was attached to the left lower anchor of the center position.

At the initial impact, the third row left occupant initiated a forward and right trajectory. The child contacted the CRS harness straps and rode down the force of the impact. At impact with the Pontiac (Event 2), the child responded to the 1 o’clock direction of the impact force with a forward and right trajectory. The child continued to load the CRS harness straps with her shoulders and chest. The loading of the harness straps resulted in contusions and abrasion to the shoulders.

The occupant rebounded and came to rest restrained in the CRS in the left seating position of the Honda. She was unbuckled from the CRS and removed from the vehicle by the first responders and transported to a regional trauma center by ground ambulance. She was treated in the emergency department and released the same day.

Third Row Right Occupant Demographics

Age/Sex: 3 years / Female
 Height: 91 cm (36 in) (reported by interview)
 Weight: 16.7 kg (36.7 lb) (reported by medical records)
 Eyewear: None
 Seat Type: CRS installed to a split bench with folding back
 Seat Track Position: Not adjustable
 Manual Restraint Usage: Lap and shoulder used to install CRS, 5-point harness in CRS
 Usage Source: Vehicle Inspection
 Air Bags: Right IC air bag deployed
 Alcohol/Drug Involvement: None
 Egress from Vehicle: Exited with some assistance
 Transport from Scene: Ground ambulance
 Medical Treatment: Treated in ER and released the same day

Third Row Right Occupant Injuries

Injury No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	8 cm (3 in) contusion to right cheek	210402.1,1	Right rear window through IC air bag	Certain
2	8 cm (3 in) light abrasion to right cheek	210202.1,1	Right IC air bag	Certain
3	“Dark” contusion 5 cm (2 in) wide and 15 cm (6 in) long on front of right shoulder	710402.1,1	CRS 5-point harness webbing	Certain
4	“Dark” contusion 5 cm (2 in) wide and 15 cm (6 in) long on front of left shoulder	710402.1,2	CRS 5-point harness webbing	Certain
5	8 cm (3 in) abrasion on front of left shoulder	710202.1,2	CRS 5-point harness webbing	Certain

Source = Medical records; Interview (surrogate)

Third Row Right Occupant Kinematics

The 3-year-old female rear right occupant was restrained by the 5-point harness system in an Evenflo Express Vision forward facing CRS. The CRS had been installed forward-facing in the third row right seat using the vehicle safety belt and the top tether strap. Only the left (inboard side) LATCH hook was in use and was attached to the right lower anchor of the center position.

At the initial impact, the third row right occupant initiated a forward and right trajectory. The child contacted the CRS harness straps and rode down the force of the impact. At impact with the Pontiac (Event 2) the right IC air bag deployed. The child responded with a forward and right trajectory and the child continued to load the CRS harness straps with her shoulders and chest. The harness strap loading resulted in the contusions and abrasion to the shoulders. The Honda rotated counterclockwise (CCW) as it slid to final rest. During the CCW rotation, the child responded with a right lateral trajectory and contacted the deployed right IC air bag. Her contact to the IC resulted in an abrasion to her cheek. The cheek contusion resulted from loading the inflated IC that was backed up by right rear window.

The child rebounded and came to rest still restrained in the CRS in the right seating position of the Honda's third row. Post-crash, she was unbuckled from the CRS and removed from the vehicle by EMS and transported to a regional trauma center by ground ambulance. She was treated in the emergency department and released the same day.

2004 TOYOTA CAMRY

Description

The 2004 Toyota Camry LE was manufactured in October 2003 and identified by the VIN JTDBE32K140xxxxxx. The front-wheel drive Toyota was powered by a 2.4-liter inline, 4-cylinder engine linked to a four-speed automatic transmission. The braking system consisted of power-assisted front disc and rear drum brakes. The vehicle was equipped with four Kumho Solus RR21 tires in size P205/65R15 that matched the vehicle manufacturer's recommended tire size. The tires were mounted on OEM steel wheels with plastic covers. The vehicle manufacturer recommended cold tire pressure was 200 kPa (29 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Restriction	Damage
LF	152 kPa (22 PSI)	2 mm (3/32 in)	No	None
LR	186 kPa (27 PSI)	4 mm (5/32 in)	No	None
RR	186 kPa (27 PSI)	4 mm (5/32 in)	No	None
RF	172 kPa (25 PSI)	2 mm (3/32 in)	No	None

