

Side Air Curtain Investigation / Vehicle Rollover
Dynamic Science, Inc. / Case Number: DS05014
2001 Volkswagen Jetta
Colorado
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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 Curtain Protection air bag system installed in a 2001 Volkswagen Jetta four-door sedan. The air bags extend from front pillar to the rear seat pillar. The 2001 Volkswagen Jetta GL four-door sedan was being driven by a restrained 19-year-old male. The front right seat was occupied by a restrained 20-year-old male. The second row right seat was occupied by an unrestrained 19-year-old male. The Jetta was traveling eastbound on an interstate roadway at an unknown speed. For unknown reasons, the Jetta drifted off the right side of the roadway. The driver corrected and steered back onto the roadway. The driver overcorrected to the right and the vehicle began a clockwise rotation. The vehicle left the roadway and began a lateral skid with the left side leading. The vehicle tripped at some point and overturned eight quarter turns before coming to rest on its wheels. During the rollover sequence the rear seat occupant was ejected and fatally injured.				
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BACKGROUND

This on-site investigation focused on the performance of the Side Curtain Protection air bag system installed in a 2001 Volkswagen Jetta four-door sedan. The curtain-type air bags deploy in side collisions to protect the heads of occupants in both the front and rear seats. The air bags extend from front pillar to the rear seat pillar. The 2001 Volkswagen Jetta GL four-door sedan was being driven by a restrained 19-year-old male. The front right seat was occupied by a restrained 20-year-old male. The second row right seat was occupied by an unrestrained 19-year-old male. The Jetta was traveling eastbound on an interstate roadway at an unknown speed. For unknown reasons, the Jetta drifted off the right side of the roadway. The driver corrected and steered back onto the roadway. The driver overcorrected to the right and the vehicle began a clockwise rotation. The vehicle left the roadway and began a lateral skid with the left side leading. The vehicle tripped at some point and overturned eight quarter turns before coming to rest on its wheels. During the rollover sequence the rear seat occupant was ejected.

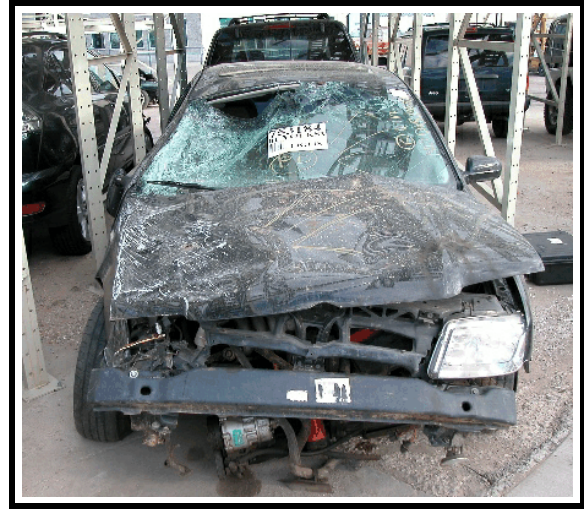


Figure 1. Case vehicle, 2001 Volkswagen Jetta

This Side Air Bag investigation was identified by NHTSA during a review of GES police reports. DSI was faxed a copy of the police report on September 8, 2005 with instructions to locate the case vehicle. DSI located and obtained permission to inspect the case vehicle on September 8, 2005. The vehicle and scene inspections took place during the week of September 12, 2005.

SUMMARY

Crash Site

This single vehicle crash occurred on the roadside of a divided two-lane interstate highway. The asphalt roadway was straight and level. There were no roadway defects. The roadway is bordered on the right by a solid white line followed by a concrete shoulder that has a formed in rumble strip. A depressed, grass covered median separates the eastbound and westbound lanes. South of the roadway there is a slight inclined, grass covered embankment. The speed limit is 121 km/h (75 mph).

