Certified Advanced 208-Compliant Air Bag Investigation/Vehicle to Vehicle
Dynamic Science, Inc./Case Number: DS06014
2006 Volkswagen Jetta
Nebraska
May 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 on-site investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2006 Volkswagen Jetta. A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This two vehicle crash occurred in May 2006 during daylight hours in an urban area of Nebraska. The crash occurred within the confines of a four-leg intersection. The case vehicle was a 2006 Volkswagen Jetta four-door sedan being driven by a restrained 20-year-old male. There were no other occupants in the vehicle. The other vehicle was a 1998 Mercury Mountaineer being driven by a restrained 64-year-old male. The driver was the sole occupant. The Jetta was traveling westbound in the second lane from the right on a five lane, one-way street. The Mountaineer was traveling northbound on an intersecting two-way street in the second lane from the right. The Volkswagen Jetta did not stop for a red light and entered the intersection at the same time as the Mountaineer. The front of the case vehicle struck the right side of the Mountaineer, resulting in the deployment of the Jetta's driver side frontal air bag. The Mountaineer was pushed laterally from the impact and began to rollover to the left while still within the intersection. The Mountaineer rolled over a total of eight quarter turns and came to final rest on its tires, partially off the roadway at the northwest corner of the intersection facing northwest. After the initial impact, the Jetta rotated clockwise and came to final rest still in the intersection, facing northwest. Neither driver was injured in the crash. Both vehicles were towed from the scene and the Volkswagen Jetta was later declared a total loss.

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**Dynamic Science, Inc.**
**Crash Investigation**
**Case Number: DS06014**

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## BACKGROUND

### Description

**Figure 1**. Front - 2006 Volkswagen Jetta

This on-site investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2006 Volkswagen Jetta. A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This two vehicle crash occurred in May 2006 during daylight hours in an urban area of Nebraska. The crash occurred within the confines of a four-leg intersection. The case vehicle was a 2006 Volkswagen Jetta four-door sedan being driven by a restrained 20-year-old male. There were no other occupants in the vehicle. The other vehicle was a 1998 Mercury Mountaineer being driven by a restrained 64-year-old male. The driver was the sole occupant. The Jetta was traveling westbound in the second lane from the right on a five lane, one-way street. The Mountaineer was traveling northbound on an intersecting two-way street in the second lane from the right. According to security video camera footage viewed by the investigating officer, the Volkswagen Jetta did not stop for a red light and entered the intersection at the same time as the Mountaineer. The front of the case vehicle struck the right side of the Mountaineer, resulting in the deployment of the Jetta's driver side frontal air bag. The Mountaineer was pushed laterally from the impact and began to rollover to the left while still within the intersection. According to the police report, the Mountaineer rolled over a total of eight quarter turns and came to final rest on its tires, partially off the roadway at the northwest corner of the intersection, facing northwest. After the initial impact, the Jetta rotated clockwise and came to final rest still in the intersection facing northwest. Neither driver was injured in the crash. Both vehicles were towed from the scene and the Volkswagen Jetta was later declared a total loss.

This CAC case was identified by SCI. DSI personnel located and obtained permission to inspect the case vehicle on June 28, 2006. NHTSA assigned the case on June 29, 2006. Field work was completed on July 10, 2006.

## SUMMARY

### Crash Site

This two vehicle crash occurred in May 2006 at 1428 hours in an urban area of Nebraska. The collision occurred within the confines of a four-leg intersection controlled by traffic signals. The eastern leg of the intersection is comprised of five westbound travel lanes. The concrete roadway has a positive 2.2% grade in the pre-crash area. It was clear and dry at the time of the crash. The southern leg of the intersection is comprised of two northbound travel lanes and two

southbound travel lanes that are divided by painted, no passing double lane lines. The asphalt roadway has a negative 4.4% grade. The speed limit for both roadways was 48 km/h (30 mph). This intersection is controlled by tri-color traffic signals.

**Pre-Crash**

The case vehicle was a 2006 Volkswagen Jetta four-door sedan being driven by a restrained 20-year-old male. The Jetta was traveling westbound in the second lane from the right curb. The other vehicle was a 1998 Mercury Mountaineer being driven by a restrained 64-year-old male. The Mountaineer was traveling northbound in the second lane from the right. According to security video camera footage viewed by the investigating officer, the Jetta failed to stop for a red light and entered the intersection at the same time as the Mountaineer.