Exterior Damage

The front plane of the Toyota sustained moderate damage as a result of the Event 1 impact with the Honda. The combined width of the direct and induced damage extended across the full 148 cm (58.2 in) width of the front plane. The frame rail ends were shifted laterally to the right as a result of the impact force that was located within the 10 o'clock sector. The left and right frame shift measured 34 cm (13.4 in) and 33 cm (13 in), respectively. The front fascia and bumper support bar separated during the impact.

A residual crush profile was documented between the frame rail ends and across the lower radiator support (**Figure 10**). The profile produced the following measurements: C1 = 28 cm (11.0 in), C2 = 17 cm (6.7 in), C3 = 16 cm (6.3 in), C4 = 11 cm (4.3 in), C5 = 8 cm (3.1 in), C6 = 13 cm (5.1 in). The maximum crush was located at C1. The Damage Algorithm of the WinSMASH program was used to calculate the severity of the crash. The total calculated delta-V of the Toyota was 24 km/h (14.9 mph). The Toyota's longitudinal and lateral delta-V components were -15 km/h (-9.3 mph) and 18 km/h (11.2 mph), respectively. The CDC assigned for the Event 1 impact was 70FDEW1, incremented by 60 to denote the lateral end shift of the frame rails.



Figure 10: Frontal damage to the Toyota.

Event Data Recorder

The EDR of the Toyota was imaged using a proprietary scan tool (ROT) provided by Toyota Motor Corporation, with software version 1.4.1.1. Power was applied to the vehicle with a battery booster and a connection was established through the use of the Diagnostic Link Connector (DLC) located under the instrument panel. The imaged data indicated the driver and passenger frontal air bags had a deployment time of 46 milliseconds. The deployment level for the driver and front passenger air bags was "High". The driver and front passenger safety belts were both recorded as buckled at the time of the recording. The module recorded 150 milliseconds of post-crash data in 10 millisecond intervals. The maximum velocity change was 19 km/h (11.8 mph) at 150 milliseconds. A writing flag indicated that the recording was completely written to memory. This EDR did not have the capability to record pre-crash data.

Occupant Data

The Toyota was occupied by a 62-year-old female driver and a 62-year-old female front right passenger. Based on the police reports and the vehicle inspection, both were restrained by the manual 3-point lap and shoulder belt systems. The frontal air bags in the Toyota deployed as a result of the impact. Both the driver and the front right passenger were police-reported as having sustained minor injuries and were transported by ground ambulance to a regional trauma center.

2005 PONTIAC AZTEK

Description

The 2005 Pontiac Aztek was manufactured in October 2004 and identified by the VIN 3G7DA03E75Sxxxxxx. The front-wheel drive Pontiac was powered by a 3.4-liter, V-6 gasoline engine linked to a four-speed automatic transmission. The braking system consisted of power-assisted front disc and rear drum brakes. The Pontiac was equipped with four Michelin Energy LX4 tires mounted on OEM alloy wheels. The tires were size P225/60R17, which matched the vehicle manufacturer's recommended tire size. The manufacturer's recommended cold tire pressure was 241 kPa (35 PSI) for the front and rear. Specific tire data at the time of the SCI inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Restriction	Damage
LF	207 kPa (30 PSI)	6 mm (7/32 in)	No	None
LR	186 kPa (27 PSI)	7 mm (9/32 in)	No	None
RR	214 kPa (31 PSI)	6 mm (8/32 in)	No	None
RF	179 kPa (26 PSI)	6 mm (7/32 in)	No	None

Exterior Damage

The front plane of the Pontiac (**Figure 11**) sustained moderate severity damage as a result of the impact with the front of the Honda. The front fascia of the Pontiac had separated from the vehicle during the crash sequence. The combined width of the direct and induced damage extended the full 156 cm (61.4 in) width of the frontal plane. A residual crush profile was documented along the bumper reinforcement bar and was as follows: C1 = 16 cm (6.3 in), C2 = 26 cm (10.2 in), C3 = 37 cm (14.6 in), C4 = 55 cm (21.7 in), C5 = 19 cm (7.5 in), C6 = 0 cm. The maximum crush was located at C4.



