CRASH DATA RESEARCH CENTER
Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE INFLATABLE SIDE IMPACT OCCUPANT PROTECTION INVESTIGATION CALSPAN CASE NO: CA08042

VEHICLE: 2007 HONDA ACCORD
LOCATION: TENNESSEE
CRASH DATE: MAY, 2008

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract

This investigation focused on the inflatable side impact protection of 2007 Honda Accord that was involved in an intersection collision with a 1997 Honda CR-V. The crash occurred at the four-leg intersection of a five-lane east/west road and a three-lane north/south road. The left side plane of the eastbound Honda Accord was struck by the front plane of the southbound Honda CR-V. The directions of force were in the 11 o'clock sector for the Honda Accord and the 2 o'clock sector for Honda CR-V. The Honda Accord was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and front right passenger, front seat-mounted side impact air bags and side impact Inflatable Curtain (IC) air bags. The force of the impact resulted in the deployment of the Honda Accord's driver seat-mounted side impact air bag and left IC air bag. The Honda Accord was equipped with an Air Bag Control Module (ACM) that had Event Data Recording (EDR) capabilities. The ACM was removed and forwarded to the manufacturer for possible imaging of the stored crash event data. The Honda CR-V was equipped with frontal air bags for the driver and front right passenger that did not deploy as a result of the impact. The 38-year-old male driver of the Accord reported that he sustained a contusion and minor laceration to his left lower back and unspecified back and neck pain. He was not transported by ambulance at the time of crash. The 79-year-old female driver of the CR-V sustained a police reported non-incapacitating injury and was transported to a local hospital for treatment.

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SCI CASE NO: CA08042

VEHICLE: 2007 HONDA ACCORD
LOCATION: TENNESSEE
CRASH DATE: MAY, 2008

BACKGROUND

This investigation focused on the inflatable side impact protection of 2007 Honda Accord (**Figure 1**) that was involved in an intersection collision with a 1997 Honda CR-V. The crash occurred at the four-leg intersection of a five-lane east/west road and a three-lane north/south road. The left side plane of the eastbound Honda Accord was struck by the front plane of the southbound Honda CR-V. The directions of force were in the 11 o'clock sector for the Honda Accord and the 2 o'clock sector for Honda CR-V. The Honda Accord was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and front right passenger, front seat-mounted side impact air bags and side impact Inflatable Curtain (IC) air bags. The force of the impact resulted in the deployment of the Honda Accord's driver seat-mounted side impact air bag and left IC air bag. The Honda Accord was equipped with an Air Bag Control Module (ACM) that had Event Data Recording (EDR) capabilities. The ACM was removed and forwarded to the manufacturer for possible imaging of the stored crash event data. The Honda CR-V was equipped with frontal air bags for the driver and front right passenger that did not deploy as a result of the impact. The 38-year-old male driver of the Accord reported that he sustained a contusion and minor laceration to his left lower back and unspecified back and neck pain. He was not transported by ambulance at the time of crash. The 79-year-old female driver of the CR-V sustained a police reported non-incapacitating injury and was transported to a local hospital for treatment.

Figure 1: Left side view of the 2007 Honda Accord.

This crash was identified by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) through an Internet search of total loss vehicles that were located at insurance salvage facilities. A list of targeted vehicles was forwarded to the Calspan Special Crash Investigations (SCI) team on September 2, 2008. Calspan SCI conducted a follow-up investigation and established cooperation with the insurance carrier for the Honda Accord to conduct the on-site vehicle inspection and the ACM/EDR removal. The Agency subsequently assigned an on-site investigation on September 9, 2008. The on-site portion of this investigation took place on September 11, 2008. The Honda CR-V could not be located and was not inspected.

SUMMARY

VEHICLE DATA

2007 Honda Accord

The 2007 Honda Accord four-door sedan was manufactured in June 2007 and was identified by Vehicle Identification Number (VIN) 1HGCM56357A (production number deleted). The Honda was powered by a 2.4-liter, transverse mounted four-cylinder engine linked to a five-speed automatic transmission with a console mounted shift lever. The service brakes were power-assisted front disc/rear drum with antilock. The tires were Michelin Energy MXV4 P195/65R16 mounted on OEM steel wheels. The vehicle manufacturer recommended cold tire pressure was 207 kPa (30 PSI) for the front and rear. The tire data at the time of the SCI inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Damage
Left Front	186 kPa (27 PSI)	6 mm (8/32 in)	None
Left Rear	Tire Flat	6 mm (8/32 in)	Cut sidewall
Right Front	193 kPa (28 PSI)	6 mm (7/32 in)	None
Right Rear	193 kPa (28 PSI)	6 mm (7/32 in)	None

The interior of the Accord was configured for five-passenger seating with front bucket seats and a rear bench with split folding backs. The seating positions were equipped with adjustable head restraints. The front head restraints were in the full-down positions and the rear head restraints were adjusted to 3 cm (1 in) above the seat back.

