Side Curtain and Side Air Bag Investigation/Vehicle to Objects
Dynamic Science, Inc./Case Number: DS06006
2003 Volkswagen Golf
Washington
February 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 side curtain and side air bag systems in a 2003 Volkswagen Golf. This single vehicle crash occurred in February 2006 at 2139 hours in an urban area of Washington. The crash occurred on a two lane, two way, undivided street. The case vehicle is a 2003 Volkswagen Golf being driven by a 16-year-old restrained male. There were five additional occupants in the vehicle. The Volkswagen Golf was traveling north in the right lane with no traffic controls. The case vehicle was traveling north in the right lane and was approaching a hillcrest. The Volkswagen crested the hill and became airborne. As the vehicle landed, the driver lost control of the vehicle. The driver attempted to regain control, but he overcorrected and the Volkswagen Golf rotated counterclockwise as it continued north and traveled across the travel lanes towards the west shoulder. While still in a yaw, the case vehicle traveled off the left side of the roadway and impacted a number of trees before rolling. As the vehicle was transitioning between the second and third quarter turn of the rollover, the top of the vehicle impacted two moderately sized trees. The vehicle went into its third quarter turn and the left side of the Volkswagen hit the same trees. The second row right passenger sustained a severe head injury and was declared dead at the scene. The driver sustained a closed head injury, a left wrist abrasion and a contusion to the bridge of his nose. The front right passenger, the second row left occupant, and the two second row center passengers all sustained serious injuries. The Golf was towed from the scene to a police impound lot and was later declared a total loss.

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Dynamic Science, Inc.
Crash Investigation
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BACKGROUND

Description

This on-site investigation focused on the side curtain and side air bag systems in a 2003 Volkswagen Golf.

This single vehicle crash occurred in February 2006 at 2139 hours in an urban area of Washington. The crash occurred on a two lane, two way, undivided street.

The case vehicle is a 2003 Volkswagen Golf being driven by a 16-year-old restrained male. There were five additional occupants in the vehicle.

Figure 1. Right side damage - 2003 Volkswagen Golf

The Volkswagen Golf was traveling north in the right lane with no traffic controls. This road has several hills that are closely spaced and is popular with local kids who drive up and down the street at high rates of speed in order to "catch air" on the hillcrests. The case vehicle was traveling at a police estimated speed of 134 km/h (83 mph) as it traveled north in the right lane and was approaching a hillcrest. The Volkswagen crested the hill and became airborne. The vehicle landed with its right tires off the roadway's east edge, causing the driver to lose control of the vehicle. The driver attempted to regain control, but he overcorrected and the Volkswagen Golf rotated counterclockwise as it continued north and traveled across the travel lanes towards the west shoulder. While still in a yaw, the case vehicle traveled off the left side of the roadway and landed in a shallow ditch in an area covered with blackberry vines, moss and several rotting tree stumps. The vehicle continued sliding sideways over the vines, dirt and rocks as it traveled north towards the end of the ditch. Once the vehicle reached the end of the ditch, the Volkswagen's right side impacted a group of three trees, resulting in the deployment of the front right side air bag. As the trees began to tilt north from the force of the impact, the Volkswagen traveled up the tree trunks, damaging them all the way up to the upper tree branches. All three tree trunks sheared and were thrown north through the wooded area, landing beyond the Volkswagen's final rest location. Before the tree trunks broke in two from the impact, the case vehicle ramped up the trunks, became airborne, and began to rollover to the right, resulting in the deployment of the left and right side curtain air bags. While airborne, the Volkswagen Golf traveled over a berm and impacted a cluster of approximately 13 trees with its top. The Volkswagen continued north while still airborne and in total, completed three quarter turns during the rollover event. As the vehicle was transitioning between the second and third quarter turn, the top of the vehicle impacted two moderately sized trees. The vehicle went into its

Figure 2. Left side damage - 2003 Volkswagen Golf

third quarter turn and the left side of the Volkswagen hit the same trees, resulting in the deployment of the driver's seat back mounted side air bag. Pieces of the Volkswagen's left side window glazing were found embedded in the bark of both trees. The vehicle then rebounded, rotated one quarter turn to the left and fell to the ground. The 2003 Golf came to final rest completely off the roadway, laying on its right side, facing west. There were a total five quarter turns.

The second row right passenger sustained a severe head injury and was declared dead at the scene. The driver sustained a closed head injury, a left wrist abrasion, and a contusion to the bridge of his nose. He was transported to a hospital where he was treated and then was released into police custody. The front right passenger, the second row left occupant, and the two second row center passengers all sustained serious injuries and were transported to a hospital where they all were hospitalized for varying lengths of time.

The 2003 Volkswagen Golf was towed from the scene to a police impound lot and was later declared a total loss.

This crash was identified by NHTSA via a Special Crash Investigations Hotline report submitted by a Washington state police officer. On March 8, 2006, NHTSA forwarded the case information to DSI and provided a copy of the police report. On March 13, 2006, DSI was notified that the vehicle inspection request was approved by the local prosecuting attorney. DSI was assigned the case on March 14, 2006. Field work was completed on March 15, 2006. The investigating officer was present during the vehicle and scene inspections.

SUMMARY

Crash Site

This single vehicle crash occurred in February 2006 at 2139 hours in an urban area of Washington. The crash occurred on a two lane, two way undivided roadway.

