

Rollover Investigation
Dynamic Science, Inc. / Case Number: DS07003
2006 Honda CR-V
California
November 2006

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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 <p>This single vehicle rollover crash occurred in November 2006 at 0122 hours. The crash occurred in the eastbound lanes of a five lane divided interstate highway. The case vehicle was a 2006 Honda CR-V sport utility vehicle that was being driven by a restrained 37-year-old male. The driver had been drinking. The vehicle was traveling eastbound in middle lane at an unknown speed. The driver failed to negotiate the turn and the Honda crossed the two adjacent travel lanes and departed the roadway to the south. The Honda crossed the roadway shoulder and struck a metal/wood guardrail with its front end. The vehicle was re-directed to the left and began a counter-clockwise rotation as it reentered the roadway and overturned with its right side leading. Both side curtains deployed during the rollover. The Honda came to rest on its roof in the second lane. The driver sustained a contusion and a sprain to his left thumb and was able to exit the vehicle under his own power.</p>				
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BACKGROUND

This single vehicle rollover crash occurred in November 2006 at 0122 hours. The crash occurred in the eastbound lanes of a five lane divided interstate highway. The vehicle was a 2006 Honda CR-V sport utility vehicle that was being driven by a restrained 37-year-old (**Figures 1-2**). The driver had been drinking. The case vehicle was traveling eastbound in middle lane at an unknown speed. The driver failed to negotiate the turn and the Honda crossed the two adjacent travel lanes and departed the roadway to the south. The Honda crossed the roadway shoulder and struck a metal/wood guardrail with its front end. The vehicle was re-directed to the left and began a counter-clockwise rotation as it reentered the roadway and overturned with its right side leading. The Honda came to rest on its roof in the second lane. The driver sustained a contusion and a sprain to his left thumb and was able to exit the vehicle under his own power.

This Rollover case was identified by the National Highway Traffic Safety Administration (NHTSA) during a review of police reports. DSI was faxed the report on December 12, 2006. DSI located the case vehicle and obtained permission to inspect the vehicle on January 25, 2007. DSI was assigned the case on January 26, 2007 and the case vehicle was inspected during the week of January 29, 2007. The Event Data Recorder (EDR) was removed from the vehicle and was submitted to NHTSA on February 6, 2007. Readout data from the EDR was received in June 2007.

SUMMARY

Crash Site

This single vehicle crash occurred in November 2006 at 0122 hours. The crash occurred on a north/southbound interstate highway (**Figure 3**). At the crash location; however, the roadway actually travels east/west. The crash occurred in the eastbound lanes of the five lane divided interstate highway. The road surface was composed of asphalt and was dry at the time of the crash.



Figure 1. 2006 Honda CR-V



Figure 2. Exemplar 2006 Honda CR-V



Figure 3. Area of impact (east)

The crash took place in a left hand curve. The speed limit at this location was 89 km/h (55 mph).

Pre Crash

The case vehicle was a 2006 Honda CR-V sport utility vehicle that was being driven by a restrained 37-year-old male. The driver had been drinking. The case vehicle was traveling eastbound in middle lane at an unknown speed. The driver failed to negotiate the curve and the Honda crossed the two adjacent travel lanes and departed the roadway to the south.

Crash

The Honda crossed the roadway shoulder and struck a metal/wood guardrail with its right front end. The Honda was re-directed to the left and the vehicle began a counterclockwise rotation as it reentered the roadway and overturned with its right side leading. Both side air curtains deployed during the rollover. The vehicle rolled two quarter turns and came to rest on its roof in the fourth lane from the right.

Post Crash

The driver was able to exit the vehicle under his own power. He had sustained a contusion and a sprain to his left thumb. After the police conducted a series of sobriety tests, the driver was arrested on suspicion of driving under the influence of alcohol. He transported by ground ambulance to a local hospital for treatment of his injuries and arrived with a Glasgow Coma Scale (GCS) score of 15. Blood was drawn upon his arrival and placed into evidence. He was then released into the care of hospital staff for treatment. He was admitted at 0201 hours and discharged at 0635 hours into police custody.

The Honda CR-V was towed from the scene due to damage. It was later declared a total loss by the insurance company.

VEHICLE DATA - 2006 Honda CR-V

The 2006 Honda CR-V was identified by the Vehicle Identification Number (VIN): JHLRD78826Cxxxxxx. The vehicle's odometer could not be read because there was no power for the vehicle. The CR-V was a five-door sport utility vehicle that was equipped with a 2.4 liter, 4-cylinder engine, an automatic transmission, front/rear disc brakes with ABS and stability control, power steering, and a tilt steering wheel. The Static Stability Factor (SSF)¹ for the 2002 model year was 1.17. The SSF for the 2006 model year is not known. The CR-V was configured with Bridgestone Dueler H/T P125/65R16 tires. The vehicle manufacturer's recommended cold tire pressure was 200 kPa (29 psi). The specific tire information is as follows:

¹The SSF is a number that relates the height of the center of gravity of a vehicle to its width. It is used to compare the relative stabilities of different vehicles.

