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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN97-015
LOCATION - MISSOURI
VEHICLE - 1997 VOLKSWAGEN JETTA GT
CRASH DATE - June, 1997

Submitted:

July 12, 1999

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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.

Technical Report Documentation Page

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15. *Supplementary Notes*
On-site air bag deployment investigation involving a 1997 Volkswagen Jetta GT, four-door sedan, with active safety belts and dual front air bags, and a 1987 Mercedes-Benz 260E, four-door sedan

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1997 Volkswagen Jetta GT(case vehicle) and a 1987 Mercedes Benz 260E (other vehicle). This crash is of special interest because the case vehicle's front right passenger (6-year-old male) sustained a severe brain injury from his deploying front right air bag. The case vehicle was traveling south in the inside lane of a four-lane, undivided, city street and had just exited a left-hand curve, intending to continue straight ahead (i.e., there were two southbound and two northbound through lanes). The Mercedes Benz had been traveling north in the inside, northbound lane of the same city street and was in the process of turning left into the driveway of an elementary school. The crash occurred in the middle of the two southbound through lanes in the junction of the driveway access. The front of the case vehicle impacted the right side of the Mercedes Benz, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's driver (30-year-old female) was seated upright with her seat track located between its middle and forward-most positions, and her tilt steering wheel was located in its up-most position. She was not wearing her available, active, three-point, lap and shoulder belts and sustained minor abrasions and contusions to her chin, chest, arms, and right knee. The front right passenger in the case vehicle was seated slightly reclined with his seat track located between its middle and rearmost positions and was not wearing his available, active, three-point, lap and shoulder belts. He sustained, according to his medical records, severe injuries which included: a severe nonanatomic brain injury with neurologic deficit (i.e., a left hemiparesis) and respiratory compromise; subarachnoid hemorrhage; bilateral sixth nerve injuries; a vocal cord injury; a contusion to his right lung; abrasions to his chin and under chin, left ear, anterior neck, lower right chest and upper right quadrant of abdomen, and left shoulder; and a contusion to his chin and upper right chest.

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CASE SUMMARY

TRC/IU ON-SITE AIR BAG INVESTIGATION

SCI Team #2, TRC/IU Case Number IN97-015

Missouri

June, 1997

This on-site investigation was brought to NHTSA's attention on June 11, 1997 by the Insurance Institute for Highway Safety (IIHS). This crash involved a 1997 Volkswagen Jetta (case vehicle) and a 1987 Mercedes Benz 260E (other vehicle). The crash occurred in June, 1997, at 12:00 p.m., in Missouri and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's front right passenger [6-year-old, White (non-Hispanic) male] sustained a severe injury from his deploying front right air bag. This contractor inspected the scene and vehicles on 12-13 June, 1997. This contractor interviewed the driver for the case vehicle in early 1998. This summary is based on the Police Crash Report, interviews with the case vehicle's driver and the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

The case vehicle was traveling south in the inside lane of a four-lane, undivided, city street and had just exited a left-hand curve, intending to continue straight ahead in its southward direction of travel (i.e., there were two southbound and two northbound through lanes). The Mercedes Benz had been traveling north in the inside, northbound lane of the same, four-lane, undivided, city street and was in the process of turning left into the driveway of an elementary school. The case vehicle's driver attempted to avoid the crash by steering to the right and braking. The crash occurred in the middle of the two southbound through lanes in the junction of the driveway access.

The front of the case vehicle impacted the right side of the Mercedes Benz, causing the case vehicle's driver and front right supplemental restraints (air bags) to deploy. Post-impact, the case vehicle rotated approximately 75 degrees clockwise and came to rest in the driveway junction straddling, sideways, the two southbound through lanes. The Mercedes Benz was pushed in a southwesterly direction and came to rest adjacent to the apex of the curb on the southwest side of the driveway.