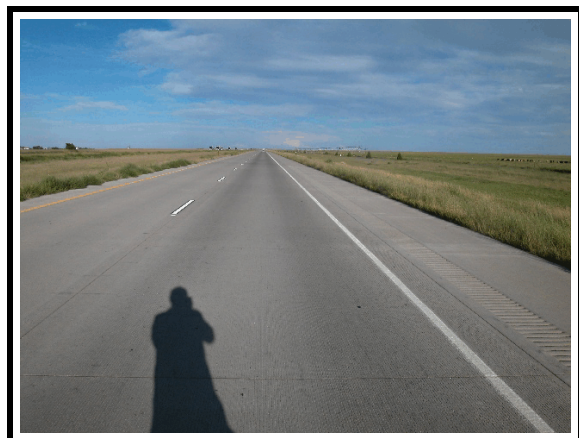


Figure 2. Overview of vehicle travel path—looking east

Pre-Crash

The case vehicle is a 2001 Volkswagen Jetta GL four-door sedan that was being driven by a 19-year-old male. The driver was wearing the manual 3-point lap and shoulder belt. The front right seat was occupied by a 20-year-old male who was wearing the manual 3-point lap and shoulder belt. The second row right seat was occupied by an unrestrained 19-year-old male.

The Volkswagen was traveling eastbound at an unknown speed. The police report indicates that the driver had been drinking. For unknown reasons, the Volkswagen drifted off the right side of the roadway.

Crash

The vehicle traveled 42 m (138 ft) before the driver corrected and steered back onto the roadway. The vehicle then traveled 51 m (166 ft) as the driver overcorrected to the right and the vehicle began a clockwise rotation. The vehicle left the roadway and began a lateral skid with the left side leading—leaving a 26 m (85 ft) furrow. The vehicle tripped at some point and overturned eight quarter turns while traveling 35 m (115 ft) in a southwest direction off the roadway (CDC=00TDDO2). During the rollover sequence, the rear seat occupant was ejected. Both front, seat-back mounted side air bags and both roof-rail mounted side air curtains deployed at this time. Both front seat belt pretensioners actuated during the rollover sequence. The frontal air bags did not deploy. The vehicle then came to rest facing west on its wheels.

Post-Crash

All three occupants of the Jetta were transported to a local hospital for treatment.

The driver arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

The front right occupant arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

The second row right occupant was found in a ditch near the crash scene. EMS personnel were dispatched at 0740 hours. This occupant sustained a LeFort III maxilla fracture, a liver contusion, fractures to right side ribs 7-9, and a lung contusion with pneumothorax. EMS personnel indicate that there was blood coming from the mouth, ears and nose. CPR was undertaken. Efforts to intubate were not successful due to the extensive facial trauma. An oral airway was inserted during transport. This occupant's pupils were fixed and dilated at all times and there was no neurological activity. His Glasgow Coma Scale (GCS) was 3, with no eye opening, no verbal response, and no motor response. This occupant expired at 0834 hours—approximately one hour post crash.

The case vehicle was towed from the scene due to damage and was later declared a total loss.

VEHICLE DATA -2001 Volkswagen Jetta

The 2001 Volkswagen Jetta four-door sedan was identified by the Vehicle Identification Number (VIN): 3VWSB69M01MXxxxxxx. The Volkswagen Jetta was equipped with a 2.0 liter four cylinder engine, automatic transmission, front wheel drive, power steering, tilt steering wheel, and front and rear disc brakes. The Jetta was configured with Goodyear Eagle LS P195/65R16 tires for the front right, left rear, and right rear. The front left was equipped with a Cavalier Accolade Plus P195/65R16. The manufacturer's recommend cold pressure was 241 kPa (35 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	3.2 mm (4/32 in)	No	None
LR	179 kPa (26 psi)	2.3 mm (3/32 in)	No	None
RR	207 kPa (30 psi)	0.8 mm (1/32 in)	No	None
RF	Flat	2.3 mm (3/32 in)	No	None

The front seating positions in the 2001 Volkswagen Jetta were equipped with fabric covered bucket seats with adjustable head restraints. The seats were adjusted to the rear most track position. The driver's seat back angle was 63 degrees and the seat bottom angle was 19 degrees. The front right seat back angle was 72 degrees and the seat bottom angle was 19 degrees. The rear seat positions were configured with a fabric covered bench seat with folding backs. There were adjustable head restraints for each of the three seat positions. The seat back angle was 66 degrees and the seat bottom angle was 17 degrees.

VEHICLE DAMAGE

Exterior Damage - 2001 Volkswagen Jetta

Damage Description: The 2001 Volkswagen Jetta sustained moderate rollover damage to the left side, right side and top of the vehicle. There was direct contact to the hood, windshield, roof, right quarter panel and left quarter panel. There was 5.0 cm (1.9 in) crush at the right A pillar. The front bumper fascia had come off and the bumper backing bar was rotated upward. Both front tires were flattened. Grass was found in the bead of the left rear tire.