Figure 3. Approach of case vehicle to roadway departure area - north

The 2003 Volkswagen Golf was traveling north in the right lane of the asphalt roadway which consisted of two undivided travel lanes. The two lanes are separated by sets of double turtles, designating them as "no passing" lanes. Adjacent to both travel lanes there are fog lines and a very thin strip of asphalt between the fog lines and the grassy shoulders. There are no curbs on either side of the street and both shoulders slope downward, away from the roadway. This street has several hills that are closely spaced and is popular with local kids who drive up and down the street at high rates of speed in order to "catch air" on the hillcrests. In the precrash area, there is an uphill grade (10%

per city engineers) leading to a hillcrest. North of the hillcrest, there is a downhill slope (10% grade) which leads to the area where the case vehicle departed the roadway. In the area where the Golf went off road, there is a ditch that is approximately 1.1 m (3.5 ft) deep. In the area where the case vehicle came to final rest, the roadway levels out a bit, but still has a slight downhill grade.

There are no traffic controls for north or southbound vehicles. The posted speed limit for this section of roadway is 40 km/h (25 mph). At the time of the crash the travel lanes were dry, there were no adverse weather conditions and no visual obstructions were present. The crash occurred during evening hours and although it was dark, there were streetlights illuminating the roadway.

Pre-Crash

The case vehicle is a 2003 Volkswagen Golf being driven by a restrained 16-year-old male. There were five additional occupants in the vehicle. There was a restrained 16-year-old female seated in the front right seat, an unrestrained 14-year-old male in the second row left seat, two unrestrained 14-year-old males sharing the second row center seating area, and an unrestrained 14-year-old male in the second row right seating position.

The Volkswagen Golf was traveling north in the right lane of the two lane, two way, undivided street. The driver of the case vehicle told investigating officers that the group of friends had just finished toilet papering another friend's home and were out "driving around, messing around, and having fun". This street has several hills that are closely spaced and is popular with local kids who drive up and down the street at high rates of speed in order to "catch air".

One of the passengers reported to police that they had just driven the hilly roadway going south, and had turned around in order to drive through the area again. The 2003 Golf was traveling at a police estimated speed of 134 km/h (83 mph) as it traveled north in the right lane and approached another hillcrest.

Figure 4. Ditch on west side of roadway; disturbed blackberry vines and damaged trees in background

Crash

The Volkswagen crested the hill and became airborne. The vehicle landed with its right tires off the east edge of the roadway and the driver lost control of the vehicle. The driver attempted to regain control, but the Volkswagen Golf rotated counterclockwise as it continued north and traveled across the roadway towards the west shoulder. While still in a yaw, the case vehicle traveled off the road and impacted the ditch (03RYEW1) in an area covered with blackberry vines, moss, and several rotting tree stumps. The vehicle continued sliding sideways over the vines, dirt and rocks as it traveled north towards the end of the ditch. Once the vehicle reached the end of the ditch, the Volkswagen's right side impacted a group of three trees (03RZAW3), resulting in the deployment of the front right side air bag. As the trees began to tilt north from the force of the impact, the Volkswagen traveled up the tree trunks, damaging them all the way up to the upper tree branches. All three tree trunks sheared and were thrown north through the wooded area, landing beyond the Volkswagen's final rest location. Before the tree trunks broke in two from the impact, the case vehicle ramped up the trunks, became airborne, and began to rollover to the right, resulting in the deployment of the left and right side curtain air bags. While airborne, the Volkswagen Golf traveled over a berm and impacted a cluster of approximately 13 small trees (40TFDW6) with its top. The CDC was incremented due to the greater than 10.2 cm (4.0 in) left and right vertical frame rail shift that resulted from this impact. The Volkswagen continued north, still airborne, and in total, completed three quarter turns. As the vehicle was transitioning between the second and third quarter turn, the top of the vehicle impacted two moderately sized trees (00TPYW4). The vehicle went into its third quarter turn and the left side of the Volkswagen hit the same trees (00LPAW3), resulting in the deployment of the driver's seat back mounted side air bag. Pieces of the Volkswagen's left front window glazing were found embedded in the tree bark. The vehicle then rebounded, rotated to the left and fell to the ground. The 2003 Golf came to final rest completely off the roadway, laying on its right side, facing west.

Figure 5. First set of impacted trees; tops of trees found north of case vehicle's final rest location

Figure 6. Damaged cluster of trees and case vehicle's final rest (police photo)

Post-Crash

The 14-year-old second row right seat passenger sustained a severe head injury and was declared dead at the scene. The other five occupants were all treated at the scene and transported to a local hospital for additional medical treatment. The 16-year old male driver sustained a closed head injury, a left wrist abrasion, and a contusion to the bridge of his nose. He was treated in the emergency room and released into police custody. The 16-year-old female front right passenger was hospitalized for one day with a dislocated right elbow, a closed head injury, and bilateral iliac crest abrasions. The 14-year-old male second row left seat passenger was hospitalized for three days with an upper right pulmonary contusion, a cerebral concussion, multiple right rib fractures, a right clavicle fracture, and multiple head/neck abrasions and lacerations. The first 14-year-old male second row center seat passenger was hospitalized for five days due to a cerebral concussion, a right pulmonary contusion, right rib fractures, and multiple contusions and abrasions. The other 14-year-old male second row center seat passenger was hospitalized for four days with a depressed skull fracture, a right wrist fracture, bilateral pulmonary contusions, a fractured right rib and left scapula, L1-L4 transverse process fractures, a minor kidney laceration, and an occipital hematoma.

Figure 7. Last set of trees impacted by case vehicle

The vehicle was towed from the scene and impounded by police. The Volkswagen Golf was later declared a total loss.

Figure 8. Distance between initial tree impacts/final rest location

Figure 9. Final rest of case vehicle (police photo)

Vehicle Data - 2003 Volkswagen Golf

The 2003 Volkswagen Golf was identified by the Vehicle Identification Number (VIN): 9BWGK61J634xxxxxx. The Volkswagen Golf is a four door hatchback, front wheel drive, passenger vehicle with seating for five. It was equipped with a 2.0 liter 4 cylinder engine, 4 speed automatic transmission, four wheel anti-lock brakes, front and rear disc brakes, and a tilt steering wheel. The vehicle mileage could not be obtained from the digital odometer because the vehicle had no power.

