Side Air Bag Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS04020
2004 Honda Accord
Washington
August, 2004

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

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

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16. Abstract

This on-site investigation focused on the performance of the side air bag installed in a 2004 Honda Accord. The Honda Accord was occupied by a restrained 36-year-old female driver, a restrained 60-year-old female front right seat passenger, and a restrained 14-year-old second row right seat passenger. The Honda was equipped with front dual-stage air bags, dual front seat belt pretensioners with force limiters, a front passenger seat position sensor, and dual front seat back mounted side air bags. The Honda was traveling through a four-leg intersection. As the Honda entered the intersection it was struck in the left side by the front of a 1995 Jeep Grand Cherokee. The driver sustained a left leg laceration, a laceration to the left side of her head, and a possible concussion. She was transported to a local hospital where she was hospitalized for four days. The front right occupant sustained three left rib fractures, a left lung laceration, and a contusion to the left side of her head. She was transported to a local hospital where she was admitted and hospitalized for six days. The second row right seat occupant sustained seat belt bruises.

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BACKGROUND:

Description

This on-site investigation focused on the performance of the side air bag installed in a 2004 Honda Accord. The Honda Accord was occupied by a restrained 36-year-old female driver, a restrained 60-year-old female front right seat passenger, and a restrained 14-year-old second row right seat passenger. The Honda was equipped with front dual-stage air bags, dual front seat belt pretensioners with force limiters, a front passenger seat position sensor, and dual front seat back mounted side air bags. The Honda was traveling through a four-leg intersection. As the Honda entered the intersection it was struck in the left side by the front of a 1995 Jeep Grand Cherokee. The driver's seat back mounted side air bag deployed at this time. The driver sustained a left leg laceration, a laceration to the left side of her head, and a possible concussion. She was transported to a local hospital where she was hospitalized for four days. The front right occupant sustained three left rib fractures, a left lung laceration, and a contusion to the left side of her head. She was transported to a local hospital where she was admitted and hospitalized for six days. The second row right seat occupant sustained seat belt bruises. She was transported by ambulance to a local hospital where she was treated and released.

Figure 1. Left side, Honda Accord

This Side Air Bag investigation was identified within a group of potential cases provided to the NHTSA by Nationwide Insurance. Dynamic Science, Inc. (DSI) received the spreadsheet containing the potential cases on September 8, 2004. DSI located and obtained permission to inspect the case vehicle on September10th. A police report was located on September 13th. DSI conducted the vehicle inspection on September 16, 2004.

SUMMARY

Crash Site

This two vehicle crash occurred in August, 2004 at 1646 hours. The crash occurred within the confines of a four leg intersection. The southern leg of the intersection is comprised of a left turn only lane, two northbound travel lanes, three southbound travel lanes, and a right turn only lane. The north and southbound lanes are separated by a yellow painted raised curb that measured 30.0 cm (11.8 in) wide by 17.0 cm (6.7 in) high. The two

Figure 2. Approach to area of impact, north, Jeep Cherokee

turn lanes are separated from the through lanes by solid white lines. The westbound leg of the intersection is comprised of one westbound and one east bound travel lane. The lanes are separated by double yellow lines. The westbound leg is wide enough that vehicles turning left and vehicles going straight ahead or turning north can sit side by side. The asphalt roadways are level and were dry at the time of the crash. The intersection is controlled by tri-color traffic signals. Lights were green for northbound travel and red for westbound. The speed limit in all directions is 64 km/h (40 mph).

Figure 3. Approach to area of impact, west, Honda Accord

Pre-Crash

The case vehicle is a 2004 Honda Accord EX four-door sedan driven by a restrained 36-year-old female. There were two additional occupants in the Honda. The front right seat was occupied by the driver's mother, a 60-year-old female. The rear right seat was occupied by a restrained 14-year-old female. The driver had just recently purchased the Honda and, according to the driver's husband, the mileage on the vehicle was 56 km (35 miles). The Honda was traveling westbound. The other vehicle was a 1995 Jeep Grand Cherokee driven by an 18-year-old female. The Jeep was traveling northbound.

Crash

The driver of the Honda failed to stop at the intersection. The front of the Jeep struck the left side of the Honda (10LPAW3). The total velocity change as calculated by the missing vehicle algorithm of WinSmash collision model was 23.5 km/h (14.6 mph). The longitudinal and lateral delta V components were -8.0 km/h (-5.0 mph) and 22.1 km/h (13.7 mph), respectively. The driver's seat back mounted side air bag deployed at this time.