The case vehicle's front right passenger [102 centimeters and 20 kilograms (40 inches, 44 pounds) was not wearing his available, active, three-point, lap and shoulder belts. The continuous loop belt system was equipped with a pretensioner. As a result, both front seat belts were extremely taut from "D"-ring to floor, indicating definite nonuse during the crash. An inspection of the front right air bag module's cover flap revealed contact (deformity) to the lower flap which further supports the fact that this occupant was unrestrained. However, no definitive injury could be associated with this contact. An inspection of the front right passenger's tethered air bag, which was located in the middle of the instrument panel, revealed skin and most likely blood to the top and center right portion.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of the available safety belts, the front right passenger moved forward, near the front right air bag module, just prior to impact. The case vehicle's impact with the Mercedes Benz enabled the front right passenger to continue forward and upward as the case vehicle decelerated. As the front right air bag deployed it engaged the front right passenger at and underneath the chin, lifting him upwards into the sun visor/roof area. As the air bag continued to expand, the brunt of the bag's force struck him in the lower face, anterior neck, and chest. At maximum engagement with the Mercedes Benz, the case vehicle rotated approximately 75 degrees clockwise, causing the front right passenger to hit the right front window glazing (smudges) as he was falling back down from contacting the sun visor/roof area. The front right passenger rebounded back to the left where he contacted the right side of the driver's seat back (skin evidence). As the case vehicle came to an abrupt stop, the front right passenger rebounded back into his seat, probably striking the right front door again, before coming to rest. According to the case vehicle's driver (i.e., mother), at final rest he was seated in the front right seat with his back against the seat back and his legs sticking out over the seat.

The front right occupant was transported by ambulance to a hospital where he was stabilized and subsequently flown by helicopter to a children's trauma center. He sustained severe injuries and was hospitalized in the trauma center for 22 days, then transferred to the rehabilitation portion of the same hospital for an additional 29 days (51 days post-crash), and treated in outpatient rehabilitation for another 45 days before finally being released (from rehabilitation) 96 days post-crash. The injuries sustained by the case vehicle's front right passenger included: a severe nonanatomic brain injury with neurologic deficit (i.e., a left hemiparesis) and respiratory compromise; subarachnoid hemorrhage; bilateral sixth nerve injuries; a vocal cord injury; a contusion to his right lung; abrasions to his chin and under chin, left ear, anterior neck, lower right chest and upper right quadrant of abdomen, and left shoulder; and a contusion to his chin and upper right chest.

The 1997 Volkswagen Jetta GT was a front wheel drive, four-door sedan (VIN: 3VWVA81H5VM------). The case vehicle was not equipped with anti-lock brakes. The 1987 Mercedes Benz 260E is a rear wheel drive, four-door sedan (VIN: WDBEA26D2HA------). The case vehicle and the Mercedes Benz were both towed due to damage from the scene. The CDCs were determined to be: **12-FDEW-1 (350)** for the case vehicle [maximum crush was 12 centimeters (4.7 inches)] and **02-RYEW-3 (50)** for the Mercedes Benz [maximum crush was 39 centimeters (15.4 inches)]. The WinSMASH reconstruction program, damage only algorithm, was used on the highest severity impact to the case vehicle. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 28.4 km.p.h. (17.6 m.p.h.), -28.0 km.p.h. (-17.4 m.p.h.), and +4.9 km.p.h. (+3.0 m.p.h).

Immediately prior to the crash, the unrestrained front right passenger was seated slightly reclined with his back against the seat back, both feet sticking out from the seat, an ice cream cone in his right hand (most likely near his mouth), and his left hand on his lap. The front right passenger's seat track was located between its middle and rearmost positions, with the seat back slightly reclined. The ice cream cone was most likely near his mouth because there was ice cream residue on the right sun visor and driver's seat, indicating that the cone was lifted upwards with the occupant by the deploying air bag.