Figure 11: Front right oblique view of the Pontiac.

The Damage Algorithm of the WinSMASH program was used to calculate the crash severity. The total calculated delta-V of the Pontiac was 55 km/h (34.2 mph). Longitudinal and lateral components of the calculated delta-V were -54 km/h (-33.6 mph) and 10 km/h (6.2 mph), respectively. The CDC assigned for the Event 2 impact was 12FDEW4.

Event Data Recorder

The EDR of the Pontiac was imaged using the Bosch Crash Data Retrieval tool and software version 3.5.1. The fuse-box method of powering the Sensing and Diagnostics Module (SDM) was used with a connection through the DLC located under the left instrument panel. Deployment and Non-deployment events were imaged from the module. The Non-deployment event was stored 200 ignition cycles prior to the Deployment event and was therefore considered to be unrelated to this crash. The Deployment event was stored 3 ignition cycles prior to the cycle number at investigation, and included pre-crash data. The imaged EDR data indicated that the air bag warning light was not illuminated prior to the crash, the driver and front right passenger's seats were in a forward position, the driver's safety belt was buckled and the front right passenger's safety belt was unbuckled. The brake switch was "Off" from eight to two seconds prior to AE and the vehicle was accelerating slightly from 60 km/h (37 mph) to 61 km/h (39 mph) until one second prior to AE. One second prior to AE, the data image indicated the throttle percentage decreased to zero and the brakes were applied. The Pontiac reduced speed to 55 km/h (34 mph). The maximum recorded longitudinal delta-V was -55 km/h (-34.0 mph) at 95 milliseconds. The Pontiac's imaged EDR data is included as **Attachment A** of this report.

Occupant Data

The Pontiac was occupied by a 68-year-old female driver at the time of the crash. She was police-reported to be using her safety belt, supported by the EDR data that indicated the belt was buckled at the time of the crash. The frontal air bags for the driver and front right passenger deployed as a result of the impact. The driver sustained police-reported minor injuries, and was transported by ground ambulance to a regional trauma center for treatment.