Figure 4. Rear left, Honda Accord

Post-Crash

The driver of the Honda was trapped in her vehicle and required extrication. She sustained a 7.6 cm (3.0 in) laceration to the left thigh that penetrated to the muscle, a laceration to the left side of her head behind the ear, and a possible concussion. She reported that she lost consciousness. She was transported to a local hospital where she was hospitalized for four days. She was out of work for nearly two months. The front right occupant sustained three left rib fractures, a left lung laceration, and a contusion to the left side of her head. She was transported to a local hospital where she was hospitalized for six days. She was retired and did not lose any working days. The second row right seat occupant sustained seat belt bruises. She was removed from the vehicle by EMS personnel as a precaution, but could have exited the vehicle on her own. She

was transported by ambulance to a local hospital where she was treated and released.

The Honda was towed from the scene due to damage and was later declared a total loss by the insurance company. The Jeep was towed from the scene due to damage.

VEHICLE DATA - 2004 Honda Accord

The 2004 Honda Accord was identified by its Vehicle Identification Number (VIN) 1HGCM56694Axxxxxx. According to the driver's husband, the vehicle was essentially brand new and had only been driven 56 km (35 miles). The Accord was equipped with a 2.4 liter, 4 cylinder engine, an automatic transmission, front wheel drive, front disc and rear drum brakes, air conditioning, power door locks, and a tilt steering column.

The 2004 Honda Accord was equipped with Michelin Energy P205/60R16 tires. The specific tire data is as follows:

Tire	Tread	Measured pressure	Manufacturer recommended pressure
LF	8 mm (10/32 in)	228 kPa (33 psi)	303 kPa (44 psi)
LR	8 mm (10/32 in)	Flat	303 kPa (44 psi)
RF	8 mm (10/32 in)	221 kPa (32 psi)	303 kPa (44 psi)
RR	8 mm (10/32 in)	228 kPa (33 psi)	303 kPa (44 psi)

The front seating positions in the 2004 Honda Accord were configured with fabric covered bucket seats with adjustable head restraints. Both front seats were slightly reclined at the time of inspection. The driver's seat was deformed by vehicle intrusion. The rear seating positions were configured with a fabric covered 60/40 split fold-down bench seat with adjustable head restraints for the outboard positions.

VEHICLE DAMAGE

Exterior Damage - 2004 Honda Accord

Damage Description:	Moderate lateral crush to left side doors Roof cut off by rescue personnel.	
CDC:	10LPAW3	
Delta V:	Total	23.5 km/h (14.6 mph)
	Longitudinal	-8.0 km/h (-5.0 mph)
	Latitudinal	22.1 km/h (13.7 mph)
	Energy	66,870 joules (49,320 ft lbs)

The case vehicle sustained 220.0 cm (86.6 in) of direct contact damage along the left side beginning 39.0 cm(15.3 in) forward of the front axle and extending to the rear. The residual crush measured above the sill was as follows: C1=0 cm (0 in), C2=17.5 cm (6.9 in), C3=39.0 cm (15.3 in), C4=13.0 cm (5.1 in), C5=15.0 cm (5.9 in), C6=11.0 cm (4.3 in). The C4 measurement was at the sill level. The maximum crush was located between C4 and C5 at the B pillar and measured 43.0 cm (16.9 in). The principle direction of force was within the 10 o'clock sector and was an estimated 290 degrees.

Figure 5. Left side, Honda Accord

Interior Damage - 2004 Honda Accord

Interior damage to the Accord was significant. Both left side doors were jammed shut and it appears likely that all the glazing on the left side disintegrated during the crash. The left side doors, A and B pillar, and sill sustained lateral intrusion. The left front seat was compressed from the intrusion. The center console was shifted by occupant contact. There were scuffs to the left door and door handle. The left lower instrument panel was cracked from contact with the driver's knee.

