Certified Advanced 208-Compliant Air Bag Investigation
Dynamic Science, Inc./Case Number: 2006-79-094J
2006 Volkswagen Passat
California
June 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

This remote investigation focused on the performance of the Certified Advanced 208-Compliant air bag system in a 2006 Volkswagen Passat. This single vehicle crash occurred in June 2006 at 0250 hours in an urban area of California. The crash occurred on a sidewalk adjacent to a five lane, two-way undivided roadway. The case vehicle was a 2006 Volkswagen Passat being driven by a restrained 29-year-old male. There were no other passengers on-board. The driver was traveling west in lane one of five, and may have fallen asleep while driving, resulting in his vehicle departing the roadway to the right. The front of the Passat struck a light pole on the north sidewalk. The impact severity was moderate and resulted in the deployment of the driver's front air bag and actuation of his seat belt pretensioner. The vehicle continued traveling west and the front of the case vehicle impacted a second, smaller pole that was stationed next to a small tree/shrub. The Passat knocked the pole over and continued west until the front end struck a large wooden utility pole. The impact severity from this crash event was severe and resulted in extensive engine damage. The case vehicle came to final rest near the utility pole, facing west. The driver was severely injured in the crash, and was transported by ambulance to a trauma center. He was hospitalized for 15 days with serious internal and spinal injuries. The Volkswagen Passat was towed from the crash scene and was later declared a total loss.

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Background:

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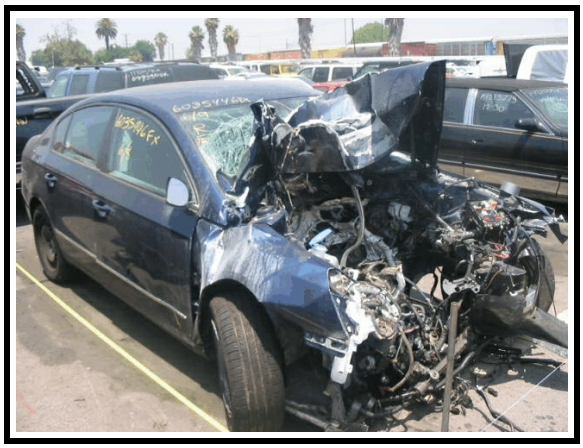

Figure 1. Front/Right - 2006 Volkswagen Passat

The case vehicle was a 2006 Volkswagen Passat being driven by a restrained 29-year-old male. There were no other passengers on-board.

The driver was traveling west in lane one of five, and may have fallen asleep while driving, resulting in his vehicle departing the roadway to the right. The front of the Passat struck a light pole on the north sidewalk. The impact severity was moderate and resulted in the deployment of the driver's front air bag and actuation of his seat belt pretensioner. The vehicle continued traveling west and the front of the case vehicle impacted a second, smaller pole that was stationed next to a small tree/shrub. The Passat knocked the pole over and continued west until the front end struck a large wooden utility pole. The impact severity from this crash event was severe and resulted in extensive engine damage. The case vehicle came to final rest near the utility pole, facing west.

The driver was severely injured in the crash, and was transported by ambulance to a trauma center. He was hospitalized for 15 days with serious internal and spinal injuries. The Volkswagen Passat was towed from the crash scene and was later declared a total loss.

This crash was identified by NHTSA and was assigned to DSI on August 10, 2006. The crash was initially researched in 2006 by a National Automotive Sampling System (NASS) team. The NASS data was used for this report. In some areas, the NASS data was either not complete or not detailed enough to be able to be used to form conclusions regarding this crash and the resulting injuries to the driver.

SUMMARY

Crash Site

This single vehicle crash occurred in June 2006 at 0250 hours in an urban area of California. The crash occurred on a sidewalk adjacent to a five lane, two-way, undivided roadway. In the pre-crash area, this street is comprised of two westbound lanes, two eastbound lanes, and a center left turn only lane. In the area where the case vehicle departed the roadway, the center lane becomes a left-turn-only lane for eastbound vehicles. This left-turn-only lane is separated from westbound traffic by a raised center strip median. The westbound travel lanes are separated from the sidewalk by a curb of standard height. The sidewalk was composed of concrete. There were three poles involved in this crash. The first was a non-breakaway steel light pole with a diameter of 20.3 cm (8.0 in), a height of 9.1 m (30.0 ft), and a 122.0 cm (4.0 ft) long luminaire arm. The second was a steel support pole with a diameter of 6.0 cm (2.4 in). The third was a wooden power pole with a diameter of 39.0 cm (15.3 in). The distance between the first pole and second pole was 11.5 m (38.0 ft). The distance between the second pole and the third pole was 5.1 m (17.0 ft).