SCENE DIAGRAM

SCENE DIAGRAM
CA11001

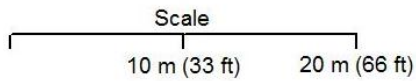
North Carolina
December 2010

Dry, Asphalt

Speed Limit
72 km/h (45 mph) - both
roadways



V1: 2007 Honda Odyssey
V2: 2004 Toyota Camry
V3: 2005 Pontiac Aztec



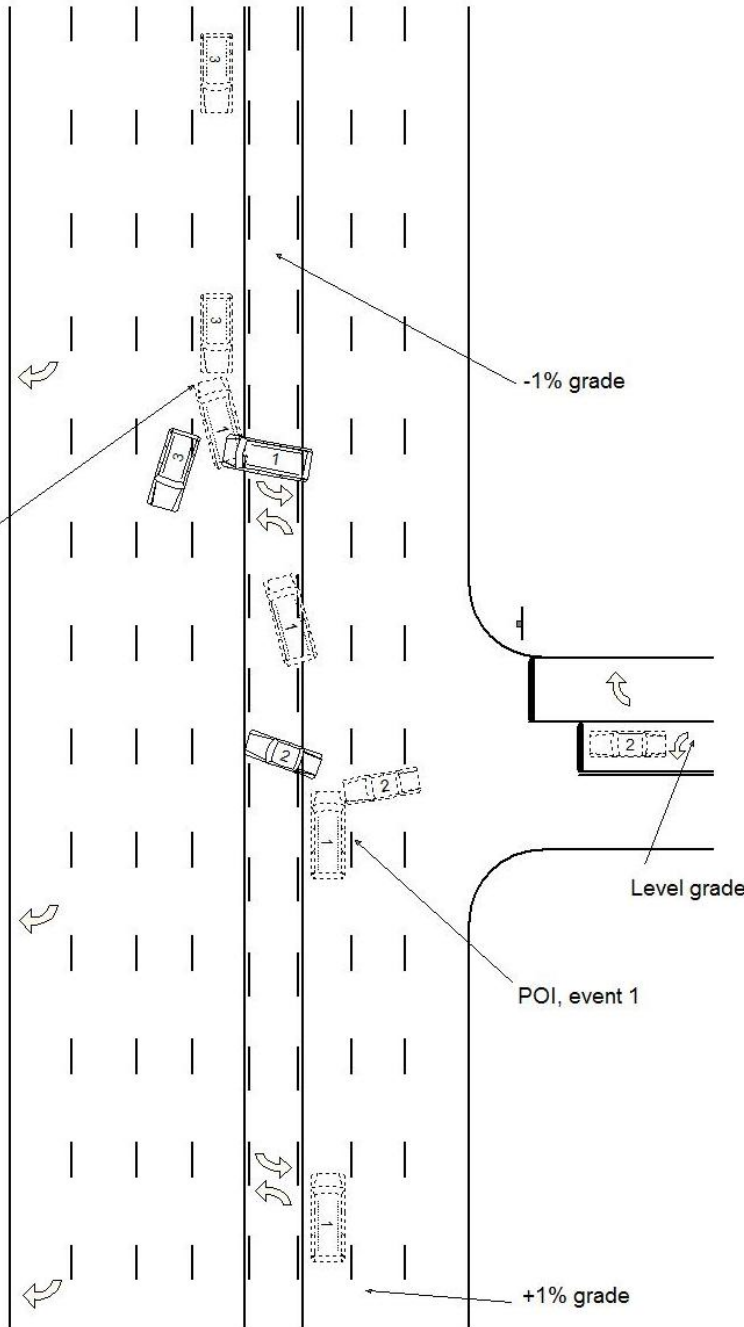
POI event 2

-1% grade

Level grade

POI, event 1

+1% grade



ATTACHMENT A

2005 Pontiac Aztec EDR Data

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	3G7DA03E75S*****
User	
Case Number	
EDR Data Imaging Date	01/19/2011
Crash Date	
Filename	CA11001_V3.CDRX
Saved on	Wednesday, January 19 2011 at 13:47:45
Collected with CDR version	Crash Data Retrieval Tool 3.5.1
Reported with CDR version	Crash Data Retrieval Tool 3.5.1
EDR Device Type	airbag control module
Event(s) recovered	Deployment Non-Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of Recorded Crash Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event may be overwritten by another Non-Deployment Event. This event will be cleared by the SDM, after approximately 250 ignition cycle. This event can be overwritten by a second Deployment Event, referred to as a Deployment Level Event, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds before a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.

The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. If a Deployment Level Event occurs within five seconds after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:

-SDM Recorded Vehicle Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 150 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.

-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

- significant changes in the tire's rolling radius
- final drive axle ratio changes
- wheel lockup and wheel slip

-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.

-Pre-Crash data is recorded asynchronously.

-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:

- the SDM receives a message with an "invalid" flag from the module sending the pre-crash data
- no data is received from the module sending the pre-crash data
- no module present to send the pre-crash data

-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Driver's Belt Switch Circuit may be reported other than the actual state.

-The Time between Non-Deployment to Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, "N/A" is displayed in place of the time.

- If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
- All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

Data Source:

All SDM recorded data is measured, calculated, and stored internally, except for the following:

- Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.
- Brake Switch Circuit Status data is transmitted by either the ABS module or the PCM, via the vehicle's communication network, to the SDM. Depending on vehicle option content, the Brake Switch Circuit Status data may not be available.
- The SDM may obtain Belt Switch Circuit Status data a number of different ways, depending on the vehicle architecture. Some switches are wired directly to the SDM, while others may obtain the data from various vehicle control modules, via the vehicle's communication network.