CDC: 00TDDO2

Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown



Figure 3. Front left, 2001 Volkswagen Jetta

Interior Damage - 2001 Volkswagen Jetta

The 2001 Volkswagen Jetta sustained moderate interior damage as a result of passenger compartment intrusion and occupant contacts. The right side A pillar, roof, and windshield header sustained vertical intrusion. The windshield was broken and holed. The right side windows were all disintegrated. The center console was dislodged by occupant contact. The control stalk on the right side of the steering wheel was broken off. The right rear door/window frame was deformed outward due to occupant ejection.

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
Front right	A pillar	5.0 cm (1.9 in)	Vertical
Front right	Windshield header	8.0 cm (3.1 in)	Vertical
Front right	Roof	8.0 cm (3.1 in)	Vertical
Front right	Roof side rail	≥ 3.0 cm (1.2 in) to < 8.0 cm (3.1 in)	Vertical

MANUAL RESTRAINT SYSTEMS - 2001 Volkswagen Jetta

The Volkswagen Jetta was configured with manual 3-point lap and shoulder belts for both front positions and all three rear seat positions. The front seat restraints were configured with adjustable shoulder belt upper anchorages that were in 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).

Supplemental Restraint System - 2001 Volkswagen Jetta

The Volkswagen Jetta was equipped with frontal air bags for the driver and front right passenger positions. The driver's air bag was housed in the steering wheel hub. The front right passenger's air bag was housed at the mid point of the instrument panel. There were no frontal air bag deployments.

The Jetta was also equipped with side impact head protection air curtains for the front and rear seat positions and side torso protection air bags for the front seat positions. Both the side air curtains and side air bags deployed during the rollover sequence. The side air curtains deployed from the roof rail cladding and extended from the A pillar to the C pillar. The curtain was 185.0 cm (72.8 in) long and measured 33.0 cm (12.9 in) high at its highest point. There were three stitches at the top of the curtain that ran its entire length. There were a total 21 folds at the highest point.



Figure 4. Driver's side air curtain

The side air bags were mounted in the respective front seat backs. The air bags measured 27.0 cm (10.6 in) forward from the seat back and were 55.0 cm (21.6 in) in height. There was no damage to either the curtains or the air bags.



Figure 5. Exterior view, right side air curtain for front and rear seats



Figure 6. Front right occupant's side air curtain and side air bag

OCCUPANT DEMOGRAPHICS - 2001 Volkswagen Jetta

	Driver	Occupant 2
Age/Sex:	19/Male	20/Male
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat, adjusted to the rear most track position	Fabric covered bucket seat, adjusted to the rear most track position
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	Yes, not tested	Yes, not tested
Driving Experience:	Unknown	NA
Body Posture:	Presumed upright	Presumed upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted frontal air bag, did not deploy. Side air curtain, deployed. Side air bag, deployed.	Mid mount frontal air bag, did not deploy. Side air curtain, deployed. Side air bag, deployed.

	Occupant 3
Age/Sex:	19/Male
Seated Position:	Second row right
Seat Type:	Fabric covered bench seat
Height:	Unknown
Weight:	68 kg (150 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	NA
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	Side air curtain, deployed.

OCCUPANT INJURIES - 2001 Volkswagen Jetta

Driver: Transported from the scene by ambulance. Arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

Front right occupant: Transported from the scene by ambulance. Arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

Second row right occupant: Injuries obtained from pre-hospital care report, radiology report, and emergency room records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
LeFort III maxilla fracture	250808.3,4	Ground	Possible
Liver contusion	541810.2,1	Door panel	Possible
Fracture to right ribs 7-9	450220.2,1	Door panel	Probable
Right lung contusion with pnemothorax	441406.3,1	Door panel	Probable
Abrasions, back, right flank	590202.1,1	Ground	Probable
Abrasions, back, left flank	590202.1,2	Ground	Probable
Head trauma without recovering consciousness	115099.7,0	Ground	Possible