The 2003 Volkswagen Golf was equipped with Goodyear Eagle LS P195/65R15 tires. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	193 kPa (28 psi)	3 mm (4/32 in)	No	None
LR	221 kPa (32 psi)	5 mm (6/32 in)	No	None
RR	186 kPa (27 psi)	4 mm (5/32 in)	Yes	Tree debris embedded in rim; axle damaged
RF	Flat	3 mm (4/32 in)	No	Holed/Torn

The front row seating in the 2003 Volkswagen Golf was configured with dual cloth covered bucket seats. The seats were equipped with adjustable head restraints that were not damaged. The second row was configured as a cloth covered 60/40 split bench seat with folding backs. All three second row seating positions were equipped with adjustable head restraints. The left head restraint was not damaged, but the center and right head restraints were missing. One head restraint was found in the cargo area but it could not be determined whether it was the second row center or right head restraint**.**

Vehicle Damage

Exterior Damage - 2003 Volkswagen Golf

The initial report of the crash events from the investigating police agency was as follows: the 2003 Volkswagen Golf was traveling north in the right lane at a high rate of speed. The vehicle traveled over a hillcrest, became airborne and came down with its right tires just off the edge of the roadway. The driver lost control of the vehicle and the Volkswagen rotated counterclockwise while it began traveling across both travel lanes. As it was in a yaw, the case vehicle departed the west side of the roadway and the front end traveled into a ditch, causing the vehicle to rollover. It was believed that the rollover initiation point was at the roadway's edge, caused in part by the precrash counterclockwise yaw, the precrash speed of the vehicle and the height differential between the roadway and the ditch. After the scene inspection had been completed, a different picture of the crash events began to emerge.

Figure 10. Right front damage

Figure 11. Right rear damage

The case vehicle sustained right side damage from sliding through the blackberry vines, dirt and grassy ditch area. The investigating agency initially reported that this right side damage occurred when the Volkswagen was being towed out of the brush. While some of this damage may be attributed to tow-out activities, the scene inspection and other post-vehicle inspection reconstruction activities showed that this damage occurred prior to the rollover event. The CDC for this event was 03RYEW1. The damage from this event mainly consisted of dirt and scrapes to the lower passenger compartment sill and right front tire and hubcap.

The 2003 Volkswagen Golf sustained moderate right side damage as a result of the impact with the first set of three trees. Due to the amount of sporadic vehicle damage, the location of the direct damage from this specific event could not be determined. The CDC for this event was 03RZAW3. The area of maximum crush was to the right C pillar. The right rear tire and axle were severely damaged during this event. The fuel tank filler neck was deformed and out of position, but no evidence of fuel leakage was found.

The case vehicle sustained moderate top damage due to the impact between the hood and the second cluster of trees. It is possible that the front right fender hit the cluster of trees first and the hood impacted them as the vehicle continued to rollover mid-air. There is right fender damage that is similar and somewhat consistent to the hood damage. Only one CDC was coded because the impact configuration could not be verified. The vehicle was airborne and rolling over at the time of the impact, resulting in sporadic damage to the vehicle's hood. The CDC for this event was 40TFDW6. Both frame rails sustained downward vertical frame rail shift that was greater than 10 cm (4.0 in).

Figure 12. Damage to front end/hood

The Volkswagen sustained moderate top damage as a result of the impact between the case vehicle and the last set of two trees. This damage occurred while the vehicle was airborne and still rolling over. The distance between the larger cluster of trees and the last two trees is not far and it is possible that the vehicle was still in its second quarter turn, just beginning its third quarter turn when this impact occurred. The CDC for this event was 00TPYW4. The area of maximum crush was located 86.0 cm (33.9 in) behind the left front axle. There was 44.0 cm (17.3 in) of vertical crush, which is the maximum crush documented for the rollover event. The area of maximum lateral crush was in the same location and measured 7.0 cm (2.8 in).

The left side of the Volkswagen sustained moderate damage as a result of the final impact between the case vehicle and the last grouping of trees. Just after the top of the Volkswagen impacted the trees, the vehicle began its third quarter turn of the rollover event. The left side of the vehicle impacted the trees, causing direct damage and crush to the left front and rear doors and left B pillar. The CDC for this event was 00LPAW3.

Figure 13. Left A, B pillar and LF door damage

The case vehicle sustained moderate right, top and left side damage during the rollover event. This was an unusual rollover event, given that the case vehicle completed the three quarter turns while airborne and while impacting multiple objects. The maximum vertical and lateral crush was in the same location, 86.0 cm (33.9 in) behind the left front axle. At this location, there was 44.0 cm (17.3 in) of vertical crush and 7.0 cm (2.8 in) of lateral crush. The vehicle inspection took place at the investigating police agency with one of the lead investigating officers present.

Figure 14. A pillar damage from tree impact - occurred during the rollover event

CDC (Impact 1):	03RYEW1
(Impact 2):	03RZAW3
(Impact 3):	00T99O9
(Impact 4):	40TFDW6
(Impact 5):	00TPYW4
(Impact 6):	00LPAW3

Interior Damage - 2003 Volkswagen Golf

The case vehicle sustained moderate interior damage due to occupant contacts, intrusion and normal air bag deployment related damage.