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	276 kPa (40 psi)	10 mm (13/32 in)	No	No
LR	207 kPa (30 psi)	7 mm (9/32 in)	No	No
RR	207 kPa (30 psi)	10 mm (13/32 in)	Yes	No
RF	Flat	7 mm (9/32 in)	No	Tire debedded, side wall cut

The seating in the Honda CR-V was configured with fabric covered front bucket seats with adjustable head restraints and a 60-40 split bench rear seat. The driver's seat was in the mid-track position. The seat back angle was 17 degrees from vertical and the seat bottom angle was 11 degrees from horizontal. The front right seat was in the mid-track position. The seat back angle was 25 degrees from vertical and the seat bottom angle was 9 degrees from horizontal.

Vehicle Damage

Exterior Damage - 2006 Honda CR-V

The 2006 Honda CR-V sustained moderate front end damage as a result of the impact with the guardrail. The direct damage began at the front right corner and extended 62 cm (24.4 in) to the right. The bumper fascia and backing bar were dislodged during the crash and were no longer with the vehicle. It appears likely that the direct contact was outboard of the right bumper mounting bracket. The direct damage extended longitudinally down the right side and terminated at the mid point of front right door—near the sill. The right front tire was damaged and separated from the vehicle. Both front mounting brackets were shifted to the left, with the right bracket shifted 21 cm (8.3 in) and left shifted 5 cm (2.0 in). Two crush measurements (**Figures 4-5**) were documented at the mounting bracket as follows: C1 = 0 cm, C2 = 2 cm (0.8 in). The Collision Deformation Classification (CDC) for the impact with the guardrail was 01FZEW1. The EDR reported Delta V End was 9.2-10.7 km/h (5.7-6.7 mph). The barrier routine of the WinSmash program computed a total delta V of 11.0 km/h (6.8 mph), based on the CR-V's front crush profile. The longitudinal and lateral components were -10.3 km/h (-6.4 mph) and -3.8 km/h (-2.3 mph), respectively.



Figure 4. Front end damage, Honda CR-V

The Honda CR-V also sustained damage to the right side and roof from the rollover (**Figures 6-7**). The direct damage on the right side began at the right rear bumper corner and extended forward 304 cm (119.7 in). There was direct contact to the hood and roof. The hood contact measured 136 cm (53.5 in) wide by 55 cm (21.6 in) long. The roof damage began at the A pillars/windshield header

and extended rearward past the sun roof. The maximum vertical crush was located at the windshield header 35 cm (13.8 in) to the right of the A pillar (**Figure 8**). The maximum crush 9.5 cm (3.7 in). The CDC for the rollover was 00TDDO2.



Figure 5. Right side damage

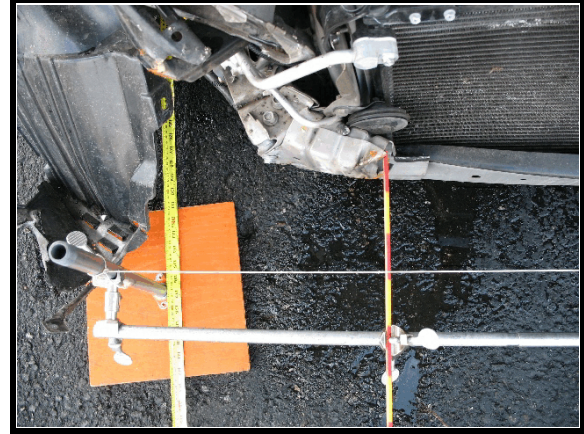


Figure 6. Shifted right bracket

Interior Damage - 2006 Honda CR-V

The Honda CR-V sustained minor interior damage as a result of passenger compartment intrusion. This was primarily along the windshield header. The windshield was cracked and holed from the rollover impact. The driver's side window, the third window on the left, the third window on the right, and the moon roof were disintegrated. The damage to the driver's window and the third window on the left was due to downward forces from the roof, while the damage to the right side window and moon roof was due to ground contact. The driver's mirror had been knocked off. There was blood found in several spots near the driver's seat.



Figure 7. Roof damage



Figure 8. Maximum vertical crush

Manual Restraints - 2006 Honda CR-V

The 2006 Honda CR-V was configured with manual 3-point lap and shoulder belts for each seating position. Both front seat safety belts were equipped with buckle pretensioners and adjustable anchorage adjustments. The driver anchorage adjustment was between the middle and full down position; the front right passenger's was in the full down position. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). At the time of the vehicle inspection, the driver's retractor was locked in the used position as a result of pretensioner actuation. There was 3 cm (1.2 in) of compression as compared to the front right seat pretensioner (**Figure 9**). The remaining safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR).



Figure 9. Driver's compressed seat belt latch

Supplemental Restraint Systems - 2006 Honda CR-V

The 2006 Honda CR-V was equipped with dual-stage frontal air bags and safety belt pretensioners for the driver and front right passenger positions, front seat back mounted side air bags, and side curtain air bags that provided protection for both the first and second rows of the vehicle.