The interior safety systems consisted of three-point lap and shoulder belts for the five seat positions, a CAC frontal air bag system, seat track position sensors, a front right occupant presence detection senor, front safety belt retractor pretensioners, front safety belt buckle switches, front seat-mounted side impact air bags, and side impact IC air bags.

1997 Honda CR-V

The 1997 Honda CR-V sport utility vehicle was identified by the Vehicle Identification Number (VIN): JHLRD1854VC (Production sequence deleted). The power train in the Honda CR-V consisted of a 2.0-liter, four-cylinder engine, and a four-speed automatic transmission with front-wheel drive. The vehicle was equipped manual three-point lap and shoulder belts in the five seat position and air bags for the driver and front right passenger. The air bags did not deploy as a result of the crash. The Honda CR-V could not be located and was not inspected.

CRASH SITE

This two-vehicle crash occurred during the daylight hours of May 2008. At the time of the crash, the weather was not a factor. The crash occurred at the four-leg intersection of a five-lane east/west road and a three-lane north/south road in an urban setting. There was a shallow right curve and slight down grade eastbound leading into the intersection. **Figure 2** is an eastbound trajectory view of the Honda Accord on the approach to the intersection. The eastbound traffic lanes were configured with two through lanes and a left turn only lane. The east/west speed limit was 64 km/h (40 mph). The southbound traffic lanes were configured with a single through lane and a left turn only lane. **Figure 3** is a southbound trajectory view of the Honda CR-V. The

traffic flow through the intersection was controlled by stop signs for the north/south traffic. The north/south speed limit was 56 km/h (35 mph). At the time of the SCI scene inspection, there were no apparent obstructions that would have obscured either driver's visibility to intersecting traffic.

Figure 2: Eastbound trajectory view of the Honda Accord approaching the intersection.

Figure 3: Southbound trajectory view of the Honda CR-V.

CRASH SEQUENCE

Pre-Crash

The 2007 Honda Accord was driven by a 38-year-old restrained male. He was operating the vehicle on the outboard eastbound through lane. The 1998 Honda CR-V was southbound driven by a 79-year-old restrained female. Both vehicles were passing straight through the intersection. **Figure 8** at the end of this report is an overhead schematic of the crash.

Crash

The southbound Honda CR-V entered the intersection and struck the left plane of the eastbound Honda Accord. The force of the impact caused the Honda Accord's driver safety belt pretensioner to actuate, and the driver's seat back mounted side impact air bag and the left IC air bag to deploy. The front air bags in the Honda CR-V did not deploy. The severity of the crash (delta-V) was calculated by the Missing Vehicle Algorithm of the WinSMASH program. The total delta–V of the Honda Accord was 20 km/h (12.4 mph). The longitudinal and lateral components of the delta-V were -15.3 km/h (-9.5 mph) and 12.9 km/h (8.0 mph), respectively. The total delta–V of the Honda CR-V was 22 km/h (13.7 mph). The longitudinal and lateral components of the Honda CR-V's delta-V were -14.1 km/h (-8.8 mph) and -16.9 km/h (-10.5 mph), respectively. Both vehicles separated from the impact with a counterclockwise rotation. The Honda Accord came to rest in the east leg of the intersection facing northwest. The Honda CR-V came to rest in the middle of the intersection facing northwest.

Post-Crash

The police and ambulance personnel responded to the crash. The driver of the Honda Accord exited his vehicle without assistance though the front right door. He refused medical transport at the time of the crash. He reported in an interview that he sustained a minor laceration and contusion to the left lower aspect of his back and indicated that he sought follow-up exam the day following the crash. He also complained of neck and back pain. The driver of the Honda CR-V sustained police reported non-incapacitating injuries and was transported to a local hospital.