There were scuffs to the shoulder portion of the driver and front right passenger's seat belts due to the actuation of the B pillar pretensioners. There were friction marks on the front right passenger's seat belt latch plate from this occupant loading the belt. Both belts were found to be locked in place post crash due to the actuation of the retractor pretensioners. The left front door armrest was deformed due to contact from the driver. There was a scuff to the left front roof side rail, near the top of the A pillar, possibly due to occupant contact from the driver's nose and/or head. There was a black mark near the sunroof in the driver's area, which may have had nothing to do with the crash and could have been a slight burn from a lit cigarette. There was blood found on the right instrument panel, likely due to contact from the front right occupant's head and/or face. The front right seatback was deformed and locked in place, likely due to occupant contact from the backseat passengers. This seatback was found folded forward, with the head restraint nearly on top of the instrument panel. There were scuffs to the back of the front left seatback, likely due to occupant contact. There were scuffs to the back of the front right seatback, likely due to occupant contact from the hands and/or legs of the second row right seat passenger. The right rear door armrest was deformed, likely due to occupant contact from the

second row right seat passenger. On the roof side rail and roof area in the second row right seating position, there were black hairs, blood and brain matter found. The handle located on the roof side rail above the right rear glazing had blood and black hair on it as well. All of the contact evidence found in this area was due to occupant contact from the head of the fatally injured second row right seat passenger.

The left and right front doors remained closed and operational. The rear hatch, left rear and right rear doors were jammed shut post crash. There was integrity loss in several of the glazing areas. The following windows disintegrated due to impact forces: the sunroof, backlight, left front, left rear, right rear, and small window just behind the right rear glazing. The windshield was cracked and in place post-crash.

Figure 15. Intrusion and possible occupant contact points in driver area

Figure 16. Passenger compartment damage/intrusion

There were multiple vertical and lateral intrusions into the passenger compartment seating areas. The specific passenger compartment intrusions were documented as follows:

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
1L	Windshield	29.0 cm (11.4 in)	Vertical
1L	Windshield header	24.0 cm (9.4 in)	Vertical
1L	A pillar	21.0 cm (8.3 in)	Vertical
1L	Roof side rail	14.0 cm (5.5 in)	Vertical
1L	Roof	13.0 cm (5.1 in)	Vertical
1L	B pillar	2.0 cm (0.8 in)	Lateral
1C	Windshield	21.0 cm (8.3 in)	Vertical
1C	Windshield header	20.0 cm (7.9 in)	Vertical

1C	Roof	13.0 cm (5.1 in)	Vertical
1R	Windshield	18.0 cm (7.1 in)	Vertical
1R	Windshield header	15.0 cm (5.9 in)	Vertical
1R	Roof	11.0 cm (4.3 in)	Vertical
2L	Roof side rail	3.0 cm (1.2 in)	Vertical
2R	C pillar	8.0 cm (3.1 in)	Lateral
2R	Roof side rail	8.0 cm (3.1 in)	Vertical
2R	Roof side rail	5.0 cm (2.0 in)	Lateral

Manual Restraints - 2003 Volkswagen Golf

The 2003 Volkswagen Golf 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 and seat belt height adjusters. The driver and front right passenger's pretensioners actuated during the crash. The driver's seat belt height adjuster was set between the center and full up position and the passenger's 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 an switchable ELR/Automatic Locking Retractor. All three second row seat belts had sliding latch plates and switchable retractors.

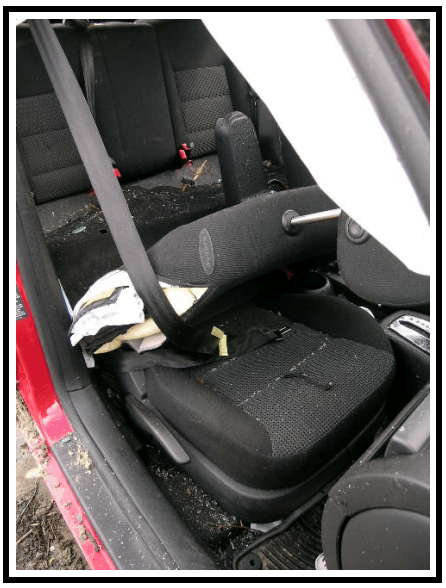

Figure 17. Right front seat belt

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 second row seating positions were equipped with child safety top tether strap anchor points, located on the back of the second row seat backs.

Supplemental Restraint Systems - 2003 Volkswagen Golf

The case vehicle was equipped with advanced occupant protection systems. The systems consist of the dual front advanced air bags with occupant sensors and driver and front right passenger buckle switches. It is also equipped with front row driver and passenger side impact air bags, and side curtains with a coverage area starting at the A pillar and extending back to the C pillar. The vehicle was also equipped with front row driver and passenger B pillar seat belt pretensioners which actuated during the crash.

Neither front air bag deployed during the crash. Both front row side air bags and the left and right side curtains deployed during the crash events.

Both deployed seat back mounted side air bags were semi-circular in shape with a height of 66.0 cm (26.0 in) and an excursion of 26.0 cm (10.2 in) in their deflated state. They did not have tethers or vent ports.

The inner portion of the driver's side air bag had visible blood stains extending from the 1 to the 3 o'clock locations. There were no visible signs of occupant contact or damage to the outside portion of the air bag.

The inner portion of the passenger's side air bag had two small reddish stains but neither appear be due to occupant contact. The bag had been exposed to the elements post-crash and the discolorations may have occurred due to the exposure.

Figure 18. Front right passenger side air bag

Figure 19. Driver's side air bag

The deployed left and right side curtain air bags extended from the A pillars to the C pillars. There was a small coverage gap present at both A pillars, but the gap was eliminated on the left side due to the A pillar intrusion. The gap on the right side measured 46.0 cm (18.1 in) wide by 14.0 cm (5.5 in) high. The side curtains were rectangular in shape and in their deflated state, measured 186.0 cm (73.2 in) in length. The height of both side curtains was 28 cm (11.0 in). The curtains did not have tethers or vent ports. The side curtains deployed from the roof side rails.