Figure 2. Approach of case vehicle (west)

Figure 3. Impacted light post (foreground), pole and wooden utility pole (background)

The travel lanes were composed of asphalt and there was an uphill grade for westbound vehicles. At the time of the crash, the travel lanes were dry. The crash occurred during the early morning hours and it was still dark out. The investigating officer reported that the roadway was illuminated by single over hanging globe light standards. The nearest light standard was located 71.0 ft (21.6 m) east of the crash scene. There were no adverse weather conditions present and no visual obstructions that would have played a factor in this collision. The posted speed limit was 64 km/h (40 mph).

Pre-Crash

The case vehicle was a 2006 Volkswagen Passat being driven by a restrained 29-year-old male (188 cm/74 in, 82 kg/180 lb). There were no other occupants or cargo in the vehicle.

The driver was traveling west in lane one of five, and may have fallen asleep while driving, resulting in his vehicle departing the roadway to the right.

Crash

The driver of the case vehicle reported that he was on his way home and was tired. He said he decided to pull over to the side of the road, but instead went off the north side of the street and struck the first pole. Given the length of the crash scene and the severity of the vehicle damage, it is not likely that the driver was pulling over in order to stop the Passat when the case vehicle left the roadway. When the Passat departed the travel lanes, the front of the case vehicle impacted the first pole. The pole was severed at the base and fell to the ground. The impact severity was moderate and resulted in the deployment of the driver's front air bag and actuation of his seat belt pretensioner. The vehicle continued traveling west and the front of the case vehicle impacted a second, smaller pole that was positioned next to a small tree/shrub. The Passat knocked the pole over and continued west until the front end struck a wooden utility pole. The impact severity from this crash event was severe and resulted in extensive engine damage. The case vehicle came to final rest near the utility pole, facing west.

Figure 4. Impact with first pole

Figure 5. Struck second pole and path to impact with third pole

Post-Crash

The driver was severely injured in the crash, and was transported by ambulance to a trauma center. He was hospitalized for 15 days with serious internal and spinal injuries. The Volkswagen Passat was towed from the crash scene and was later declared a total loss.

Figure 6. Impact with third pole

The first steel pole was knocked down during the crash. According to the power company, it was replaced by an identical steel pole.

Vehicle Data - 2006 Volkswagen Passat

The 2006 Volkswagen Passat was identified by the Vehicle Identification Number (VIN): WVWAK73C86xxxxxx. The vehicle's digital odometer could not be read because there was no power to the instrument panel. The driver was unable to estimate the mileage. The case vehicle is a four-door sedan with front wheel drive and seating for five. It was equipped with a 2.0 liter 4-cylinder engine, six speed automatic transmission, front and rear disc anti-lock brakes with electronic brake distribution, electronic traction control via ABS and engine management, stability control and a tilt and telescoping steering wheel.

The Passat was equipped with advanced occupant protection systems including dual stage Certified Advanced 208-Compliant driver and front right passenger air bags with occupant sensors. The multi-stage air bags were certified by the manufacturer to meet the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The case vehicle was also equipped with dual front seat belt pretensioners, active front row head restraints, dual front row seat back mounted side air bags and front and rear side curtains. The second row outboard seat belts were also equipped with retractor pretensioners.

The 2006 Volkswagen Passat was equipped with Goodyear Eagle LS P215/55R16 tires. The vehicle manufacturer's recommended cold tire pressure was 228 kPa (33 psi) for the front and rear. The maximum tire pressure inflation for these tires was 340 kPa (50 psi). The Passat was equipped with a direct low tire pressure warning system that monitors all four tires. The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	310 kPa (45 psi)	8 mm (10/32 in)	Yes	None
LR	310 kPa (45 psi)	6 mm (8/32 in)	No	None
RR	310 kPa (45 psi)	6 mm (8/32 in)	No	None
RF	Flat	6 mm (8/32 in)	Yes	Tire debeaded; rim damaged

The front row seating in the 2006 Volkswagen Passat was configured with dual vinyl covered bucket seats. The seats were equipped with adjustable active head restraints that were not damaged. The second row was configured as a vinyl covered 60/40 bench seat with folding backs. All three second row seating positions were equipped with adjustable head restraints that were not damaged. The second row outboard seating positions were equipped with the lower anchor points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. There were child safety seat top tether anchor points located on the back of the seat backs, just below the bottom edge of the head restraints.