The frontal air bags and the driver's seat back mounted side air bag did not deploy.

The front right passenger's seat back mounted side air bag deployed during the rollover (**Figures 10-11**). The deployed air bag measured 26 cm (10.2 in) in height by 33 cm (13.0 in) in width. Two vent ports were located at the top and bottom leading edge of the air bag in the 9 o'clock position.



Figure 10. Front right passenger side air bag

Both side air curtains deployed during the rollover (**Figures 12-14**). The deployed curtains measured 155 cm (61.0 in) in length. They extended from the A-pillar to the C-pillar longitudinally and provided protection for front and rear seat occupants. They extended vertically from the roof cladding downward to just below the side window frames. They were attached at the A-pillar by an 11 cm (4.3 in) tether and at the D-pillar by a 30 cm (11.8 in) tether.



Figure 11. Front right side air bag (exterior view)



Figure 12. Right side air curtain



Figure 13. Left side air curtain



Figure 14. Left side air curtain. Outside view at driver's location.

Event Data Recorder

The EDR information was provided by the vehicle manufacturer. The EDR data confirmed the deployment of the air bags; however, there was a discrepancy regarding the left side curtain air bag. In one section of the EDR report, it was recorded that the left side curtain did not deploy, whereas, in another section it confirmed that the deployment command was given. There was also conflicting data regarding when the driver's pretensioner actuated, but it was determined during the vehicle inspection that they actuated during the rollover event.

The following information was learned from the EDR data:

Frontal and Side Air Bags	Driver side	Front right passenger side
Seat belt status:	Belted	Unbelted
Driver seat position sensor status:	Far	NA
Pretensioner Fire:	Yes	No
Seat weight sensor (front air bag):	NA	Empty/Inhibit
OPDS status (side air bag):	NA	Empty/Fire
Front air bag deployment status:	Pretensioner only	No fire
Side air bag deployment status:	No fire	Deploy
Curtain air bag deployment status:	No fire	Deploy
Safing "ON" time:	12.288 ms	
Delta T "ON" time:	No trigger	30.208 ms
Front crash sensor "ON" time:	No trigger	No trigger
SRS ECU "ON" time (front):	No trigger	No trigger
Delta V End	9.18- 10.71 km/h (5.71-6.658 mph)	

In Trigger 1, the right side curtain air bag deployed and the driver's pretensioner actuated. In Trigger 2, the left side curtain deployed. The report showed a maximum roll angle of 66.625 degrees and a minimum roll angle of -131.2 degrees.

EDR Rollover Data	Trigger 1
Type and roll direction	Trigger – roll right
Safing Sensor ON time before Trigger 1	-16.384 ms
ON time	0 ms
Decision logic	Hard soil
Rate at Main ON	-109.2 deg/s
Angle at Main ON	-2.05 deg

EDR Rollover Data	Trigger 2
Type and roll direction	Trigger – roll right
Safing Sensor ON time before Trigger 2	-1024 ms
ON time	0 ms
Decision logic	Normal
Rate at Main ON	-93.6 deg/s
Angle at Main ON	-37.925 deg

OCCUPANT DEMOGRAPHICS - 2006 Honda CR-V

Driver

Age/Sex: 37/Male

Seated Position: Front left

Seat Type: Bucket

Height: 170 cm (67 in)

Weight: 59 kg (130 lbs)

Pre-existing Medical Condition: None noted

Alcohol/Drug Involvement: Had been drinking. BAC of 0.08 per police.

Driving Experience: Unknown

Body Posture: Normal, upright

Hand Position: Both hands likely on steering wheel

Foot Position: Right foot on brake, left on floor

Restraint Usage: Lap and shoulder belt available, used

Air bag: Driver's frontal and seatback mounted side air bags did not deploy. The left side curtain bag deployed.

Driver Kinematics

The 37-year-old male driver was likely seated in an upright posture. He was restrained by the 3-point manual lap and shoulder belt. The seat track was adjusted to the mid position. The driver's seat back angle was 17 degrees from vertical and the seat bottom angle was 11 degrees from horizontal. There were no indications of any braking. At impact with the guardrail, the driver initiated a forward and slightly left trajectory. The driver likely sprained and contused his left thumb at this time. The guardrail impact appears to have been relatively minor. As the vehicle began a counterclockwise rotation, the driver shifted to the right. As the vehicle tripped over onto its right side, the side curtain air bags deployed. The driver's safety belt pretensioner also appears to have actuated during the rollover. The driver was held in place by the belt system during the rollover. He was able to exit the vehicle under his own power. He was transported by ground ambulance to a local hospital.



Figure 15. Driver's seated position

OCCUPANT INJURIES - 2006 Honda CR-V

Driver: Injuries obtained from emergency room records.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Sprain, left thumb	750402.1,2	Steering wheel rim	Probable
Contusion, left thumb	790402.1,2	Steering wheel rim	Probable

Attachment 1. Scene Diagram

