Remote Combination ODI Side Curtain Non Deployment Investigation
Dynamic Science, Inc. (DSI), Case Number 2007-75-041J
2005 Volkswagen Touareg
Colorado
April 2007

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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 Remote Combination ODI Side Curtain Non Deployment Investigation focused on the side curtain air bags installed in a 2005 Volkswagen Touareg. This single-vehicle rollover crash occurred in April 2007 at 0650 hours. The subject vehicle was being driven by a 37-year-old male that was traveling eastbound on a curved, two-lane roadway. To the left of the roadway, there was a steep descending embankment. The driver lost control of his vehicle and it departed the roadway on the left side. The vehicle slid down the embankment before striking a low-lying boulder with its left side. The vehicle then rolled four quarter turns. The driver was ejected at some point during this initial roll. The subject vehicle rolled two more quarter turns before coming to rest on its roof facing east. During the crash event, the right side curtain air bag deployed. There were no other air bag deployments. The driver sustained a skull fracture, multiple brain injuries, a rib fracture, and multiple contusions, abrasions, and lacerations. The Touareg was towed from the scene due to damage.

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BACKGROUND

Figure 1. Subject vehicle, 2005 Volkswagen Touareg

This single-vehicle rollover crash occurred in April 2007 at 0650 hours. The subject vehicle was a 2005 Volkswagen Touareg 4-door sport utility vehicle that was being driven by an unrestrained 37-year-old male (**Figure 1**). The vehicle was equipped with electronic stability control, 4-wheel ABS, a driver's frontal air bag, a right passenger frontal air bag, seat mounted side air bags, and left/right side curtain air bags. The Touareg was traveling eastbound on a curved, two-lane roadway. To the left of the roadway, there was a steep descending embankment. The driver lost control of his vehicle and it departed the roadway on the left side. The vehicle slid down the embankment for 19.6 m (64.4 ft) before striking a low-lying boulder with its left side. The vehicle then began a left side leading rollover and rolled four quarter turns for 24.9 m (82.0 ft). The driver was ejected at some point during this initial roll. The vehicle rolled two more quarter turns for 3.6 m (28.4 ft) before coming to rest on its roof facing east. During the rollover, the right side curtain air bag deployed. There were no other air bag/side curtain deployments. The driver sustained a skull fracture, multiple brain injuries, a rib fracture, and multiple contusions, abrasions, and lacerations. The Touareg was towed from the scene due to damage.

This Remote Combination ODI Side Air Curtain Non Deployment Investigation was initiated in response to a Field Service Notification (FSN) from the Colorado National Automotive Sampling System (NASS) team reporting the non deployment of a side curtain air bag in a 2005 Volkswagen Touareg during a rollover crash.

Summary

Crash Site

Figure 2. Eastbound approach to area of roadway departure

This single vehicle crash occurred on a two-lane, curved mountain road (**Figure 2**). The gravel/dirt road curved to the right and had an uphill grade. It was dark at the time of the crash. There were no streetlights present. The posted speed limit was 16 km/h (10 mph). To the left of the roadway (north) there was a steep embankment. The scene schematic is included as Attachment 1 at the end of this narrative report.

Pre Crash

The 2005 Volkswagen Touareg was traveling eastbound up the mountain road. The 37-year-old unrestrained male driver entered the right hand curve and lost control of the vehicle. The vehicle crossed through the westbound lane and departed the roadway on the left (**Figure 3**).

Figure 3. Area of roadway departure (east)

Crash

The vehicle traveled down the embankment for 19.6 m (64.4 ft) before engaging a low-lying boulder with its left side (**Figure 4**). The vehicle tripped, then rolled four quarter turns with its left side leading for 24.9 m (82.0 ft). The driver was ejected through the sun roof at some point during this initial roll, probably between the second and third quarter turns. The ejection point was based on the area of the initial overturn relative to the ejected driver's final rest. The Touareg rolled two more quarter turns for 3.6 m (28.4 ft) before coming to rest on its roof facing east. During the crash, the right side air curtain deployed. There were no other air bag/side curtain deployments.

Figure 4. Path down embankment (north)

Post Crash

Emergency personnel arrived on the scene and transported the driver to a local trauma center via ground ambulance. As a result of being ejected, the driver sustained severe injuries and was hospitalized for 12 days. The vehicle was towed due to damage.

