Combination Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: 2002-82-104F
2003 Volkswagen Passat GLS four-door
Washington
December, 2002

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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 front to side crash occurred in Washington in December, 2002 at 0014 hours. It was dark at the time of the crash and the street lights were on. The crash occurred within the confines of a four-leg intersection.

The case vehicle is a 2003 Volkswagen Passat GLS four-door sedan driven by a restrained 22-year-old male. The Volkswagen was equipped with a driver's air bag, a front right passenger's air bag, left and right side curtain air bags, a seat back mounted driver's side impact air bag, a seat back mounted front right passenger's side impact air bag, and front and rear outboard seat belt pretensioners. This vehicle was traveling southbound approaching the intersection at a police witness estimated speed in excess of 129 km/h (80 mph). The other vehicle is a 1997 Mercury Sable GS four-door sedan driven by a 46-year-old male. The front right seat was occupied by an unrestrained 19-year-old female. This vehicle was traveling westbound approaching the intersection.

As both vehicles entered the intersection, the driver of the case vehicle began braking. The front of the case vehicle struck the right side of the other vehicle. The front right passenger air bag deployed and the driver's pretensioner fired at this point. The case vehicle was redirected to the right, entered the western leg of the intersection and struck a curb on the south side of the roadway with its left front tire. This impact caused the driver's side curtain and seat mounted side air bag to deploy.

The driver of the case vehicle attempted to flee the scene with his vehicle. There were no injuries listed for the driver of the case vehicle.

17. Key Words	18. Distribution Statement
Air bag, deployment, side air bag, side air curtain	

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Dynamic Science, Inc.
Accident Investigation
Case Number: 2002-82-104F

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BACKGROUND:

Description:	This two-vehicle, side air bag case was generated through NASS PSU 82. DSI was assigned the case on January 23, 2003. This two vehicle crash is being investigated as a combination case.
Investigation Type:	Combination
Crash Location:	Washington
Crash Date:	December, 2002
Notification Date:	January 23, 2003
Field Work Completed:	December 13, 2002

SUMMARY:

This front to side crash occurred in Washington in December, 2002 at 0014 hours. It was dark at the time of the crash and the street lights were on. The crash occurred within the confines of a four-leg intersection. The northern leg of the intersection is comprised of two southbound through lanes, a left hand turn lane, and two northbound through lanes. The eastern leg of the intersection is comprised of two westbound through lanes, a left hand turn lane, and two eastbound through lanes. The asphalt roadways were dry. The intersection is controlled by tri-color traffic signals. The signal was green for westbound traffic. The posted speed limit is 56 km/h (30 mph) for all roadways.

The case vehicle is a 2003 Volkswagen Passat GLS four-door sedan driven by a restrained 22-year-old male (183 cm/72 in, 88 kg/195 lbs). He was seated in a leather covered bucket seat that had been adjusted to between the middle and rear most track positions. The Volkswagen was equipped with a driver's air bag, a front right passenger's air bag, left and right side curtain air bags, a seat back mounted driver's side air bag, a seat back mounted front right passenger's side impact air bag, and front and rear outboard seat belt pretensioners. This vehicle was traveling southbound approaching the intersection at a police estimated speed in excess of 129 km/h (80

Figure 1. Approach to area of initial vehicle to vehicle impact (south).

Figure 2. Post-impact path of case vehicle

mph). The other vehicle is a 1997 Mercury Sable GS four-door sedan driven by a 46-year-old male. The front right seat was occupied by an unrestrained 19-year-old female. This vehicle was traveling westbound approaching the intersection.

As both vehicles entered the intersection, the driver of the case vehicle began braking. The front of the case vehicle struck the right side of the other vehicle (11FLEE2). The total velocity change calculated by the WinSmash collision model was 10 km/h (6 mph). The longitudinal and lateral delta V components were -9 km/h (6 mph) and 3 km/h (2 mph), respectively. The front right passenger's air bag deployed and the driver's pretensioner fired at this point. The case vehicle was redirected to the right, entered the western leg of the intersection and struck a curb on the south side of the roadway with its left front tire (10LFWN1). This impact caused the driver's side curtain and seat mounted side impact air bag to deploy.