**Crash**

The front of the Volkswagen Jetta (11FDEW1) struck the right side of the Mercury Mountaineer. The impact severity was moderate and resulted in the deployment of the Jetta's driver side front air bag. The barrier equivalent routine of the WinSmash program computed a total delta V of 19.0 km/h (11.8 mph). The longitudinal and lateral components were -16.5 km/h (-10.3 mph) and 9.5 km/h (5.9 mph), respectively. The Mountaineer was pushed laterally from the impact and began to rollover to the left while still within the intersection. According to the police report, the Mountaineer rolled over a total of eight quarter turns and came to final rest on its tires, partially off the roadway at the northwest corner of the intersection, facing northwest. After the initial impact, the Jetta rotated clockwise and came to final rest still in the intersection, facing northwest.

**Figure 2**. Approach of case vehicle to intersection (west)

**Figure 3**. Approach of other vehicle to intersection (north)

**Figure 4**. General rollover location - 1998 Mercury Mountaineer (northwest)

**Post-Crash**

According to the police report, neither driver was injured in the crash. Both vehicles were towed from the scene and the Volkswagen Jetta was later declared a total loss.

**Vehicle Data - 2006 Volkswagen Jetta**

The 2006 Volkswagen Jetta was identified by the Vehicle Identification Number (VIN): 3VWXJ81K26Mxxxxxx. The Jetta is a four-door sedan with seating for five. The Jetta was equipped with a 2.0 liter four cylinder engine, a six speed manual transmission, front wheel drive, four-wheel-disc ABS with electronic brake-force distribution and brake assist, stability control, an electronic differential lock, speed-dependent electro mechanical rack-and-pinion steering and a tilt/telescoping steering wheel.

The 2006 Volkswagen Jetta was equipped with Michelin MXM4 XSE P225/45R17 tires. The manufacturer's recommended cold tire pressure for the front and rear tires was 241 kPa (35 psi). The specific tire information is as follows:

| Position | Measured Pressure | Measured Tread Depth | Restricted | Damage |
|---|---|---|---|---|
| LF | 193 kPa (28 psi) | 8 mm (10/32 in) | No | None |
| LR | 207 kPa (30 psi) | 7 mm (9/32 in) | No | None |
| RR | 200 kPa (29 psi) | 7 mm (9/32 in) | No | None |
| RF | 214 kPa (31 psi) | 7 mm (9/32 in) | No | None |

The front row seating in the Jetta was configured with dual leather bucket seats. The seats were equipped with adjustable active head restraints that were not damaged. In a rear end crash the active head restraints will actuate when pressure is applied to the backrests. According to the manufacturer, when the head restraints are activated, they "will move forward and upward at the same time to help reduce the risk of neck injuries". The second row was configured as a leather bench seat with folding backs. All three second row seating positions were equipped with adjustable head restraints that were not damaged.

## Vehicle Damage

### Exterior Damage - 2006 Volkswagen Jetta

The 2006 Volkswagen Jetta sustained moderate front end damage as a result of the impact with the Mercury Mountaineer. The case vehicle sustained 84.0 cm (33.1 in) of direct damage along the front bumper beginning at the left front bumper corner, extending to the right. The bumper backing bar was no longer with the vehicle and a complete crush profile could not be obtained. Two crush measurements were documented at the left and right bumper mounting brackets as follows: C1=42.0 cm (16.5 in), C2=33.0 cm (13.0 in).

**Figure 5**. Left front damage

| | | |
|---|---|---|
| CDC: | 11FDEW1 | |
| Delta V: | Total | 19.0 km/h (11.8 mph) |
| | Longitudinal | -16.5 km/h (-10.3 mph) |
| | Latitudinal | 9.5 km/h (5.9 mph) |
| | Energy | 22,146 joules (16,334 ft lbs) |

**Interior Damage - 2006 Volkswagen Jetta**

The 2006 Volkswagen Jetta sustained minor interior damage due to normal air bag deployment related damage.

The driver's B pillar seat belt pretensioner actuated during the collision and was locked in place post-crash. There was evidence of occupant loading to the driver's seat belt, located 35.0 cm (13.8 in) from the belt's stop button and 78.0 cm (30.7 in) from the D ring. The second row outboard seating positions were equipped with seat belt retractor pretensioners that actuated during the collision and were locked in place post-crash.