Vehicle Damage

Exterior Damage - 2006 Volkswagen Passat

Damage Description: The 2006 Volkswagen Passat sustained severe front end damage as a result of the impacts with the three poles. There was extensive engine damage. The hood was crumpled rearward and appears to have partially impacted the case vehicle's windshield, holing the glazing in the lower center section.

Figure 7. Front - 2006 Volkswagen Passat

The location of direct damage from the individual impacts was not documented due to overlapping damage. Crush profiles were not obtained. For the initial crash event between the Passat's front end and the first pole, the NASS researcher assigned a Collision Deformation Classification (CDC) of 12FDEW6. Given the diameter of the pole, it is unlikely the direct damage extended across the entire front end of the vehicle. It is also unlikely that the direct damage from this first crash event would have resulted in crush that extended into extent zone 6. It is more likely that the third impact to the large wooden pole caused the most damage and crush to the vehicle. This third event left the most distinctive crush pattern to the vehicle's front end, including a distinct outline of the shape of the pole near the center of the hood.

Figure 8. Right front tire & rim damage

CDC (Impact 1):	12FDEW6 (based on final appearance)	
(Impact 2):	12F99999	
(Impact 3):	12F99999	
Delta V (Impact 1):	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Interior Damage - 2006 Volkswagen Passat

The 2006 Volkswagen Passat sustained moderate interior damage due to occupant contacts, intrusion and normal air bag deployment related damage.

The front and second row seat belt retractor pretensioners actuated during the crash and were locked in place post-impact. The driver's seat belt was cut by fire/rescue personnel.

Figure 9. Windshield damage/intrusion

Figure 10. Front row intrusion

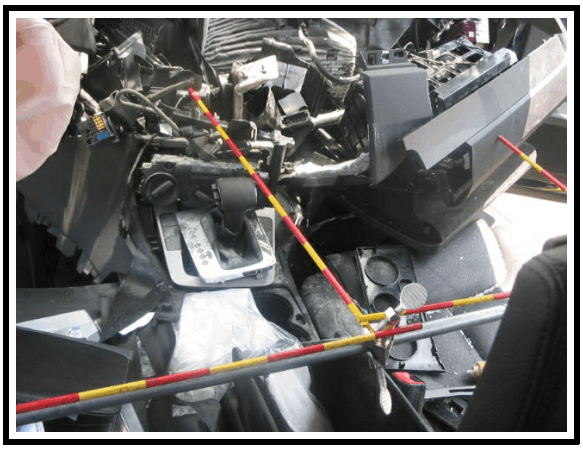

Figure 11. Center & Right instrument panel intrusion

There was integrity loss to the windshield. The glazing was in place and holed near the bottom center. The entire windshield was cracked due to impact forces and the hole appears to have been caused by contact with the damaged hood. The rearview mirror broke off its base, either due to impact damage or occupant contact. The vehicle's side doors all remained closed and operational.

There was longitudinal intrusion of the windshield and instrument panel. It appears that there were additional components that had intruded but the photographic documentation of the front row passenger compartment was not sufficient to be able to use for coding. The specific passenger compartment intrusions were documented as follows:

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
1M	Instrument panel	> = 8.0 to < 15.0 cm (3.1 - 5.9 in)	Longitudinal
1R	Instrument panel	> = 8.0 to < 15.0 cm (3.1 - 5.9 in)	Longitudinal
1M	Windshield	0 to < 8.0 cm (0 - 3.1 in)	Longitudinal
1R	Windshield	0 to < 8.0 cm (0 - 3.1 in)	Longitudinal

Manual Restraint Systems - 2006 Volkswagen Passat

The 2006 Volkswagen Passat was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front seat belts were equipped with an energy management feature, retractor pretensioners and anchorage adjustments. Both front row pretensioners actuated and were locked in place post-crash. The driver's safety belt was configured with a sliding latch plate and an emergency locking retractor (ELR). The left front anchorage adjustment was set to the full down position. The front right seat belt had a sliding latch plate and switchable ELR/Automatic Locking Retractor (ALR). The anchorage adjustment was set to the full up position. The second row seat belts were all equipped with sliding latch plates and switchable ELR/ALR retractors. The second row outboard safety restraints were equipped with retractor pretensioners that actuated during the crash.