Figure 3. Case vehicle impact with curb

Figure 4. Case vehicle (VW Passat)

The driver of the case vehicle attempted to flee the scene with his vehicle. He traveled approximately two blocks before his vehicle stopped due to damage. The driver of the case vehicle was subsequently arrested for "Hit and Run."

Both vehicles were eventually towed due to damage from their respective final rest positions.

The driver of the case vehicle was not injured. The driver and front right passenger of the other vehicle were taken by ambulance to a local hospital where they were treated and released. The driver of the other vehicle sustained a lumbar strain and bilateral knee contusions. The front right passenger sustained a cervical strain and a contusion to her right hip.

Figure 5. Damage to front left tire/rim

Figure 6. Other vehicle (Mercury Sable)

Scene Diagram

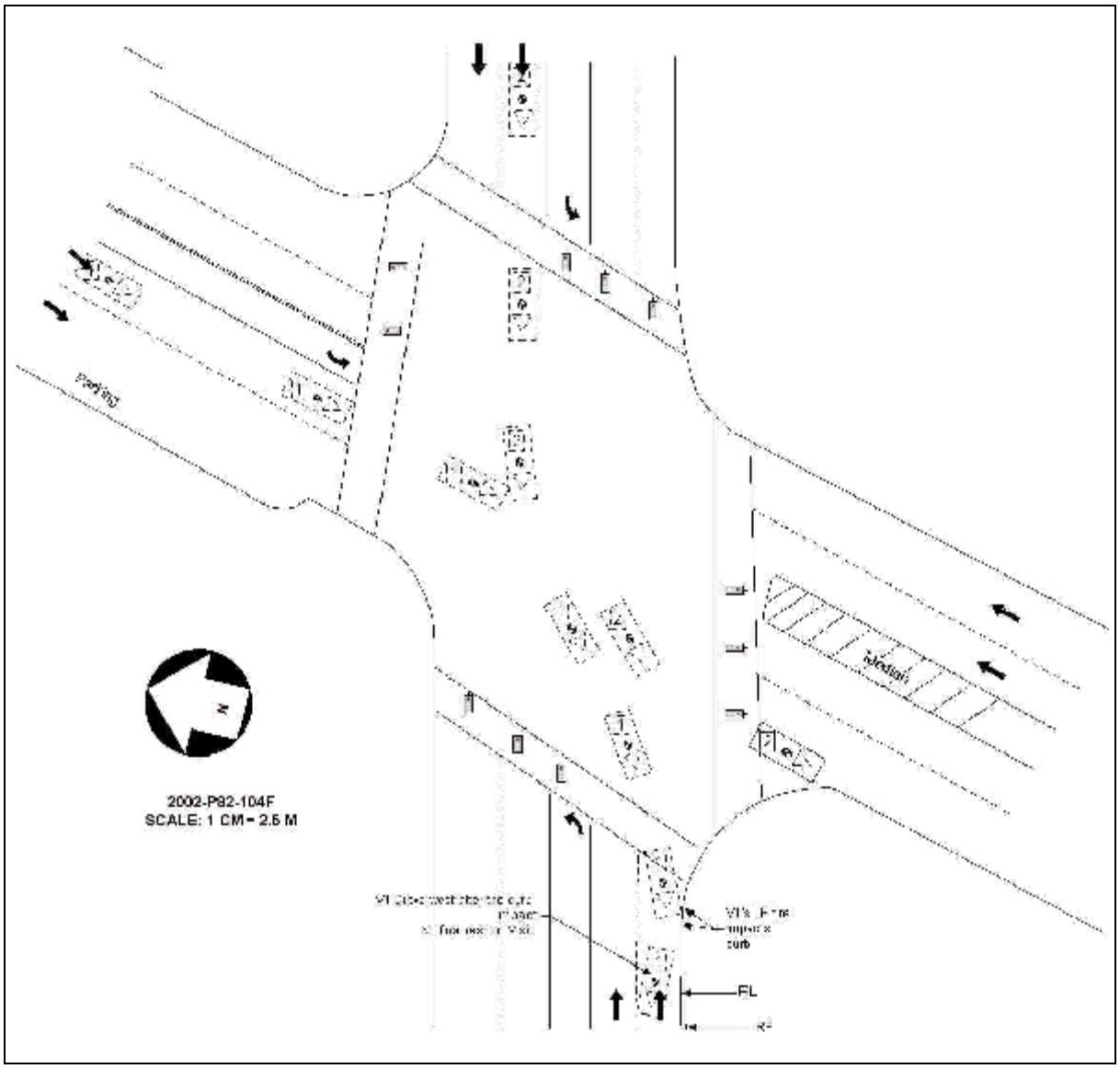

Figure 7. Scene Diagram

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	2003 Volkswagen Passat GLS four-door	
VIN:	WVWPD63B93Pxxxxxx	
Odometer:	2,231 km (1,386 miles)	
Engine:	4 cylinder, 1.8 L	
Reported Defects:	None noted	
Cargo:	54 kg (119 lbs), per vehicle inspection	
Damage Description:	Bumper fascia and reinforcement bar, the hood, left fender, left tire rim	
CDC:	Impact 1: 11FLEE2 Impact 2: 10LFWN1[1]	
Delta V (Impact 1):	Total	10 km/h (6 mph)
	Longitudinal	-9 km/h (-6 mph)
	Latitudinal	3 km/h (2 mph)
	Energy	13,724 joules (10,122 ft-lbs)

The Passat sustained 22 cm (9 in) of direct contact damage that began at the left bumper corner. The residual crush measured across the front bumper was as follows: C1=3 cm (1 in), C2=5 cm (2 in), C3=6 cm (2 in), C4=6 cm (2 in), C5=4 cm (2 in), C6=0 cm (0 in). The maximum crush was located between C2 and C3; it measured 6 cm (2 in). The principle direction of force was within the 11 o'clock sector was an estimated 340 degrees. The impact energy was managed by the forward structures of the vehicle. The damaged components from the initial