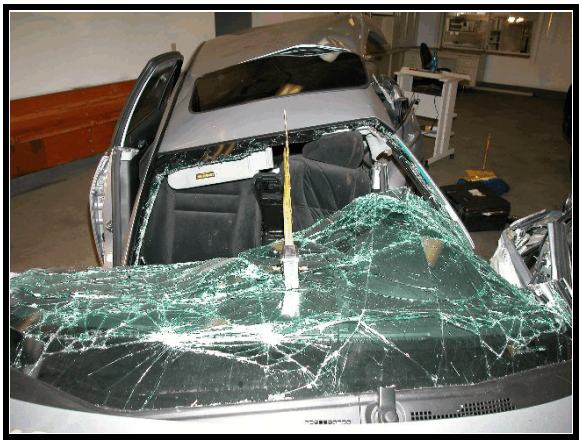

Figure 6. Overview of vehicle intrusion

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
LF	Left front door	15.0 cm (5.9 in)	Lateral
LF	Sill	12.0 cm (4.7 in)	Lateral
LF	Left B pillar	29.0 cm (11.4 in)	Lateral
LF	Left A pillar	4.0 cm (1.6 in)	Lateral
LR	Left rear door	44.0 cm (17.3 in)	Lateral
LF	Left roof side rail	Unknown	Lateral
LF	Left window frame	Unknown	Lateral
LF	Kicker panel	>=3.0 cm (1.2 in) to < 8.0 cm (3.1 in)	Lateral
LF	Seat back	>=8.0 cm (3.1 in) to <15.0 cm (5.9 in)	Lateral
LF	Seat cushion	Unknown	Lateral
LF	Roof	Unknown	Vertical
LR	Left window frame	Unknown	Lateral
LR	Left roof side rail	Unknown	Lateral
LR	Sill	Unknown	Lateral

MANUAL RESTRAINT SYSTEMS - 2004 Honda Accord

All five seating positions in the Honda Accord were configured with manual 3-point lap and shoulder belts. The front seat restraints were configured with adjustable shoulder belt upper anchorages. The left anchorage had been adjusted to the full up position; the right had been adjusted to the full down position. All the seat belts were equipped with sliding latch plates. The driver's seat belt was equipped with an emergency locking retractor. The front right passenger's seat belt and all three rear seat belts were equipped with switchable retractors (retractors that can be changed from an emergency locking retractor to an automatic locking retractor to assist in securing child seats).

Front Air Bags - 2004 Honda Accord

The Honda Accord was equipped with advanced dual stage front air bags. The multi-stage air bags were certified by the manufacturer to meet the advanced air bag requirement of FMVSS208. The system consists of the SRS unit, the driver's air bag, the front right passenger's air bag, front seat belt pretensioners, and front impact sensors. There were no front air bag deployments.

Side Air Bags - 2004 Honda Accord

The Honda Accord was equipped with seat back mounted side air bags for the front seat positions. The driver's side air bag deployed. The air bag is semi-circular in shape with a height of 32.0 cm (12.6 in) and an excursion of 27.0 cm (10.6 in). There are two vents, located at the 11 and 5 o'clock position as viewed from the left side of the vehicle. There was no damage to the air bag. There were blood drops found on the inward facing portion of the air bag. The front right passenger side air bag is controlled by what Honda calls its Occupant Position Detection System (OPDS). The OPDS determines the size and position of the passenger, and prevents deployment whenever it could cause head or neck injuries. It also alerts the driver when the passenger's position is unsuitable for side air bag deployment. The passenger's seat back incorporates position sensors running from top to bottom. These determine the height of the occupant. A further sensor is incorporated into the seat back bolster, this determines the lateral position of the occupant. Signals from these sensors allow the OPDS to determine the passenger's seated position. In a side collision, OPDS can calculate if it is safe to deploy the side air bag or not.

Figure 7. Outboard facing portion of side air bag

Figure 8. Inboard facing view of driver's side air bag

VEHICLE DATA - 1995 Jeep Grand Cherokee

Description:	1995 Jeep Grand Cherokee 4x4 Limited 4-door sport utility vehicle	
VIN:	1J4GZ78SCXCxxxxxx	
Odometer:	Unknown	
Engine:	4.0L I-6	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Frontal damage. Towed from scene.	
CDC:	Unknown	
Delta V:	Total	23.8 km/h (14.8 mph)
	Longitudinal	-22.4 km/h (-13.9 mph)
	Latitudinal	-8.1 km/h (-5.1 mph)
	Energy	32,159 joules (23,719 ft lbs)