The left curtain showed no visible signs of occupant contact. The right curtain was dirty toward the front of the bag and the back section had multiple bloodstains from the second row right seat passenger. The material on the outer side of both curtains was dirty from the rollover event.

Figure 20. Front section of the left side curtain

Figure 21. Back section of the left side curtain

Figure 22. Front section of passenger side curtain

Figure 23. Right side curtain gap distance at the right A pillar

Figure 24. Back section of the right side curtain

Occupant Demographics - 2003 Volkswagen Golf

	Driver	Occupant 2	Occupant 3
Age/Sex:	16/Male	16/Female	14/Male
Seated Position:	Front left	Front right	Second left
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered 60/40 split bench seat with folding backs
Height:	175 cm (69 in)	173 cm (68 in)	Unknown
Weight:	59 kg (130 lb)	50 kg (110 lb)	Unknown
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Blood test - negative for both drugs & alcohol	Not Applicable	Not Applicable
Driving Experience:	Less than 1 year	Not Applicable	Not Applicable
Body Posture:	Presumed to be upright, forward facing	Presumed to be upright, forward facing	Presumed to be upright, forward facing
Hand Position:	Presumed to be on the steering wheel, actively steering	Unknown	Unknown
Foot Position:	Presumed to be on the foot controls and/or floorboards	Presumed to be on the floorboards	Presumed to be on the floorboards
Restraint Usage:	Manual 3-point lap and shoulder belt available - used	Manual 3-point lap and shoulder belt available - used	Manual 3-point lap and shoulder belt available - not used
Air bag:	Front air bag available - nondeployed. Seat back mounted side air bag available - deployed. Side curtain available - deployed.	Front air bag available - nondeployed. Seat back mounted side air bag available - deployed. Side curtain available - deployed.	Side curtain available - deployed.

	Occupant 4	Occupant 5	Occupant 6
Age/Sex:	14/Male	14/Male	14/Male
Seated Position:	Second center (sharing seat with Occupant 5)	Second center (sharing seat with Occupant 4)	Second right
Seat Type:	Fabric covered 60/40 split bench seat with folding backs	Fabric covered 60/40 split bench seat with folding backs	Fabric covered 60/40 split bench seat with folding backs
Height:	Unknown	Unknown	156 cm(61.5 in)
Weight:	Unknown	Unknown	34 kg (75 lb) **estimated on Autopsy
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable. Medical records show a negative drug screen for this occupant.	Not Applicable. Autopsy report lists that no drugs or alcohol were found in his system.
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Presumed to be upright, forward facing	Presumed to be upright, forward facing	Presumed to be upright, forward facing
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Presumed to be on the floorboards	Presumed to be on the floorboards	Presumed to be on the floorboards
Restraint Usage:	Manual 3-point lap and shoulder belt available - not used	Manual 3-point lap and shoulder belt available - not used	Manual 3-point lap and shoulder belt available - not used
Air bag:	No air bags available	No air bags available	Side curtain available - deployed.

Occupant Injuries - 2003 Volkswagen Golf

Driver: Injuries obtained from Emergency Room records, radiological records and hospital records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Abrasion, left wrist	790202.1,2	Door panel	Possible
Contusion, bridge of nose	290402.1,4	A-pillar	Possible
Closed head injury NFS	115099.7,0	A-pillar	Possible

Front Right Occupant: Injuries obtained from Emergency Room records, radiological records and hospital records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Dislocation, right elbow	750630.1,1	Seat back	Possible
Abrasion, iliac crest, right	590202.1,1	Seat belt webbing	Certain
Abrasion, iliac crest, left	590202.1,2	Seat belt webbing	Certain
Closed head injury NFS	115099.7,0	Right instrument panel	Probable

Second Row Left Occupant: Injuries obtained from Emergency Room records, radiological records and hospital records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Fracture of lateral clavicle, right side	752200.2,1	Contact with another occupant	Possible
Cerebral concussion, no intracranial injury	161000.2,0	Roof	Possible
Multiple rib fractures, R1-R6, R-8, Posterior, without pneumothorax	450230.3,1	Contact with another occupant	Possible
Pulmonary contusion (hemothorax), right side upper	441402.3,1	Back of left front seat back	Possible
Abrasion, mandible right side	290202.1,1	Contact with another occupant	Possible
Abrasion, right temporal area	290202.1,1	Contact with another occupant	Possible
Multiple lacerations, minor, forehead	290602.1,7	Broken window glazing	Possible
Multiple lacerations, minor, anterior neck	390602.1,5	Broken window glazing	Possible

Second Row Center Occupant: Injuries obtained from Emergency Room records, radiological records and hospital records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Contusion, lower back	690402.1,8	Unknown	Unknown
Contusion, lower extremity, right side	890402.1,1	Contact with another occupant	Possible
Abrasion, mid lower back	690202.1,8	Unknown	Unknown
Abrasion, right ankle	890202.1,2	Unknown	Unknown
Contusion, right lung NFS	441402.3,1	Contact with another occupant	Possible
Fractures, R1 and R2 ribs, posterior	450220.2,1	Contact with another occupant	Possible
Cerebral concussion NFS	161000.2,0	Roof	Possible
Abrasion, left patella (knee)	890202.1,2	Back of left front seat back	Possible
Contusion and medial collateral ligament strain, left knee	840602.1,2	Back of left front seat back	Possible

Other Second Row Center Occupant: Injuries obtained from Emergency Room records, radiological records and hospital records.