Figure 12. Driver's seat belt, cut by fire/rescue personnel

The driver's seat belt was cut by fire/rescue personnel post-crash.

Active restraints - 2006 Volkswagen Passat

The front bucket seats in this vehicle come equipped with active head restraints that are designed to actuate in certain rear-end crashes. These are Reactive Head Restraints that automatically move up and forward during the crash and are actuated by the weight of the occupant in the seat. Neither restraint actuated during this collision, as there was no rear-end impact to the case vehicle.

Supplemental Restraint Systems - 2006 Volkswagen Passat

The 2006 Volkswagen Passat was equipped with advanced occupant protection systems. The systems consist of dual stage Certified Advanced 208-Compliant driver and front right passenger air bags with occupant sensors, front row seat back mounted side air bags and front and rear side curtains.

The driver, front right passenger and second row outboard seating positions were equipped with seat belt retractor pretensioners. During the initial impact with the first pole, the driver's front air bag deployed and all of the pretensioners actuated.

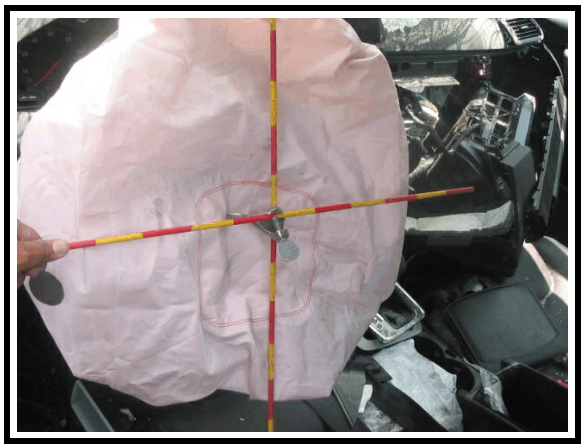

Figure 13. Deployed driver front air bag

The driver's front air bag was mounted in the center of the steering wheel hub. The NASS researcher did not document the air bag module cover flap configuration and flap measurements. The air bag was circular in shape. The diameter of the air bag is unknown. It is not known if the air bag had tethers. It appears from the photographs that there is at least one vent port, located near the 9 o'clock position. There was no damage to the air bag or air bag module cover flaps. There was a scuff to the lower left section of the air bag which may have been a cover flap transfer that occurred during the deployment.

The front right passenger air bag was a top instrument mount. There was no occupant seated in this position. The air bag was suppressed and did not deploy.

Occupant Demographics - 2006 Volkswagen Passat

	Driver
Age/Sex:	29/Male
Seated Position:	Front left
Seat Type:	Vinyl covered bucket seat
Height:	188 cm (74 in)
Weight:	82 kg (180 lb)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	No alcohol found in his system. Drugs found: cocaine, marijuana, benzodiazepine (pain killer) and amphetamines
Driving Experience:	Unknown
Body Posture:	Driver reported he was upright, forward facing, with his back against the seat back. Driver may have been asleep during the pre-crash phase and may have been out of position.
Hand Position:	Unknown
Foot Position:	Presumed to be on the foot controls and/or floorboards
Restraint Usage:	Manual lap and shoulder belt available - used. The driver reported that both the lap and shoulder portions were snug with no slack, but he could not recall how the belt was positioned on his body.
Air bag:	Front air bag available - deployed. Seat back mounted side air bag - non deployed. Side curtain - non deployed.

Occupant Injuries - 2006 Volkswagen Passat

Driver: Injuries obtained from Emergency Room and Post-ER medical records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Jejunum-ileum laceration, massive (OIS Grades IV or V)	541426.4,8	Belt restraint webbing/buckle	Certain
Mesentery laceration complex	542026.4,8	Belt restraint webbing/buckle	Certain
Colon laceration perforation (OIS Grade III)	540824.3,8	Belt restraint webbing/buckle	Certain
Orbit fracture closed	251202.2,1	Center instrument panel and below	Possible
Lumbar spine fracture, transverse process (L1)	650620.2,8	Belt restraint webbing/buckle	Certain
Lumbar spine fracture, vertebral body, minor compression	650632.2,8	Belt restraint webbing/buckle	Possible
Lumbar spine fracture, transverse process (L5)	650620.2,8	Belt restraint webbing/buckle	Certain
Lumbar spine fracture, pedicel	650626.3,8	Belt restraint webbing/buckle	Certain
Lumbar spine fracture, spinous process	650618.2,8	Belt restraint webbing/buckle	Certain
Right eyelid laceration	297602.1,1	Center instrument panel and below	Possible
Facial skin laceration, minor	290602.1,7	Center instrument panel and below	Possible
Facial skin laceration, minor	290602.1,8	Center instrument panel and below	Possible
Upper extremity skin laceration, minor	790602.1,1	Center instrument panel and below	Certain
Lower extremity skin laceration, minor	890602.1,1	Center instrument panel and below	Certain
Abdomen skin contusion	590402.1,4	Belt restraint webbing/buckle	Certain
Lower extremity skin contusion	890402.1,2	Belt restraint webbing/buckle	Certain
Upper extremity skin contusion	790402.1,2	Steering wheel	Certain