The case vehicle's driver [30-year-old, White (non-Hispanic) female] was seated upright with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel. The driver's seat track was located between its middle and forward-most positions, the seat back was upright, and her tilt steering wheel was located in its up-most position. The case vehicle's driver [165 centimeters and 54 kilograms (65 inches and 120 pounds)] was not wearing her available, active, three-point, lap and shoulder belts. The continuous loop belt system was equipped with a pretensioner. As a result, the driver's seat belts were extremely taut from "D"-ring to floor, indicating definite nonuse during the crash. The driver was transported by ambulance to the hospital where she was treated and released. She sustained minor abrasions to her: chin, left upper arm, bilateral forearms, and right knee, and contusions: to her anterior chest, left hand, and left anterior forearm.

TRC/IU ON-SITE AIR BAG INVESTIGATION

TRC/IU CASE NO. IN97-015

VEHICLE - 1997 VOLKSWAGEN JETTA GT
LOCATION - MISSOURI

CRASH DATA

Location/Street:	City Street
State:	Missouri
Area/Type:	Rural, residential
Crash Date/Time:	June, 1997, @ 12:00 p.m.
Investigating Police Agency:	City police department
Crash Type:	Vehicle / Vehicle - obtuse angle
Occupant Injury Severity (air bag vehicle):	Nonanatomic brain injury (AIS-4)

AMBIENT CONDITIONS

Light Conditions:	Daylight
Weather Condition:	Overcast
Precipitation:	None
Road Surface:	Dry
Temperature:	Unknown

ROADWAY

	Case Vehicle	**Other Vehicle**
Location:	City street	City street
Number of Travel Lanes:	Four lanes, undivided	Four lanes, undivided
Width:	3.8 meters (12.5 feet)	3.8 meters (12.5 feet)
Surface Type:	Concrete	Concrete
Median:	None	None
Shoulders:	Concrete, 1 meter (3.3 feet) wide	Concrete, 0.7 meter (2.3 feet) wide
Vertical alignment:	Level (actual grade is less than -2%)	Level (actual grade is less that +2%)
Horizontal alignment:	Straight just prior to impact; vehicle had just exited a left-hand curve	Straight
Estimated Coefficient of Friction:	.80	1.00

ROADWAY (Continued)

	Case Vehicle	Other Vehicle
Traffic Density:	Light	Light

TRAFFIC CONTROLS

	Case Vehicle	Other Vehicle
Signals:	None	None
Signs:	Regulatory SPEED LIMIT sign	Regulatory SPEED LIMIT sign and information ENTRANCE ONLY sign
Markings:	Double solid yellow centerline between north and southbound lanes, dashed white lines between inside and outside southbound lanes	Double solid yellow centerline between north and southbound lanes, dashed white lines between inside and outside northbound lanes
Speed Limit:	40 km.p.h. (25 m.p.h.)	40 km.p.h. (25 m.p.h.)

VEHICLES

	Case Vehicle	Other Vehicle
Year:	1997	1987
Make:	Volkswagen	Mercedes Benz
Model:	Jetta GT	260E
Body Type:	Four-door sedan, five passengers	Four-door sedan, five passengers
V.I.N.	3VWVA81H5VM------	WDBEA26D2HA------
Color:	White	Bronze
Mileage:	810 kilometers (503 miles)	208,444 km (129,521 miles)
Engine:	2.0 liters, I-4	2.6 liters, I-6
Transmission:	Five-speed, manual	Four-speed, automatic
Steering:	Power-assisted, rack-and-pinion	Power-assisted, rack-and-pinion
Brakes:	Power-assisted, four-wheel disc	Power-assisted, four-wheel disc
Padding:	Steering wheel and hub, sun visors, dash, "A"-pil-lars, side door surfaces	Steering wheel and hub, sun visors, dash, A"-pil-lars, side door surfaces

VEHICLES (Continued)

	Case Vehicle	**Other Vehicle**
Active Restraints:	Three-point, manual, lap and shoulder belts in front and rear outboard seating positions; lap belt only at rear center position. The front outboard safety belts were equipped with pre-tensioners	Three-point, manual, lap and shoulder belts in front and rear outboard seating positions; lap belt only at rear center position
Passive Restraints:	Factory installed driver and front right passenger supplemental restraint systems (air bags)	Factory installed driver supplemental restraint system (air bag)
Anti-lock brakes:	Option, not equipped	No
Defects:	None	None
Fleet:	Private vehicle	Private vehicle
Tow status:	Towed due to damage	Towed due to damage