Injury	OIC Code	Injury Mechanism	Confidence Level
Pulmonary contusions, bilateral	441410.4,3	Contact with another occupant	Possible
Depressed skull fracture, posterior Right vertex	150404.3,6	Roof	Possible
Transverse process fractures, L1 - L4, Right side	650620.2,8 650620.2,8 650620.2,8 650620.2,8	Contact with another occupant	Possible
Laceration (minor), kidney, right posterior	541620.2,1	Contact with another occupant	Possible
Fracture, left scapula	753000.2,2	Contact with another occupant	Possible
Fracture, right distal radial (wrist)	752802.2,1	Right front seat back	Possible
Contusion (hematoma) occipital area	190402.1,6	Roof	Possible
Fractured rib, R1	450212.1,1	Contact with another occupant	Possible

Second Row Right Occupant: Injuries obtained from the Autopsy.

Injury	OIC Code	Injury Mechanism	Confidence Level
Multiple skull fractures, massively depressed, covering frontal, parietal, temporal and occipital regions, right side	150408.4,1	Right roof side rail and handle mounted on side rail	Certain
Scalp avulsion, superficial, measuring 6.5 x 1.5 cm, right sagittal plane	190802.1,1	Right roof side rail and handle mounted on side rail	Certain
Scalp laceration, minor, measuring 7.0 x 2.0 cm, right frontal plane	190602.1,1	Right roof side rail and handle mounted on side rail	Certain
Laceration, minor, chin, measuring 6.8 x 4.0 cm	290602.1,8	Broken window glazing	Possible
Laceration, minor, lower lip	290602.1,8	Broken window glazing	Possible
Laceration, minor, central orbital ridge	290602.1,7	C pillar	Possible
Multiple lacerations, minor, forehead	290602.1,7	Broken window glazing	Possible
Multiple abrasions, right shoulder	790202.1,1	Right rear window frame	Possible
Multiple abrasions, central chest	490202.1,4	Right front seat back	Possible
Abrasion, left upper arm, measuring 5.7 x 2.7 cm	790202.1,2	Contact with another occupant	Possible
Fractured humerus, left, comminuted and displaced	752604.3,2	Contact with another occupant	Possible
Abrasion, left forearm, measuring 6.5 x 3.8 cm	790202.1,2	Contact with another occupant	Possible
Contusion, left wrist	790402.1,2	Contact with another occupant	Possible
Contusion, left knee	890402.1,2	Right front seat back	Possible

Injury	OIC Code	Injury Mechanism	Confidence Level
Contusion, anterior left tibia	890402.1,2	Right front seat back	Possible
Multiple lacerations, cerebrum, bilateral, left and right temporal lobes	140688.4,1 140688.4,2	Right roof side rail and handle mounted on side rail	Probable
Epidural, subdural and subarachnoid hemorrhages, bilateral	140650.4,1 140650.4,2	Right roof side rail and handle mounted on side rail	Probable
Contusion, cerebrum, left temporal lobe (cortex)NFS	140604.3,2	Contact with another occupant	Possible
Multiple lacerations, heart; two, measuring 1.5 cm each	441016.6,4	Impact forces	Possible
Contusions, lungs, bilateral	4414104.,3	Impact forces	Possible
Fracture, right clavicle, displaced	752200.2,1	Right rear window frame	Possible
Flail (unstable chest wall, <15 yrs. old), multiple fractures, ribs R1, R2, R3, R4 right side, with lung contusion	450268.5,1	Right rear door panel	Possible
Laceration, kidney(major), right	541626.4,1	Right rear door panel	Possible
Multiple lacerations (minor), liver	541822.2,1	Right rear door panel	Possible
Multiple lacerations (minor), spleen	544222.2,2	Contact with another occupant	Possible

Occupant Kinematics - 2003 Volkswagen Golf

Driver Kinematics

The 16-year-old male driver of the case vehicle appears to have been seated in an upright posture in the cloth covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was set between the middle and full up position. The seat was adjusted to the forward most track position. The seat back was reclined at a 104 degree angle and the seat bottom had an 11 degree angle.

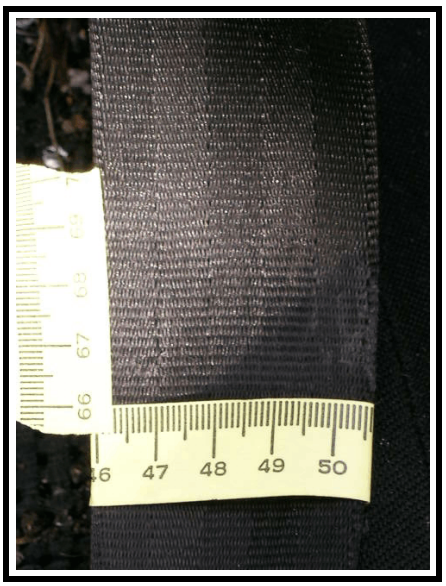

Figure 25. Evidence of loading - Driver's seat belt

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing the driver to pitch against the left front door. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it touched down in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. This event may have caused the driver and front right passenger seat belt pretensioners to actuate. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, causing the male driver to initiate a lateral and slightly rearward trajectory towards the 3 o'clock direction of force. As the Volkswagen Golf traveled up the tree trunks and became airborne, the driver pitched to his left likely contacting the left front door area again. As the vehicle traveled up the trunks and through the air it began to rollover to the right, resulting in the deployment of the side curtain air bags. As the hood impacted the second group of trees, it is likely that the driver was in his general seating area, being held somewhat in place by the locked seat belt retractor. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, the driver initiated a forward and slightly lateral trajectory, towards the left A pillar. The A pillar and roof side rail intruded into the vehicle and may have been the source of the driver's head injury and nose contusion. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees, resulting in the

Figure 26. Possible occupant contact to top of left A pillar

Figure 27. Deformation to LF door armrest

deployment the driver's side impact air bag. The vehicle rebounded from the trees, rotated one quarter turn to the left, and fell to the ground, landing on its right side, causing the driver to initiate a lateral trajectory to his right.