Lethargic, stuporous, obtunded post resuscitation on admission or initial observation at scene (GCS 9-14). Unconsciousness known to be < 1 hr.	160610.2,0	Center instrument panel and below	Possible (Note: pain killers and marijuana were found in the driver's system post-crash)

Occupant Kinematics - 2006 Volkswagen Passat

Driver Kinematics

The 29-year-old male driver of the case vehicle was seated in the vinyl covered bucket seat and was restrained by the available 3-point manual lap and shoulder belt. This driver reported that he was sitting upright with his back against the seat back, but he may have been out of position prior to the initial crash event. He reported that he was on his way home, was tired and "tried to pull over" but ended up hitting the poles. It is possible that he may have started to fall asleep while still driving, and may have been slumped in his seat, allowing the lap portion of the seat belt to ride higher on his abdomen. The driver reported that he was wearing both the lap and shoulder portions of the seat belt and said they were snug and without slack, but he could not recall how they were positioned on his torso and abdomen. The seat belt was cut by fire/rescue personnel and it appears from the lengths of the two pieces of the cut lap belt that this portion of the belt would have been fairly taut across this driver's body. At the time of the inspection, the driver's seat was adjusted to between the forward most and middle track position. The driver reported he had the seat track set to the center track position. The seat back was set to the fully upright position. According to the driver, the seat back did not move during the crash events.

Figure 15. Driver's seat belt - cut by fire/rescue personnel

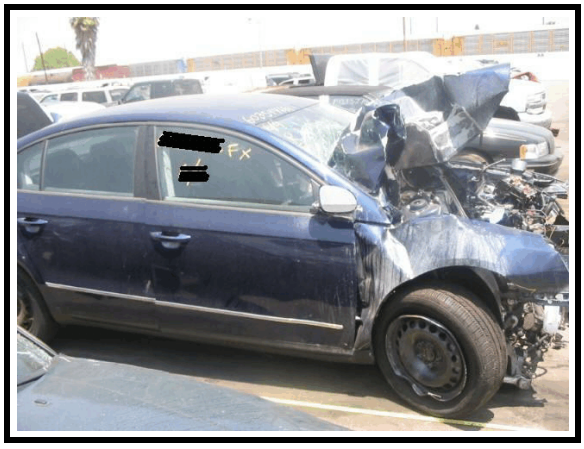

Figure 14. Angled hood damage

During the initial impact between the case vehicle and the first pole, the driver's safety belt pretensioner actuated and the front air bag deployed. The male driver initiated a forward trajectory towards the 12 o'clock direction of force. He loaded the safety belt and may have engaged the deployed front air bag with his face, although there were no visible signs of occupant contact to the air bag. After striking the first pole, the case vehicle continued traveling west and the front of the Passat impacted a small pole that was being used as a support post for a tree/shrub. This was a low delta V event, and the driver likely remained within his general seating area. The case vehicle knocked the post over and continued traveling a short distance west, where the front of the Passat impacted a large wooden utility pole. Based on the extensive engine and hood damage, as well as the amount of intrusion caused by this impact, it appears that this final crash event was the highest delta

V event. The angled hood damage gives the appearance that the back of the case vehicle may have lifted up into the air during this crash event, possibly resulting in the driver's lumbar compression fracture. It is possible that the driver's face may have contacted the rearview mirror, resulting in the driver's orbital fracture and eyelid laceration. The vehicle came to final rest near the struck utility pole, facing west.

The driver was transported by ambulance to a local trauma center where he was hospitalized for 15 days with serious abdominal and spinal injuries.

Attachment 1. Scene Diagram