2007 HONDA ACCORD

Exterior Damage

The 2007 Honda Accord sustained moderate severity damage to the left plane as a result of the impact. The damage consisted of lateral deformation to the left doors, left sill, and left B-pillar structure. The front left wheel was contacted during the impact. Its involvement in the impact was evidenced by abrasions to the face of the alloy rim and a fracture of the wheel rotor. The contact damage began at the left front axle, 100 cm (39.4 in) rear of the front bumper, and extended across the left plane to the quarterpanel. The length of the left side damage measured, 283 cm (111.4 in). The crush profile documented at the mid-door level was as follows: C1 = 0 cm, C2 = 22 cm (8.6 in), C3 = 25 cm (9.8 in), C4 = 17 cm (6.7 in), C5 = 3 cm (1.2 in), C6 = 0 cm. The maximum crush was located at C3, the forward aspect of the left rear door and measured 25 cm (9.8 in). The elevation of the maximum crush measured 67 cm (26.3 in) above the ground. The Door Sill Differential (DSD) was 15 cm (6 in). The left side doors were jammed closed. The right doors remained closed during the crash and were operational post-crash. The left door glazing disintegrated during the crash. The windshield and the remainder of the side glazing were intact. The Collision Deformation Classification (CDC) for the impact was 11-LDEW2.

Figure 4: Oblique view of the left side damage.

Interior Damage

The interior of the Honda Accord sustained moderate severity damage consisting of occupant compartment intrusion and the deployment of the left side impact air bag and left IC air bag. The left B-pillar intruded and was in contact with outboard aspect of the driver's seat. The passenger compartment intrusions are listed in the table below:

Location	Component	Magnitude	Direction
Front Left	Door panel - forward upper quadrant at the arm rest	21 cm (8.2 in)	Lateral
Front Left	B-pillar	8 cm (3.2 in)	Lateral
Rear Left	Door panel - forward upper quadrant	33 cm (13 in)	Lateral

An 11 cm (4.5 in) fracture of the forward aspect of the arm rest, at the windows controls, was identified. The fracture occurred during the impact and deformation of the left door. The fractured panel was ruled out as a driver contact due to its forward location and the lack of injury to the driver's left lower extremity. There was no direct evidence of driver contact to the door panel or the deployed air bags. However, due to the driver's close proximity to the intruded left arm rest and the deployed air bags, contact to these components occurred.

The powered driver seat was adjusted to a mid-track position that measured 8 cm (3 in) rear of full forward. The seat track travel measured 17 cm (6.5 in). The driver seat was jammed and its position was measured with respect to the manual front right passenger seat. The driver seat back angle measured 10 degrees aft of vertical. The horizontal distance from the seat back to the driver air bag module in the center of the steering wheel rim measured 61 cm (24 in). The steering wheel rim was not deformed. There was no shear capsule displacement. There was no knee bolster contact.

Manual Safety Belt System

The driver's manual safety belt system consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring, an Emergency Locking Retractor (ELR), and a retractor-mounted pretensioner. The driver's D-ring was adjusted to the full-down position. At inspection, the safety belt webbing was exposed in the used position. The length of the exposed webbing measured 159 cm (62.5 in). The retractor was locked due to the deformation of the B-pillar and the actuation of the retractor pretensioner. A 5 cm (2 in) abrasion was identified on the webbing between the D-ring and retractor. This abrasion resulted from frictional contact between the webbing and D-ring surface when the pretensioner actuated and the webbing was spooled back onto the retractor. A small cut to the webbing and a corresponding abrasion to the latch plate were also identified. A fragment of the disintegrated left glazing was captured between the webbing and the latch plate at the time of the impact resulting in the observed evidence. The driver was restrained during the crash based on the observed condition of the safety belt.

Certified Advanced 208-Compliant Frontal Air Bag System

The Honda Accord was equipped with a CAC frontal air bag system for the driver and front right passenger positions. This system consisted of dual-stage air bags, seat track position sensors, safety belt buckle switch sensors, a front right passenger occupant presence detection sensor, and front safety belt retractor pretensioners. A CAC vehicle is certified by the vehicle manufacturer to be compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The frontal air bag system did not deploy during the crash.

Event Data Recorder

The Honda Accord was equipped with an Air bag Control Module (ACM) that was believed to have Event Data Recording (EDR) capabilities. The ACM was located under the center aspect of the instrument panel. Permission to remove the module from the vehicle for imaging by the manufacturer was obtained from the insurance company. The ACM was removed at the time of the SCI inspection and the module was forwarded to the NHTSA. The Agency in-turn sent the module to the vehicle manufacturer. The task of imaging the EDR was not completed at the time of this report submission.