Vehicle Data - 2005 Volkswagen Touareg

The 2005 Volkswagen Touareg was identified by the Vehicle Identification Number (VIN): WVGZG77L15xxxxxx. The Volkswagen Touareg was a five passenger, 4-door sport utility vehicle that was equipped with a 3.2 liter, 6-cylinder engine, an automatic transmission, all-wheel drive, electronic stability control, four-wheel ABS, and a height-adjustable/telescopic steering column. The Touareg was configured with Pirelli Scorpion STR P225/60R17 tires. The vehicle manufacturer's recommended cold tire pressure was 248 kPa (36 psi) for the front and 303 kPa (44 psi) for the rear. The tire manufacturer's maximum tire pressure was 303 kPa (44 psi). The specific tire information was at the time of the inspection follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	7 mm (0.3 in)	No	Tire debeaded
LR	131 kPa (19psi)	8 mm (0.3 in)	No	None
RR	172 kPa (25 psi)	7 mm (0.3 in)	No	None
RF	Tire Flat	8 mm (0.3 in)	No	Tire debeaded

The seating in the Touareg was configured with front bucket seats with adjustable head restraints and a rear split bench seat with folding backs. The driver's seat was located at the rear most track position. The front right passenger seat was located between the middle and rear most track position.

Figure 5. Overview of rollover damage

Vehicle Damage

Exterior Damage - 2005 Volkswagen Touareg

The 2005 Volkswagen Touareg sustained moderate top damage as a result of the rollover event (**Figures 5-6**). The vehicle rolled a total of six quarter turns with the Touareg coming to rest on its roof. There was direct contact damage to the roof and both sides of the vehicle. The left rear door was jammed shut. The windshield was cracked from impact forces but remained in place. The glazing was disintegrated for the left front window, the right rear window, the second right rear window, the sun roof and the backlight.

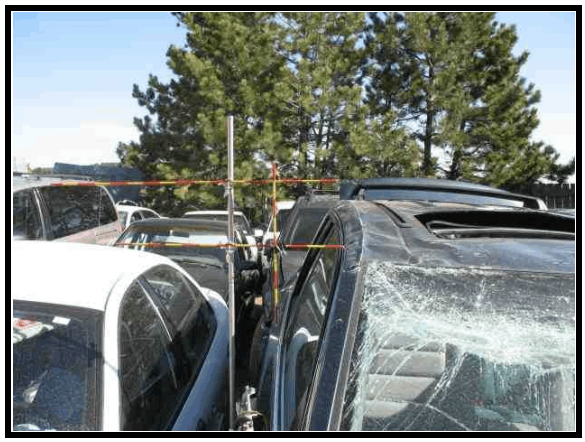

Figure 6. Area of maximum crush

The maximum vertical crush was located at the right windshield header and measured 7 cm (2.8 in). The Collision Deformation Classification (CDC) for the rollover event was 00TDDO3. The maximum lateral crush was located at the right A-pillar and measured 2 cm (0.8 in).

Interior Damage - 2005 Volkswagen Touareg

The 2005 Volkswagen Touareg sustained minor interior damage as a result of passenger compartment intrusion and occupant contacts (**Figure 7**). There were occupant related scuffs located on the roof console, the left side roof rail, the left A pillar, the roof and the sunroof.

The specific passenger compartment intrusions were documented as follows:

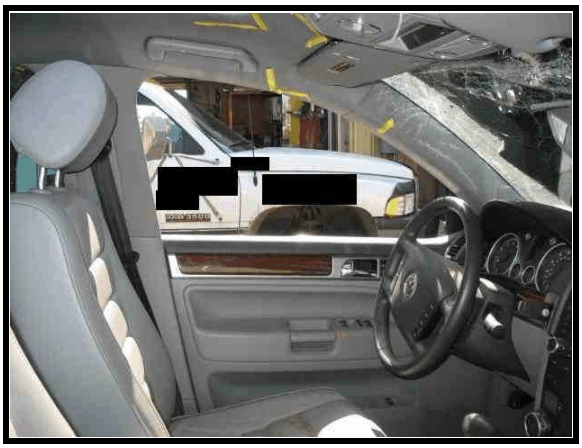

Figure 7. Overview of occupant contacts

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
First row right	Windshield	12 cm (4.7 in)	Vertical
First row middle	Windshield	9 cm (3.5 in)	Vertical
First row middle	Other interior component	9 cm (3.5 in)	Vertical
First row middle	Windshield header	8 cm (3.1 in)	Vertical
First row left	Roof	7 cm (2.8 in)	Vertical
First row middle	Other interior component	7 cm (2.8 in)	Vertical
First row left	Windshield header	7 cm (2.8 in)	Vertical
First row right	Windshield header	7 cm (2.8 in)	Vertical
First row right	Roof	6 cm (2.4 in)	Vertical
First row left	Windshield	4 cm (1.6 in)	Vertical
First row middle	Roof	>=3 to < 8 cm (>=1.2 to < 3.1 in)	Vertical

Manual Restraints - 2005 Volkswagen Touareg

The 2005 Volkswagen Touareg was configured with 3-point manual lap and shoulder belts for each seating position. The front seats were equipped with retractor pretensioners and seat belt load force limiters. The second row outboard seats were equipped with retractor pretensioners. The driver was unrestrained. The driver's belt was located in the stowed position at the time of the vehicle inspection.

The outboard seats were equipped with adjustable D rings. The driver's seat D ring was in the full up position. The front right seat D ring was in the full down position.