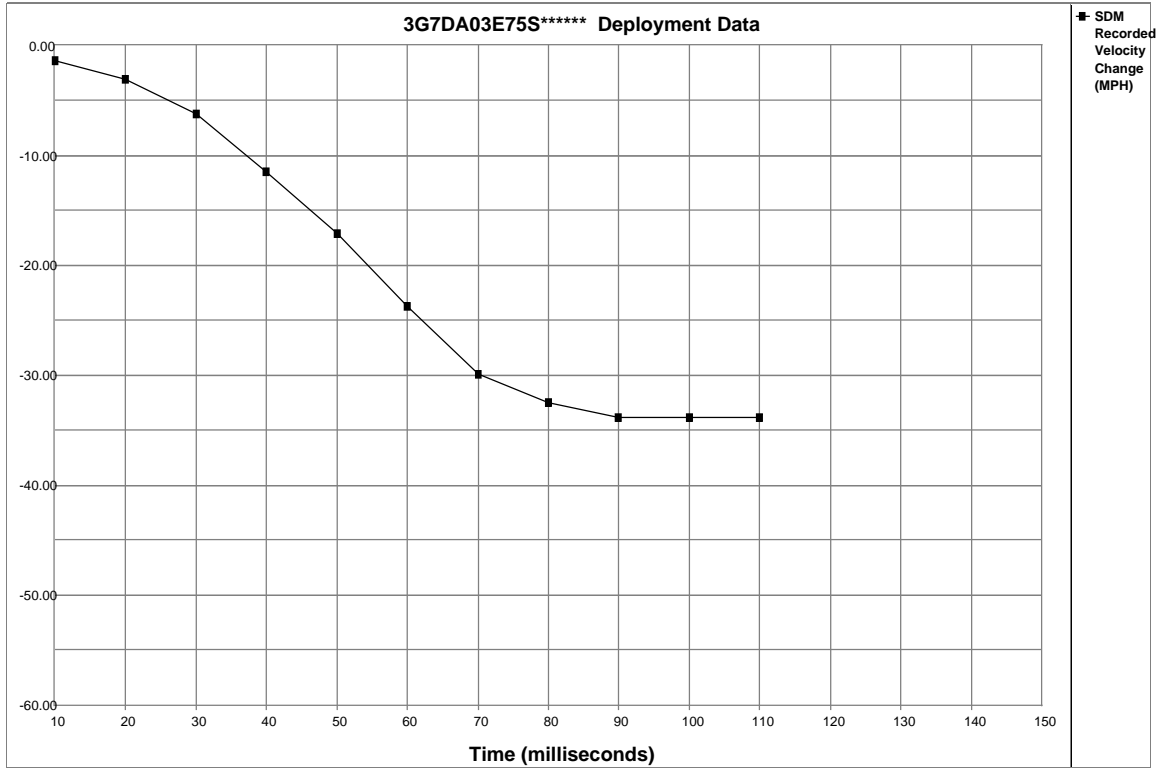
01014_SDMDW_r002

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Belt Switch Circuit Status (If Equipped)	UNBUCKLED
Driver Seat Position Status (If Equipped)	Forward
Passenger Seat Position Status (If Equipped)	Forward
Passenger SIR Suppression Switch Circuit Status (if equipped)	Air Bag Not Suppressed
Ignition Cycles At Deployment	4660
Ignition Cycles At Investigation	4663
Maximum SDM Recorded Velocity Change (MPH)	-34.02
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	95
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	15
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	15
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	15
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	15
Time Between Non-Deployment And Deployment Events (sec)	N/A
Event Recording Complete	Yes

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	37	1600	8
-4	38	1536	8
-3	38	1536	8
-2	39	1600	8
-1	34	1344	0

Seconds Before AE	Brake Switch Circuit State
-8	OFF
-7	OFF
-6	OFF
-5	OFF
-4	OFF
-3	OFF
-2	OFF
-1	ON