Side Impact Air Bag Systems

The Honda was equipped with front seat-mounted side impact air bags and side impact IC air bags. The left seat-mounted side impact air bag and the left IC air bag deployed during the crash.

The left seat-mounted air bag, **Figure 5**, was concealed within the outboard aspect of the seat back and the bag deployed through a 28 cm (11 in) tear seam. The air bag was elliptical in shape, and measured 38 cm (15 in) in height and 23 cm (9 in) in width. The bag consisted of two panels sewn together at the forward edge. The base of the air bag was located at the horizontal surface of the arm rest, 23 cm (9 in) above the seat cushion. The expanded air bag filled the area above the arm rest. The air bag was vented at the forward edge by a port that measured 5 cm (2 in) in width and 8 cm (3 in) in height. The air bag contained two circular tethers that were sewn to the panels. The tethers were located at the 12 and 6 o'clock positions, 16 cm (6.2 in) apart. The air bag was not damaged and did not contain occupant contact evidence.

Figure 5: Left side impact air bag.

The left IC air bag deployed from the roof side rail. The curtain air bag measured 173 cm (68 in) in length and 39 cm (15.5 in) in height. The curtain provided vertical coverage that extended 3 cm (1 in) below the beltline. The IC air bag overlapped the seat-mounted air bag by 7 cm (2.8") in the deflated state. The air bag was not tethered to the A- and C-pillars. Longitudinally, the coverage area of this curtain air bag did not completely span across the front glazing. A triangular shaped void was present between the curtain air bag and the A-pillar. The maximum length of the void was 30 cm (12 in) with a maximum height of 18 cm (7 in). In its deflated state, the air bag overlapped the C-pillar approximately 10 cm (4 in) providing protection beyond the rear glazing area. There was no occupant contact evidence or damage to the curtain air bag. **Figure 6** depicts the deployed left seat-mounted and IC air bags.

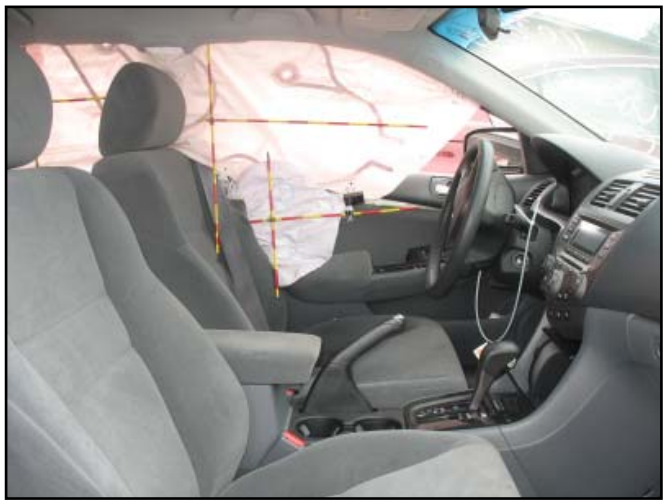

Figure 6: Right interior view of the deployed air bags at the driver's position.

DRIVER DEMOGRAPHICS
2007 Honda Accord

	Driver
Age / Sex:	38-year-old / Male
Height:	178 cm (70 in)
Weight:	79 kg (175 lb)
Seat Track Position:	Mid-track, 8 cm (3 in) rear of full-rear
Restraint Use:	3-point lap and shoulder safety belt
Usage Source:	SCI interior inspection
Medical Treatment:	Examined the day following the crash and released

DRIVER INJURY
2007 Honda Accord

Injury	***Injury Severity (AIS 90 Update 98)***	***Injury Source***
Contusion left lower back	Minor (690402.1,2)	Left arm rest – left front door upper rear quadrant
Minor laceration left lower back	Minor (690602.1,8)	Left arm rest – left front door upper rear quadrant
Cervical pain, NFS	Not codeable per AIS rules	Crash force
Back pain, NFS	Not codeable per AIS rules	Crash force

Source: Driver interview

DRIVER KINEMATICS
2007 Honda Accord

The driver was seated in a mid-track position and was restrained by the vehicle's safety belt. At impact, the front safety belt pretensioner actuated and the left side impact air bag and left IC air bag deployed. The driver responded to the 11o'clock direction of the crash force with a left and forward trajectory. The driver's chest loaded the locked safety belt system. The driver's left flank loaded the deployed side impact air bag and his shoulder and head loaded the deployed left curtain. The force of the impact caused the left door to intrude laterally. The left arm rest was located below the level of the deployed side impact air bag. The left lower aspect of the driver's back loaded the intruding arm rest resulting in a contusion and minor laceration. The driver rebounded and came to rest within the driver's seat. After regaining his composure he exited the vehicle unassisted through the right door.