OCCUPANT DEMOGRAPHICS - 2004 Honda Accord

	Driver	Occupant 2
Age/Sex:	36/Female	60/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat. Seat adjusted to rearmost track position at time of inspection. The seat back angle was 77 degrees from horizontal. The seat bottom angle was 13 degrees from horizontal.	Fabric covered bucket seat. Seat adjusted to between the rear most and middle track position. The seat back angle was 51 degrees from horizontal. The seat bottom angle was 13 degrees from horizontal.
Height:	170 cm (67 in)	157 cm (62 in)
Weight:	68 kg (150 lbs)	84 kg (185 lbs)
Occupation:	Unknown	Not currently employed
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Both hands on steering wheel.	Unknown
Foot Position:	Left on floorboard, right on accelerator.	Both feet on floorboard.
Restraint Usage:	Lap and shoulder belt available, used.	Lap and shoulder belt available, used.
Air bag:	Front air bag available, did not deploy. Side air bag available, deployed.	Front air bag available, did not deploy. Side air bag available, did not deploy.

	Occupant 3
Age/Sex:	14/Female
Seated Position:	Rear right
Seat Type:	Fabric covered bench seat
Height:	152 cm (60 in)
Weight:	75 kg (165 lbs)
Occupation:	Not currently employed
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	NA
Driving Experience:	NA
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used.

OCCUPANT DEMOGRAPHICS - 1995 Jeep Cherokee

	Driver
Age/Sex:	18/Female
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Presumed to be upright, normal
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used

OCCUPANT INJURIES - 2004 Honda Accord

Driver: Injuries obtained from interview with driver's husband.

Injury	OIC Code	Injury Mechanism	Confidence Level
7.6 cm (3.0 in) deep laceration, left thigh	890602.1,2	Door side panel	Certain
Laceration, left side of head	190602.1,2	Window frame	Probable
Possible concussion. Loss of consciousness. Memory loss.	Not codeable	NA	NA

Front right occupant: Injuries obtained from interview with driver's husband.

Injury	OIC Code	Injury Mechanism	Confidence Level
Fractured ribs (3), left	450220.2,2	Center console	Probable
Lung laceration, left	441414.3,2	Center console	Probable
Contusion, left side of head	190402.1,2	Unknown	NA

Second row right occupant: Injuries obtained from interview with driver's husband.

Injury	OIC Code	Injury Mechanism	Confidence Level
"Seat belt bruises"	790402.1,1	Seat belt webbing	Certain
	490402.1,4	Seat belt webbing	Certain
	590402.1,4	Seat belt webbing	Certain

OCCUPANT KINEMATICS - 2004 Honda Accord

Driver Kinematics

Figure 9. Driver's seated position

The 36-year-old female driver of the Honda Accord was seated in a forward facing, upright fashion. She was wearing the available 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full up position. The fabric covered bucket seat was in the middle track position according to the interviewee. The seat back angle was 77 degrees from horizontal. The seat bottom angle was 13 degrees from horizontal. Both of her hands were on the steering wheel (unknown clock position). Her left foot was on the floorboard; her right was on the accelerator. She was looking straight ahead. At impact with the Jeep, the driver's seat back mounted side air bag deployed. The driver initiated a lateral and slightly forward trajectory to the left. Her left hip/thigh contacted the door and door handle causing a laceration. Her head likely contracted some portion of the window frame, causing a laceration behind her left ear. She removed from the vehicle by EMTs. She was transported and hospitalized for four days.

Front Right Occupant Kinematics

Figure 10. Front right passenger's seated position

The 60-year-old female front right occupant was seated in a forward facing, upright fashion. She was wearing the available 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full down position. The fabric covered bucket seat was adjusted to between the rearmost and middle track position according to the vehicle inspection. The seat back angle was 51 degrees from horizontal at the time of the vehicle inspection. The seat bottom angle was 13 degrees from horizontal. Both of her feet were on the floor. At impact, this occupant initiated a lateral and slightly forward trajectory to the left. She pivoted laterally and struck the console with her left torso–causing the rib fractures and lung laceration. She was removed from the vehicle by EMTs. She was transported and hospitalized for six days.

Rear Right Occupant Kinematics

The 14-year-old female second row right seat occupant was seated in a forward facing, upright fashion on the fabric covered bench seat. She was wearing the available 3-point manual lap and shoulder belt. At impact, this occupant initiated a lateral and slightly forward trajectory to the left. She loaded the seat belt system causing seat belt bruises. She removed from the vehicle by EMTs. She was transported, treated, and then released.

Attachment 1. Scene Diagram