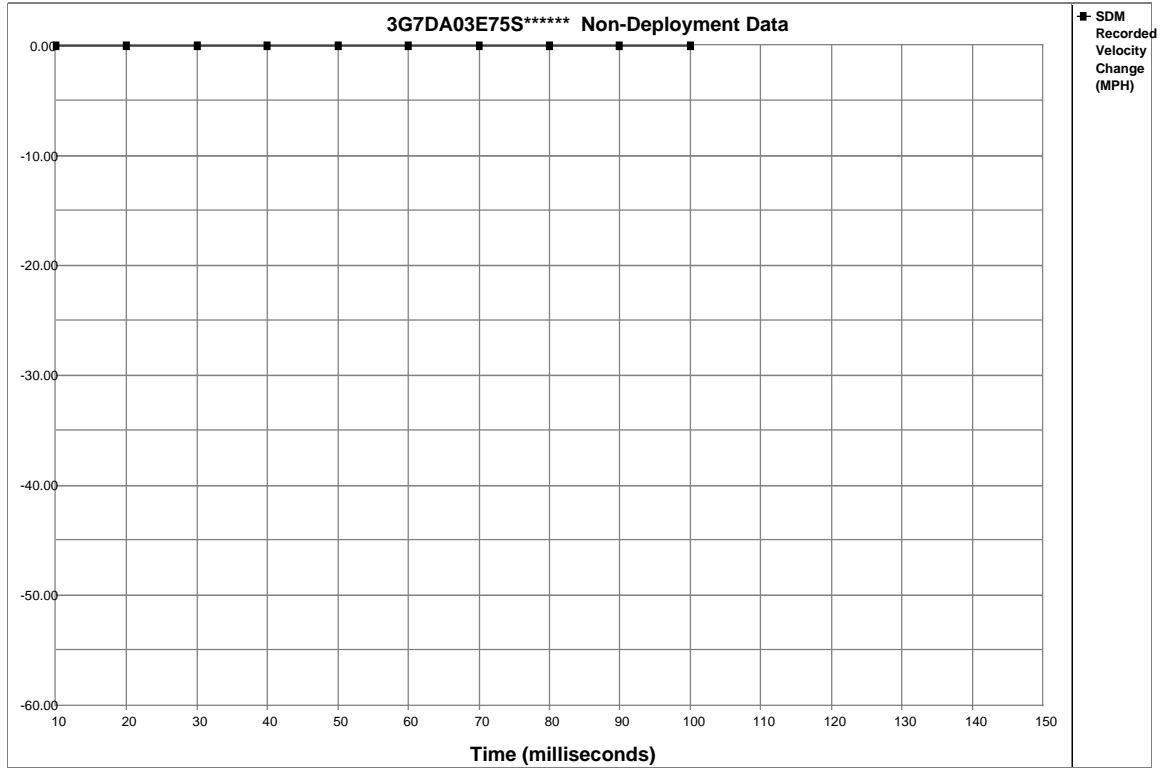
Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Recorded Velocity Change	-1.32	-3.07	-6.14	-11.41	-17.11	-23.70	-29.84	-32.47	-33.79	-33.79	-33.79	N/A	N/A	N/A	N/A

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger Belt Switch Circuit Status (If Equipped)	UNBUCKLED
Driver Seat Position Status (If Equipped)	Forward
Passenger Seat Position Status (If Equipped)	Forward
Passenger SIR Suppression Switch Circuit Status (if equipped)	Air Bag Not Suppressed
Ignition Cycles At Non-Deployment	4460
Ignition Cycles At Investigation	4663
Maximum SDM Recorded Velocity Change (MPH)	-0.01
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	0
A Deployment was Commanded Prior to this Event	No
Event Recording Complete	Yes

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	0	832	0
-4	0	832	0
-3	0	832	0
-2	0	832	0
-1	0	832	0

Seconds Before AE	Brake Switch Circuit State
-8	OFF
-7	OFF
-6	OFF
-5	OFF
-4	OFF
-3	OFF
-2	OFF
-1	OFF



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Recorded Velocity Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	N/A	N/A