VEHICLE DAMAGE

EXTERIOR

Deployment Impact	**Case Vehicle**	**Other Vehicle**
Event number:	First	First
Object Struck:	Other vehicle	Case vehicle
Damage location		
Damaged Plane:	Front	Right side
Vertical Location		
On Plane:	Bumper level	Above sill
Direct Begins:	Bumper corner to bumper corner	54.0 cm forward of right rear axle
Length Direct:	148.0 cm (58.3 in)	204.0 cm (80.3 in)
Field L:	144 cm (56.7 in)	306 cm (120.5 in)
C_1:	3.0 cm (1.2 in)	0.0 cm (0.0 in)
C_2:	3.0 cm (1.2 in)	8.0 cm (3.2 in)
C_3:	4.0 cm (1.6 in)	29.0 cm (11.4 in)
C_4:	5.0 cm (2.0 in)	36.0 cm (14.2 in)
C_5:	7.0 cm (2.8 in)	10 cm (3.9 in)
C_6:	12.0 cm (4.7 in)	0.0 cm (0.0 in)
D:	0.0 cm (0.0 in)	+21.0 cm (8.3 in)
Maximum Crush:	12.0 cm (4.7 in)	39.0 cm (15.4 in)

VEHICLE DAMAGE (Continued)

EXTERIOR	**Case Vehicle**	**Other Vehicle**
Location:	C_6	C_4
CDC:	**12-FDEW-1 (350)**	**02-RYEW-3 (50)**
Damaged Components:	Front bumper, hood, both front headlight assemblies, and right front fender	Right front fender, right front door, and right rear door

INTERIOR	**Case Vehicle**	**Other Vehicle**
Damaged Components:	Driver and front right passenger air bag modules and driver's knee bolster	Right front and right rear door panels, "A"- and "B"-pillars and both right side door glazings
Other Evidence of Occupant Contact:	Driver and front right passenger seat backs; front right air bag module's cover flap; right front window glazing; and front right sun visor	None
Manual Restraint System Failures:	None	None
Seat Performance Failures:	None	None
REPAIR		
Cost Estimate:	Unknown	Unknown

VEHICLE VELOCITY ESTIMATES

HIGHEST DELTA "V"	**Case Vehicle**	**Other Vehicle**
Reconstruction Program:	WinSMASH	WinSMASH
Program Algorithm:	Damage only	Damage only
Barrier Equivalent Delta V:	16.0 km.p.h. (9.9 m.p.h.)	32.7 km.p.h. (20.3 m.p.h.)
Total Delta "V":	28.4 km.p.h. (17.6 m.p.h.)	24.3 km.p.h. (15.1 m.p.h.)
Longitudinal Delta "V":	-28.0 km.p.h. (-17.4 m.p.h.)	-15.6 km.p.h. (-9.7 m.p.h.)
Lateral Delta "V":	+4.9 km.p.h. (+3.0 m.p.h.)	-18.6 km.p.h. (-11.6 m.p.h.)

COLLISION SEQUENCE

The following is based on the Police Crash Report, interviews with the case vehicle's driver and the investigating police officer, scene and vehicle inspections, occupant medical records, and this contractor's evaluation of the evidence.

PRE-CRASH: The case vehicle (Jetta) was traveling south in the inside lane of a four-lane, undivided, city street and had just exited a left-hand curve (**Figures 1** and **2**), intending to continue straight ahead in its southward direction of travel (i.e., there were two southbound and two northbound through lanes). The Mercedes Benz had been traveling north in the inside, northbound lane of the same, four-lane, undivided, city street and was in the process of turning left into the driveway of an elementary school (**Figures 3** and **4**). The driver of the case vehicle attempted to avoid the crash by braking and steering to the right. The case vehicle moved to the right, straddling the two southbound through lanes, and continued forward just prior to impact (**Figure 2**). The driver of the Mercedes Benz made no known pre-crash avoidance maneuvers. The crash occurred in the middle of the two southbound through lanes in the junction of the driveway access (**Figure 4**).