**Figure 6**. Driver's seating area

There was no integrity loss and no damage to any of the vehicle glazing. All four doors remained closed and operational.

**Manual Restraint Systems - 2006 Volkswagen Jetta**

The 2006 Volkswagen Jetta was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front seat belts were equipped with B-pillar pretensioners with load limiters and seat belt height adjusters. The driver's pretensioner actuated during the crash. The right front seat belt pretensioner did not actuate as there was no occupant seated in that position. The driver's seat belt height adjuster was in the full up position and the right front adjuster was in the center position. The driver's safety belt was configured with a sliding latch plate and an emergency locking retractor (ELR). The right front safety belt had a sliding latch plate and a switchable ELR/Automatic Locking Retractor. The second row seating positions were not equipped with seat belt anchorage adjustments. The outboard positions in the second row were equipped with seat belt retractor pretensioners. All three safety belts had sliding latch plates and switchable retractors.

**Figure 7**. Evidence of occupant loading to driver's seat belt

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. All three seating positions were also equipped with child safety seat top tether anchor points, located on the hat shelf behind the second row seat backs.

**Supplemental Restraint Systems - 2006 Volkswagen Jetta**

The Volkswagen Jetta was equipped with a dual stage front "Advanced Air Bag System" in compliance with the Federal Motor Vehicle Safety Standard (FMVSS) 208. According to the manufacturer this air bag system "has been certified to meet the low risk requirements for 3 and 6 year-old children on the passenger side and very small adults on the driver side".

The front air bag system consists of crash sensors in the front of the vehicle, an electronic control unit (with integrated crash sensors for front and side impacts), a dual stage steering wheel mounted advanced air bag, a dual stage mid instrument mounted front right passenger air bag, a weight sensing mat under the upholstery padding of the front right seat cushion that measures the total weight on the seat, an air bag monitoring system and indicator light in the instrument cluster, a passenger air bag OFF light in the center of the instrument panel, a sensor below the safety belt latch for the front right passenger to measure the tension on the safety belt, and a sensor in the safety belt latch for the driver and front right passenger that senses whether the safety belt is latched or not.

The electronic control unit monitors the conditions at the time of the crash and decides whether or not to fire one or both stages of the front air bags and whether or not to actuate the front row seat belt pretensioners. According to the manufacturer, the front air bags and seat belt system components work together as follows:

1. Driver front air bag - if the electronic control unit registers a "low severity crash" and the driver's seat belt is in use, the air bag will not deploy. If the driver's seat belt is not in use, the air bag will deploy in two stages.
2. Passenger front air bag - operates the same as the driver front air bag in a "low severity crash" and deploys the air bags based on seat belt usage at the time of the collision.
3. The passenger air bag will be turned off "if the weight on the passenger seat is less than the amount programmed in the electronic control unit", regardless of whether the seat belt is in use at the time of the crash. It will also turn off if "one of the child seats that was used to certify the Advanced Airbag System under FMVSS 208 has been recognized on the seat". In this situation, the Passenger Air Bag "OFF" light will illuminate.
4. If the electronic control unit senses a "higher severity" impact, regardless of seat belt usage, both the driver and passenger front air bags will deploy both stages nearly simultaneously.

The Jetta was also equipped with seat back mounted side air bags for both the front and rear outboard seating positions. The side air bag system consists of an electronic control module and external side impact sensors, and an air bag warning light in the instrument panel. There were no side air bag deployments. According to the manufacturer, the side air bags are designed to inflate "only in side impacts and only when the vehicle acceleration registered by the control unit is high enough".

The Jetta was also equipped with "Side Curtain Protection" air bags that are designed to work with the side air bags. When the system is triggered, the Side Curtain Protection air bag is filled with propellant gas and breaks through the header above the front and rear side windows and center door pillar and deploys downward. There were no side curtain deployments. According

to the manufacturer, the side curtains are designed to inflate “only in side impacts and only when the vehicle acceleration registered by the control unit is high enough”. The side curtains are not designed to deploy during a rollover event.