Per the police, this occupant was able to exit the vehicle on his own and was attempting to help extricate the other passengers when police arrived on scene. The driver was treated at the scene and was transported to a local hospital where he was treated and released into police custody.

Front Right Occupant Kinematics

The 16-year-old front right female passenger was seated forward facing in the cloth covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the center position. The seat was adjusted between the middle and forward most seat track position. The seat back was found locked in place, angled forward at a 55 degree angle. The seat bottom had an 11 degree angle.

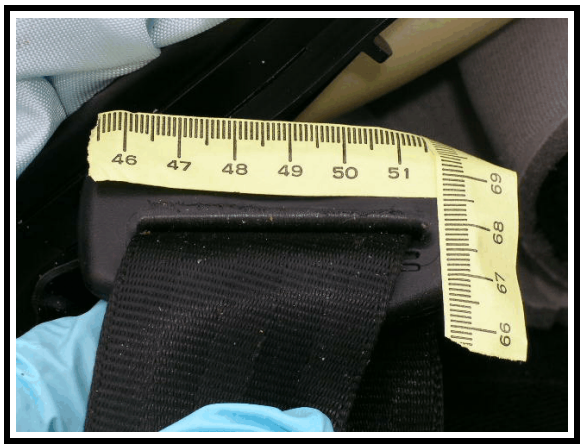

Figure 28. Evidence of loading to front right passenger's seat belt

Figure 29. Damaged front right seat back - locked in this position

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing this occupant to pitch to her left. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it landed in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. This event may have caused the driver and front right passenger seat belt pretensioners to actuate. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, resulting in the deployment the passenger's side impact air bag and causing this occupant to initiate a lateral trajectory towards the 3 o'clock direction of force. As the Volkswagen Golf traveled up the tree trunks and became airborne, this passenger pitched to her left. As the vehicle traveled up the trunks and through the air it began to rollover to the right, resulting in the deployment of both side curtain air bags. As the hood impacted the second group of trees, it is likely that this passenger was in her general seating area, being held somewhat in place by the locked seat belt retractor. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, this passenger initiated a forward and upward trajectory. During this impact, it is likely that some of the unrestrained occupants in the second row struck the back of

the front right seat back, causing it to move forward and lock at a 55 degree angle. When this occupant's seat back was struck by the back seat passengers, her upper body was forced forward with the seatback, causing her to load her seat belt and hit her head on the instrument panel. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees. The case vehicle rebounded from the tree impact, rotated one quarter turn to the left and fell to the ground, landing on its right side, causing this occupant to initiate a lateral trajectory to her right.

Figure 30. Close-up - blood on upper right instrument panel from occupant contact

This passenger was treated at the scene and was transported to a local hospital where she was hospitalized for one day. She sustained a closed head injury, a dislocated right elbow and abrasions to both iliac crests.

Second Row Left Occupant Kinematics

The 14-year-old second row left male passenger was seated forward facing in the cloth covered split bench seat and was not restrained by the available 3-point manual lap and shoulder belt. The seat back was reclined at a 99 degree angle. The precrash angle of the seat cushion could not be determined because the seat bottom was damaged in the crash. At the time of the vehicle inspection, it was found in the rear cargo area.

Figure 31. Possible occupant contact - back of the driver's seat back

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing this passenger to pitch against the left rear door. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it touched down in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, causing this occupant to initiate a lateral trajectory towards the 3 o'clock direction of force. As the Volkswagen Golf traveled up the tree trunks and became airborne, this occupant pitched to his left, likely contacting the left rear door, although no visible contact evidence was found. As the vehicle traveled up the trunks and through the air it began to rollover to the right, resulting in the deployment of both side curtain air bags. As the hood impacted the second group of trees, this occupant initiated a forward and upward trajectory, likely contacting the roof with

his head. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, this passenger initiated an upward and forward trajectory, likely striking the back of the front left seat back. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees. The vehicle rebounded from the trees, rotated one quarter turn to the left, and fell to the ground, landing on its right side, causing this passenger to initiate a lateral trajectory to his right.

This occupant was treated at the scene and was transported to a local hospital for further treatment. He sustained a concussion, a right pulmonary contusion, multiple rib fractures, a fractured right clavicle and multiple head/neck abrasions and lacerations.

Second Row Center Occupant Kinematics

The 14-year-old second row center male passenger was seated forward facing in the cloth covered bench seat and was not restrained by the available 3-point manual lap and shoulder belt. This occupant was sharing the center seat with another 14-year-old male passenger who was seated to his right. The seat back was reclined at a 99 degree angle. The precrash angle of the seat cushion could not be determined because the seat bottom was damaged in the crash and was no longer with the vehicle.

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing this occupant to pitch left against the second row left seat passenger. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it touched down in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, causing this occupant to initiate a lateral trajectory towards the 3 o'clock direction of force, likely contacting the occupant seated to his right. As the Volkswagen Golf traveled up the tree trunks and became airborne, this occupant pitched to his left again. As the vehicle traveled up the trunks and through the air it began to rollover to the right. As the hood impacted the second group of trees, this occupant initiated a forward and upward trajectory, likely contacting the roof with his head. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, this passenger initiated an upward and forward trajectory, likely striking the back of the front left seat back. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees. The vehicle rebounded from the trees, rotated one quarter turn to the left, and fell to the ground, landing on its right side, causing this passenger to initiate a lateral trajectory to his right.