Figure 1: Case vehicle's travel path from inside southbound lane of left-hand curve toward impact in driveway junction; Note: red cone marks point of impact (case photo #01)

Figure 2: Case vehicle's travel path just prior to impact with Mercedes Benz; Note: red cone marks point of impact and skid marks show rightward steering and locked braking (case photo #03)

Figure 3: Mercedes Benz's travel path in inside northbound lane just before making its left-hand turn; Note: red cone marks point of impact between two southbound lanes (case photo #09)

Figure 4: Mercedes Benz's travel path during left-hand turn into driveway; Note: red cone marks point of impact between two southbound lanes and arrows show final rest position (case photo #11)

COLLISION SEQUENCE (Continued)

CRASH: The front right (**Figures 5** and **6**) of the case vehicle impacted the right side of the Mercedes Benz (**Figure 7**), causing both the driver and front right supplemental restraint systems (air bags) to deploy. In addition, see **Figures 14**, **15**, and **16** in the **SELECTED PHOTOGRAPHS** section below. The case vehicle rotated approximately 75 degrees clockwise and came to rest sideways in the driveway junction straddling the two southbound through lanes. The Mercedes Benz was knocked sideways, in a southwesterly direction, approximately 2.5 meters (8.3 feet) and came to rest adjacent to the apex of the curb on the southwest side of the driveway heading primarily west (**Figure 8**).

Figure 5: Case vehicle's frontal damage; Note: contact extends across entire bumper with majority of crush to front right corner (case photo #15)

Figure 6: Overhead view of case vehicle's frontal damage with contour gauge present; Note: crush primarily to front right corner (case photo #16)

Figure 7: Mercedes Benz's right side damage viewed from right of back (case photo #56)

Figure 8: On scene view of both vehicles at final rest; Note: case vehicle (at left) rotated approximately 75 degrees clockwise post-crash (case photo #65)

POST-CRASH:

Occupants: The driver of the case vehicle remained inside the vehicle at final rest. She was

COLLISION SEQUENCE (Continued)

POST-CRASH:

Occupants: (Continued)

conscious and was able to exit the case vehicle without any assistance. The front right passenger remained inside the vehicle at final rest. He was unconscious and was unable to exit the case vehicle because of his injuries. Neither the case vehicle's driver nor the front right passenger were restrained by their available, active, three-point, lap and shoulder belts. This was proven by the fact that this vehicle's continuous loop belt system had what Volkswagen calls "Emergency Tensioning Retractors" (pretensioners), and at the time of the vehicle inspection, both front seat belts were extremely taut from the"D"-ring on the "B"-pillar to the floor with no slack as there would have been had they been in use at the time of the crash. This tautness indicates definite nonuse during the crash. The driver claims that the front right passenger was belted but could not recall if she unbuckled his safety belt following the crash in order to remove him.

Police: The investigating police agency was notified of the crash within three minutes post-crash and arrived on-scene six minutes post-crash. Traffic control procedures were established and emergency medical and towing services were called to assist.

Rescue: The driver was transported by ambulance to the hospital where she was treated and released. The front right occupant was transported by ambulance to a hospital where he was stabilized and subsequently flown by helicopter to a children's trauma center. He sustained severe injuries and was hospitalized in the trauma center for 22 days, then transferred to the rehabilitation portion of the same hospital for an additional 29 days (51 days post-crash), and treated in outpatient rehabilitation for another 45 days before finally being released (from rehabilitation) 96 days post-crash.