Figure 8. Front, case vehicle

[1]SCI change from EDCS

impact included the bumper fascia and reinforcement bar, the hood, and the left fender. There were no glazing fractures and all the doors remained closed and operational. There was scratching/scuffing to the front right tire/rim.

Figure 9. Close up of front left tire

Safety Systems Discussion

The Volkswagen was equipped with a driver's air bag, a front right passenger's air bag, left and right side curtain air bags for both front and rear outboard seats, a seat back mounted driver's side impact air bag, a seat back mounted front right passenger's side impact air bag, and front and rear outboard seat belt pretensioners.

During the case vehicle to vehicle impact, the driver's pretensioner fired and the front right passenger's air bag deployed. This appears appropriate for this collision. The front right passenger's air bag responded as if there were an unbelted occupant in that seat position. There would be a higher threshold for the driver's air bag since the driver was restrained.

During the case vehicle to curb side impact, the driver's side curtain and seat mounted side air bag deployed.

Figure 10. Driver's seat back mounted side impact air bag and side air curtain.

Figure 11. Side air curtain, right left seat

The driver's side curtain measured 150 cm (59 in) wide by 30 cm (12 in) tall. The driver's side impact air bag measured 16 cm (6 in) wide by 60 cm (24 in) tall. The front right passenger's air bag measured 65 cm (26 in) wide by 70 cm (28 in) tall. There was no evidence of contact or damage to any of the deployed air bags.

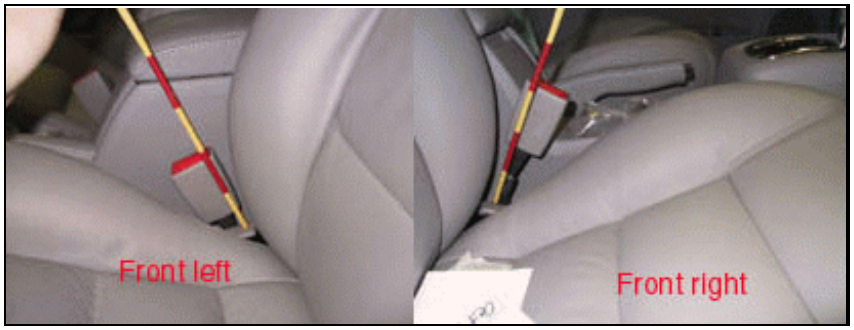

Figure 12. Driver's pretensioner fired, front right passenger pretensioner did not fire