As a result of the longitudinal deceleration of the Jetta during the impact with the Mountaineer, the driver’s front air bag deployed and the seat belt pretensioner actuated. The right front air bag and pretensioner did not actuate as there was no occupant in the right front seat. The rear seat pretensioners also did not actuate.

**Figure 8**. Driver’s front air bag

The driver’s air bag was mounted in the center of the steering wheel hub. The air bag module cover flaps had an ‘n’ configuration. The top cover flap was semi-circular in shape and measured 12.0 cm (4.7 in) in width along the upper edge, 6.0 cm (2.4 in) along the lower edge and 3.5 cm (1.4 in) along both sides. The left and right cover flap measurements were as follows: the inner flap edge heights were 7.0 cm (2.8 in), the upper flap edges were 3.5 cm (1.4 in) and the lower flap edges were 2.5 cm (1.0 in). The bottom cover flap measured 6.0 cm (2.4 in) wide and was 11.0 cm (4.3 in) tall. The air bag was circular in shape and measured 50.0 cm (19.7 in) high/wide in its deflated state. The center stitching measured 17.0 cm (6.7 in) in diameter. The air bag had one vent port on the back of the bag at the 12 o’clock position that measured 6.5 cm (2.6 in) in diameter. The material surrounding the vent port was blackened, with the darkened area more pronounced on the left side of the vent port. The air bag was not damaged and showed no sign of occupant contact.

**Figure 9**. Driver’s front air bag vent port

The front right passenger air bag was a mid instrument mount. The air bag did not deploy.

**Vehicle Data - 1998 Mercury Mountaineer**

| | | |
|---|---|---|
| Description: | 1998 Mercury Mountaineer 4x4 4-door multipurpose vehicle | |
| VIN: | 4M2ZU55P4WUxxxxxx | |
| Odometer: | Unknown | |
| Engine: | 5.0L, 8 cylinder | |
| Reported Defects: | None | |
| Cargo: | Unknown | |
| Damage Description: | Front end damage per the police report | |
| CDC: | Unknown | |
| Delta V: | Total | 17.0 km/h (10.6 mph) |
| | Longitudinal | -8.5 km/h |
| | Latitudinal | Unknown |
| | Energy | Unknown |

**Occupant Demographics - 2006 Volkswagen Jetta**

| | Driver |
|---|---|
| Age/Sex: | 20/Male |
| Seated Position: | Front left |
| Seat Type: | Leather bucket seat |
| Height: | Unknown |
| Weight: | Unknown |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | None noted |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Presumed to be <3 years |
| Body Posture: | Presumed to be upright, forward facing |
| Hand Position: | Unknown |
| Foot Position: | Unknown |
| Restraint Usage: | Manual 3-point lap and shoulder belt available - used |
| Air bag: | Front air bag available - deployed. Seat back mounted side air bag available - nondeployed. Side curtain available - nondeployed. |

**Occupant Demographics - 1998 Mercury Mountaineer**

| | Driver |
|---|---|
| Age/Sex: | 64/Male |
| 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: | Presumed to be >20 years |
| Body Posture: | Presumed to be upright, forward facing |
| Hand Position: | Unknown |
| Foot Position: | Unknown |
| Restraint Usage: | Lap and shoulder belt used per the police report |

**Occupant Injuries - 2006 Volkswagen Jetta**

Driver: Not injured per the police report.

**Occupant Injuries - 1998 Mercury Mountaineer**

Driver: Not injured per the police report.

**Occupant Kinematics - 2006 Volkswagen Jetta**

**Driver Kinematics**

The 20-year-old male driver appears to have been seated in an upright posture in the leather covered bucket seat and was restrained by the available 3-point manual lap and shoulder belt. The shoulder belt anchorage was in the full up position. The seat was adjusted to the forward most track position. The seat back was reclined at a 63 degree angle and the seat bottom had a 14 degree angle. During the initial impact, the driver's front air bag deployed and his safety belt pretensioner actuated. The male driver initiated a forward and slightly lateral trajectory towards the 11 o'clock direction of force, leaving occupant load marks on the seat belt webbing. The case vehicle rotated clockwise from the impact and came to final rest still in the intersection, facing northwest. This driver was not injured and did not receive any medical treatment at the scene.

**Figure 10**. Close-up - evidence of occupant loading to driver's seat belt

**Attachment 1. Scene Diagram**