OCCUPANT KINEMATICS - 2001 Volkswagen Jetta

Driver Kinematics

The 19-year-old driver of the case vehicle was seated in an upright manner and was restrained by the 3-point lap and shoulder belt. The fabric covered bucket seat was adjusted to the rear most track position. The driver's seat back angle was 63 degrees and the seat bottom angle was 19 degrees. It appears likely that the driver's right foot was on the brake and he had both hands on the steering wheel. After the vehicle initially drifted off the right side of the roadway, the driver steered the vehicle left and back onto the road. The driver then steered again sharply to the right. As the vehicle began a clockwise rotation and departed the roadway again, the driver likely tried an additional steering maneuver, but was unsuccessful. The case vehicle rotated until reaching an angle approximately 90 degrees from his travel path. The vehicle tripped and rotated eight quarter turns about its longitudinal axis. The driver likely contacted the left door and may have loaded the center console, but he appears to have remain generally in place until the vehicle came to rest on its wheels. The police report indicated that he sustained "B" type non-incapacitating injuries. He was transported from the scene by ambulance. He arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

Front Right Occupant Kinematics

The 20-year-old front right occupant was seated in an upright manner and was restrained by the 3-point lap and shoulder belt. The fabric covered bucket seat was adjusted to the rear most track position. The front right seat back angle was 72 degrees and the seat bottom angle was 19 degrees. This occupant's hands and feet positions are not known. After the vehicle initially drifted off the right side of the roadway, the driver steered the vehicle left back onto the road. The driver then steered again sharply to the right. This occupant likely pitched somewhat from side to side as the steering maneuver took place. As the vehicle began a clockwise rotation and departed the roadway again, the driver likely tried an additional steering maneuver but was unsuccessful. The case vehicle rotated until reaching an angle approximately 90 degrees from his travel path. The vehicle tripped and rotated eight quarter turns about its longitudinal axis. The front right occupant likely contacted the right door and may have loaded the center console, but he appears to have remained generally in place until the vehicle came to rest on its wheels. The police report indicated that he sustained "B" type non-incapacitating injuries. He was transported from the scene by ambulance. He arrived at the hospital alert and properly oriented. He refused any treatment and was discharged at 0820 hours.

Second Row Right Occupant Kinematics

The 19-year-old second row rear seat occupant was seated in an unknown manner on the fabric covered bench seat and was not restrained. The seat back angle was 66 degrees and the seat bottom angle was 17 degrees. This occupant's hands and feet positions are not known. After the vehicle initially drifted off the right side of the roadway, the driver steered the vehicle left back onto the road. The driver then steered again sharply to the right. This occupant likely pitched somewhat from side to side as the steering maneuver took place. As the vehicle began a clockwise rotation and departed the roadway again, the driver likely tried an additional steering maneuver but was unsuccessful. The case vehicle rotated until reaching an angle approximately 90 degrees from his travel path. The vehicle tripped and rotated eight quarter turns about its longitudinal axis. Based on the loading and contact evidence found on the right rear door/window frame, it appears that this occupant struck the door side panel with the right side of his chest (causing the right side rib fractures and lung injury) and then was ejected through the right rear window. Given the location of this occupant post-crash and the final rest location of the vehicle, it appears that this occupant was fully ejected between the third and fourth quarter turns. As he was being ejected it appears that his head became trapped between the ground and the vehicle at some point causing the LeFort III fracture and head trauma. This occupant was transported to local hospital and was pronounced dead at 0834 hours—approximately one hour post crash.



Figure 7. Right rear door, interior view

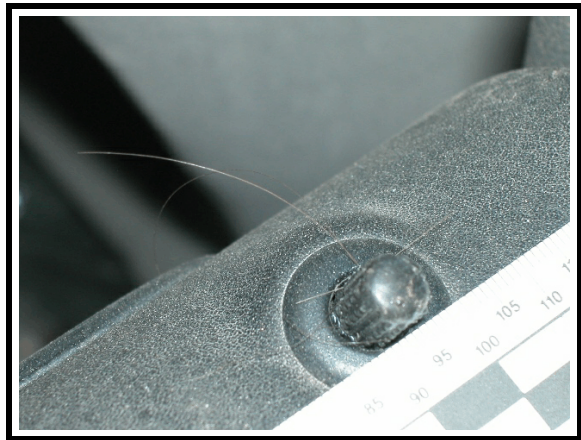


Figure 8. Hair trapped in door lock



Figure 9. Exterior view of right rear door

Attachment 1. Scene Diagram