Other vehicle

Description:	1997 Mercury Sable four-door	
VIN:	1MELM50U4VGxxxxxx	
Odometer:	120,690 km (74,995 miles)	
Engine:	6 cylinder, 3.0 L	
Reported Defects:	None noted	
Cargo:	None	
Damage Description:	Right fender, right axle. Right front tire restricted. Vehicle towed from the scene due to damage. Police report indicates $8000 damage.	
CDC:	03RYEW2	
Delta V:	Total	11 km/h (7 mph)
	Longitudinal	-2 km/h (-1 mph)
	Latitudinal	-11 km/h (-7 mph)
	Energy	5,938 joules (4,379 ft-lbs)

The Sable sustained 116 cm (295 in) of direct damage beginning 215 cm (136 in) forward of the right rear axle. The residual crush measured at the mid-door level was as follows: C1=1 cm (.5 in), C2=8 cm (4 in), C3=9 cm (4 in), C4=7 cm (3 in), C5=4 cm (2 in), C6=0 cm (0 in). The maximum crush was located 256 cm (116 in) forward of the right rear axle and measured 9 cm (4 in). The principle direction of force was within the 3 o'clock sector and was an estimated 100 degrees. The damaged components included the right fender and right tire/rim. There were no glazing fractures and all the doors remained closed and operational.

Figure 13. Right side, other vehicle

Occupants

Case vehicle	Occupant 1
Age/Sex:	22/Male
Seated Position:	Front left
Seat Type:	Leather-covered bucket seat. Seat adjusted to between mid and rear most track position. Seat back slightly reclined.
Height[2]:	183 cm (72 in)
Weight:	88 kg (195 lbs)
Occupation:	Student
Pre-existing Medical Condition:	None reported
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Right foot on brake, left on floor
Restraint Usage:	3-point, lap and shoulder belt available, used. Pretensioner fired.
Air bag:	Steering wheel mounted air bag, did not deploy. Driver's side impact air bag and side air curtain did deploy.

[2]Height/weight obtained from university football roster

Other vehicle	Front left	Front right
Age/Sex:	46/Male	19/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric-covered split bench seat. Seat adjusted to rear most track position. Seat back slightly reclined.	Fabric-covered split bench seat. Seat adjusted to rear most track position. Seat back slightly reclined.
Height:	175 (69 in)	Unknown
Weight:	84 kg (185 lbs)	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed to be greater than 10 years	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used

Injuries and Injury Mechanisms

Case vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Not injured			

Other vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Lumbar strain	640678.1,8	847.2	Seat back support
	Bilateral knee contusions	890402.1,3	924.11	Lower instrument panel
Front right occupant:	Contusion, right hip	890402.1,1	924.01	Right side door
	Cervical strain	640278.1,6	847.0	Unknown

Occupant Kinematics

The 22-year-old male (183 cm/72 in, 88 kg/195 lbs) driver of the case vehicle was likely seated in a normal, upright position. He was seated in a fabric covered bucket seat that had been adjusted to between the middle and rear-most track position. The seat back was slightly reclined. He was wearing the available 3-point lap and shoulder belt. The shoulder belt anchorage was in the full down position. The steering wheel was found at the time of the inspection to be in the full up position.

Figure 14. Driver's seated position

At impact, the driver's pretensioner fired and the passenger's front air bag deployed. The driver responded to the 11 o'clock direction of force by moving forward and to the left loading the pretensioner and locked manual restraint system. There were no indications of any occupant contacts from this occupant.

The case vehicle continued through the intersection, turning right. The left front tire struck the curb. The driver responded to the 10 o'clock direction of force by moving to the left. The curb impact caused the driver's side curtain and seat mounted side impact air bag to deploy. The driver likely engaged these air bags, but there was no evidence of any contact or injury.