The vehicle was equipped with Lower Anchors and Tethers for Children (LATCH) for the second row outboard seats.

Supplemental Restraint Systems - 2005 Volkswagen Touareg

The 2005 Volkswagen Touareg was equipped with dual-stage frontal air bags and safety belt retractor pretensioners. The Touareg was also equipped with seat mounted side air bags and left/right side curtain air bags.

The side curtain air bags were designed to deploy during side impacts. There were four remote sensors, with two of the sensors located in the lower portion of the front doors and two of the sensors located at the belt line level of the rear doors. In **Figure 8**, items 6 and 7 are sensors for lateral impact acceleration.

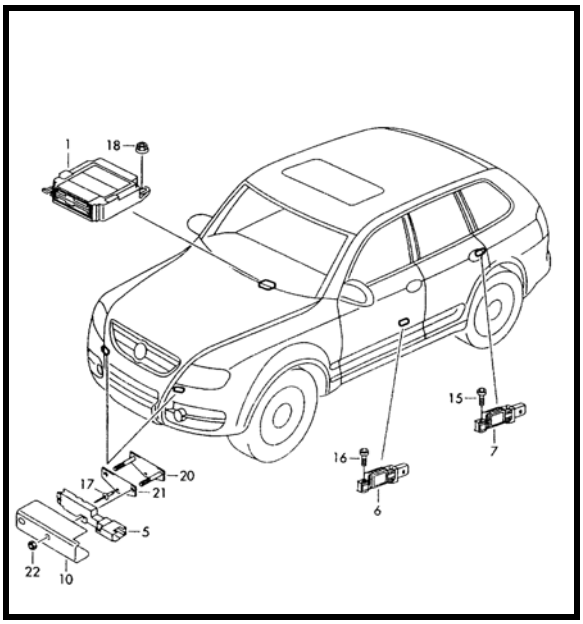

Figure 8. Remote sensor locations

The side curtain air bags were designed to deploy during side impacts and rollovers. For rollover events, the curtains are controlled by on-board sensors that are integrated with the vehicle Electronic Stability Program (ESP). There are two sensors, according to Volkswagen, one to detect a lateral rollover and one to detect a vertical rollover.

During the rollover event, the right side curtain air bag deployed (**Figure 9**). There were no other air bag deployments.

Figure 9. Right side air curtain

According to the manufacturer the side curtain air bags are designed to deploy in rollover situations. The inspection revealed no evidence as to why the left side curtain air bag did not deploy.

OCCUPANT DEMOGRAPHICS - 2005 Volkswagen Touareg

	Driver
Age/Sex:	37/Male
Seat Position:	Front left
Seat Type:	Bucket
Height:	185 cm (73 in)
Weight:	98 kg (216 lbs)
Alcohol/Drug Involvement:	None
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	Driver's air bag did not deploy. Left side curtain air bag did not deploy.

OCCUPANT INJURIES

Driver: Injuries obtained from post-ER medical records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Vault skull fracture, closed	150402.2,5	Ground	Certain
Bilateral small cerebrum contusions	140622.3,3	Ground	Certain
Right cerebrum hematoma, epidural	140632.4,1	Ground	Certain
Left parietal cerebrum hematoma, subdural, small	140652.4,2	Ground	Certain
Left brain swelling	140662.3,2	Ground	Certain
Right brain swelling	140662.3,1	Ground	Certain
Left rib fracture, 9th rib, posteriorly	450212.1,2	Seat back support	Probable
Right scalp laceration	190602.1,1	Sunroof/components	Probable
Right eyelid contusion	297402.1,1	Sunroof/components	Probable
Left cerebrum subarachnoid hemorrhage	140684.3,2	Ground	Certain
Right cerebrum subarachnoid hemorrhage	140684.3,1	Ground	Certain
Chest abrasion	490202.1,9	Ground	Probable
Bilateral lower leg abrasions	890202.1,3	Ground	Certain
Bilateral lower leg contusions	890402.1,3	Ground	Certain

OCCUPANT KINEMATICS

Driver Kinematics

The 37-year-old male driver was seated in an unknown posture. He was not wearing the manual 3-point safety belt, based on the fact that he was fully ejected. The bucket seat was in the rear most track position. The seat back was slightly reclined.

Figure 10. Contact path to sun roof

As the Volkswagen Touareg began its left side roll, the driver was displaced to the left and upward. There were scuff marks along the left A pillar area, leading onto the interior roof, and toward the sun roof. During the rollover, the sun roof disintegrated upon contact with the ground. The driver was fully ejected through the sun roof (**Figure 10**), probably during the second and third quarter turns. The driver sustained a skull fracture, multiple brain injuries, a rib fracture, and multiple contusions, abrasions, and lacerations. He was transported to a local trauma center where he arrived with a GCS of 12. He was hospitalized for 12 days.

Attachment 1. Scene Diagram