The case vehicle's driver sustained minor abrasions to her: chin, left upper arm, bilateral forearms, and right knee, and contusions: to her anterior chest, left hand, and left anterior forearm. The injuries sustained by the case vehicle's front right passenger included: a severe nonanatomic brain injury with neurologic deficit (i.e., a left hemiparesis) and respiratory compromise; subarachnoid hemorrhage; bilateral sixth nerve injuries; a vocal cord injury; a contusion to his right lung; abrasions to his chin and under chin, left ear, anterior neck, lower right chest and upper right quadrant of abdomen, and left shoulder; and a contusion to his chin and upper right chest.

Removal: Following the police investigation, the case vehicle and the Mercedes Benz was towed from the scene.

HUMAN FACTORS/OCCUPANT DATA

DRIVERS	**Case Vehicle**	**Other Vehicle**
Age:	30-year-old	34-year-old
Sex:	Female	Female
Height:	165 cm (65 in)	Unknown
Weight:	54 kg (120 lbs)	Unknown
Occupation:	Teacher	Unknown
Active Restraint System/Usage:	Three-point lap and shoulder/Not used	Three-point lap and shoulder/Used
Usage Source:	Vehicle inspection	Vehicle inspection
Passive Restraint System/Usage:	Factory installed air bag/air bag deployed	Factory installed air bag/air bag did not deploy
Usage Source:	Vehicle inspection, interviewee, and Police Crash Report	Vehicle inspection and Police Crash Report
Eyeglasses/contacts:	None	Unknown
Vehicle Familiarity:	Six days, unknown distance [Note: only 810 km (503 mi) total]	Unknown
Route Familiarity:	Daily	Unknown
Trip Plan:	Fast food store to school recital	Unknown to school
Manner of Leaving Scene:	Ambulance	Ambulance
Type of Medical Treatment:	Treated and released	Treated and released

FRONT RIGHT PASSENGER	**Case Vehicle**
Age:	6-year-old
Sex:	Male
Height:	102 centimeters (40 inches)
Weight:	20 kilograms (44 pounds)
Active Restraint System/Usage:	Three-point lap and shoulder/Not used
Usage Source:	Vehicle inspection and Police Crash Report
Passive Restraint System/Usage:	Factory installed air bag/air bag deployed
Usage Source:	Vehicle inspection, interviewee, and Police Crash Report
Eyeglasses/contacts:	None

HUMAN FACTORS/OCCUPANT DATA (Continued)

FRONT RIGHT PASSENGER **Case Vehicle**

Manner of Leaving Scene: Ambulance

Type of Medical Treatment: Hospitalized

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasions {air bag burns} to anterior left upper arm and left anterior forearm	790202.1 minor	Air bag, driver's	Certain	Emergency room records
2	Contusion left anterior forearm	790402.1 minor	Air bag, driver's	Certain	Emergency room records
3	Contusion {bruise}, small, between 3rd and 4th distal metacarpals left hand	790402.1 minor	Air bag, driver's	Probable	Emergency room records
4	Abrasion, slight, chin	290202.1 minor	Air bag, driver's	Certain	Interviewee (same person)
5	Contusion {bruise} chest and sternum	490402.1 minor	Air bag, driver's	Certain	Interviewee (same person)
6	Abrasion right forearm, location not specified	790202.1 minor	Air bag, driver's	Certain	Interviewee (same person)
7	Abrasion {scrap} right knee	890202.1 minor	Left knee bolster	Certain	Interviewee (same person)

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with loss of consciousness (GCS=6 initially; GCS=10 on arrival "transferred to" medical facility) and left hemiparesis (neurologic deficit)	160804.4 severe	Air bag, front right passenger's	Certain	Hospitalization records

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES (Continued)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2	Hemorrhage, subarachnoid near tentorium[1] [Aspect = Unknown]	140684.3 serious	Air bag, front right passenger's	Probable	Hospitalization records
3 4	Paralysis {palsy} sixth nerve, bilaterally, left greater than right	131499.2 131499.2 moderate	Air bag, front right passenger's	Probable	Hospitalization records
5	Paralysis, mild, vocal cord, not further specified	341899.2 moderate	Air bag, front right passenger's	Probable	Hospitalization records
6	Contusion right lower lobe of lung	441406.3 serious	Air bag, front right passenger's	Probable	Hospitalization records
7	Abrasion chin and under chin, large	290202.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
8	Abrasion left ear	290202.1 minor	Air bag, front right passenger's	Probable	Hospitalization records
9	Contusion {ecchymosis} chin	290402.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
10	Abrasions anterior neck	390202.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
11	Abrasion lower right chest	490202.1 minor	Air bag, front right passenger's	Certain	Emergency room records
12	Contusion {ecchymosis} right upper chest	490402.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
13	Abrasion, large, upper right quadrant	590202.1 minor	Air bag, front right passenger's	Certain	Emergency room records