This passenger was treated at the scene and was transported to a local hospital where he was hospitalized for five days. He sustained a concussion, a right pulmonary contusion, rib fractures and multiple contusions and abrasions.

Other Second Row Center Occupant

The other 14-year-old second row center male passenger was seated forward facing in the cloth covered bench seat and was not restrained by the available 3-point manual lap and shoulder belt. This occupant was sharing the center seat with another 14-year-old male who was seated to his left. The seat back was reclined at a 99 degree angle. The precrash angle of the seat cushion could not be determined because the seat bottom was damaged in the crash and was no longer with the vehicle.

Figure 32. Possible occupant contact to head restraint (restraint found in rear cargo area)

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing this occupant to pitch left against the passenger seated to his immediate left. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it touched down in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, causing this occupant to initiate a lateral trajectory towards the 3 o'clock direction of force, likely contacting the occupant seated to his right. As the Volkswagen Golf traveled up the tree trunks and became airborne, this occupant pitched to his left again. As the vehicle traveled up the trunks and through the air it began to rollover to the right. As the hood impacted the second group of trees, this occupant initiated a forward and upward trajectory, likely contacting the roof with his head. During this event, it is possible that this occupant's body was also thrust into the back of the right front seat back, causing it to move forward. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, this passenger initiated an upward and forward trajectory, likely striking the roof and back of the right front seat back again. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees. The vehicle rebounded from the trees, rotated one quarter turn to the left, and fell to the ground, landing on it's right side, causing this passenger to initiate a lateral trajectory to his right.

This passenger was treated at the scene and was transported to a local hospital for further treatment. He sustained a depressed skull fracture, a right wrist fracture, bilateral pulmonary contusions, a right rib fracture, a fractured left scapula, L1-L4 transverse process fractures, a kidney laceration and a bruised liver. He also sustained an occipital contusion, which may have been due to contacting an adjustable head restraint. At the time of the vehicle inspection, the second row center and right head restraints were not in position. One of the two head restraints was found in the rear cargo area, and showed signs of possible occupant contact, but it could not be determined whether or not it was the center or right head restraint.

Second Row Right Occupant Kinematics

The 14-year-old second row right male passenger was seated forward facing in the cloth covered bench seat and was not restrained by the available 3-point manual lap and shoulder belt. The seat back was reclined at a 99 degree angle. The precrash angle of the seat cushion could not be determined because the seat bottom was damaged in the crash and was no longer with the vehicle.

The case vehicle was in a counterclockwise yaw prior to departing the roadway, causing this occupant to pitch left against the passenger seated to his immediate left. As the Volkswagen departed the travel lanes, it became airborne for a short distance before it touched down in the ditch, on top of blackberry vines, grass, dirt, moss and rocks. The case vehicle continued sliding sideways over the terrain until the right side impacted several trees, causing this occupant to initiate a lateral trajectory towards the 3 o'clock direction of force, likely impacting the right rear door with his right hip and right arm while impacting the intruding right roof side rail with his head. There was a plastic covered handle located above the right rear window glazing which also showed signs of occupant contact. This occupant may have contacted the right rear window frame with his right shoulder and may have been partially ejected, as evidenced by the outward deformation of the right rear window frame. This deformation may also be attributed to the intrusion that occurred in the same general area. As the Volkswagen Golf traveled up the tree trunks and became airborne, this occupant pitched to his left. As the vehicle traveled up the trunks and through the air it began to rollover to the right, resulting in the deployment of both side curtain air bags. As the hood impacted the second group of trees, this occupant initiated a forward and upward trajectory, contacting the roof with his head.

Figure 33. Occupant contacts - roof side rail, roof and handle

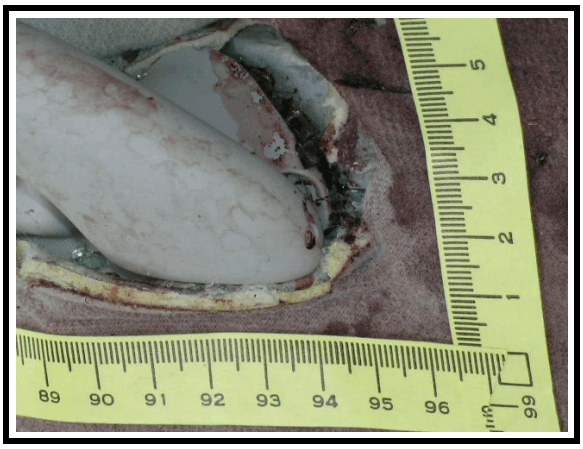

Figure 34. Close up - Handle located above the right rear window frame

Figure 35. Occupant contact - right rear door armrest

During this event, it is possible that this occupant's body was also thrust into the back of the right front seat back, causing it to move forward. The Volkswagen continued to travel north while still airborne and the top of the vehicle impacted the last two trees. During this event, this passenger initiated an upward and forward trajectory, likely striking the roof and back of the right front seat back again. The Volkswagen completed its third quarter turn, and the left side impacted the same two trees. The vehicle rebounded from the trees, rotated one quarter turn to the left, and fell to the ground, landing on it's right side, causing this passenger to initiate a lateral trajectory to his right.

According to police, due to the position of the Volkswagen at final rest, there was confusion on-scene as to the total number of passengers seated in the second row. This passenger was not discovered until the other back seat passengers had been removed from the vehicle. He was found curled into a fetal position against the right rear door. This passenger was removed from the vehicle by fire/rescue personnel but had sustained a severe head injury and was declared dead at the scene. The autopsy report listed this occupant's time of death as 2135 hours, but the police reported crash time was 2139 hours.

Figure 36. Deformed right rear window frame

Figure 37. Possible occupant contact to the back of the right front seat back

Attachment 1. Scene Diagram