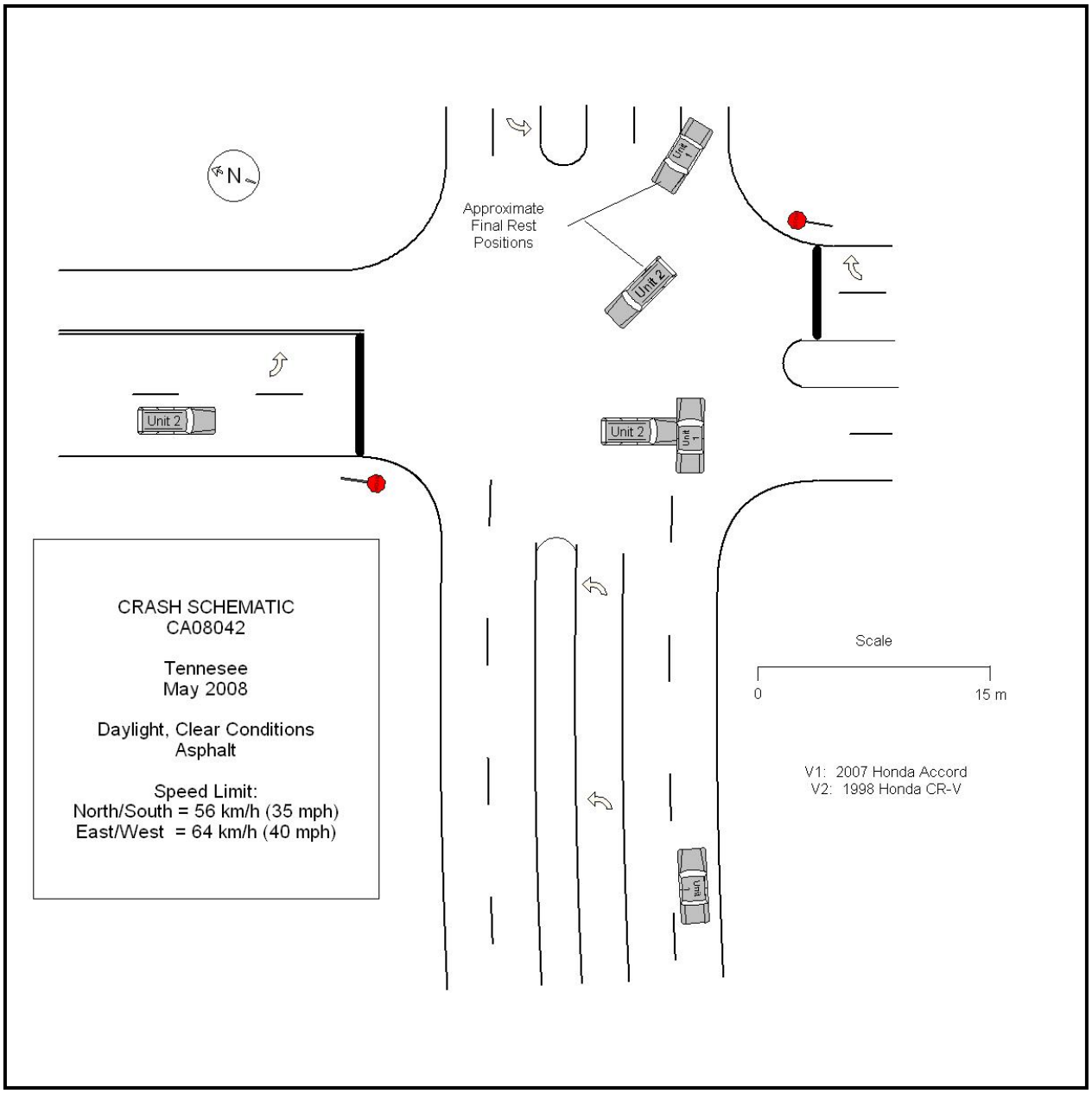

Figure 7: Crash schematic.