[1] The exact location of the subarachnoid hemorrhage was never specified. It was cited as being near the tentorium and brain stem but also in the interpeduncular cistern.
The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
cistern (sis-tern): a closed space serving as a reservoir for fluid; see also *cisterna*.
basal c.: cisterna interpeduncularis.
interpeduncular c.: cisterna interpeduncularis.
cisterna (sis-ter-na)* pl. *cisternae: a cistern -- a closed space serving as a reservoir for lymph or other body fluid, especially one of the enlarged subarachnoid spaces containing cerebrospinal fluid.
c. basalis: c. interpeduncularis.
c. interpeduncularis: interpeduncular cistern -- a dilatation of the subarachnoid space between the cerebral peduncles; called also *basal cistern*.
tentorium (ten-to-re-am): an anatomical part resembling a tent or a covering.
t. cerebelli, t. of cerebellum: the process of dura mater that supports the occipital lobes and covers the cerebellum. Its internal border is free and bounds the tentorial notch; its external border is attached to the skull and encloses the transverse sinus behind.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES (Continued)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
14	Abrasion left shoulder	790402.1 minor	Air bag, front right passenger's	Certain	Hospitalization records

CASE VEHICLE DRIVER KINEMATICS

According to the case vehicle's driver, immediately prior to the crash she was seated upright with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel. The driver's seat track was between its middle and forward-most positions, the seat back was upright, and her tilt steering wheel was located in its up-most position. Despite the claims of the case vehicle's driver, she was not wearing her available, active, three-point, lap and shoulder belts. The continuous loop belt system was equipped with a pretensioner. As a result, the driver's seat belts were extremely taut from the "B"-pillar's "D"-ring to the floor, indicating definite nonuse during the crash. The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of her available safety belts, the driver moved forward, near the driver air bag module, just prior to impact.

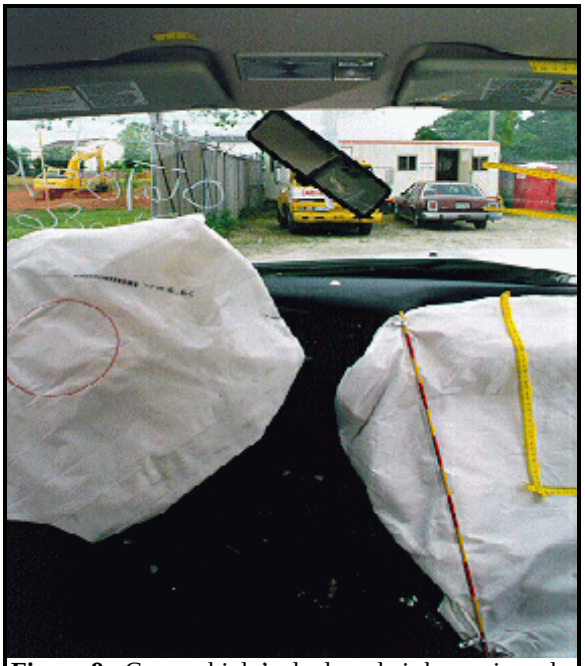


Figure 9: Case vehicle's deployed air bags viewed from back seat; Note: rear view mirror knocked askew by front right air bag (case photo #34)

Figure 10: Case vehicle's deployed driver air bag showing no clear evidence of driver contact (case photo #28)

CASE VEHICLE DRIVER KINEMATICS (Continued)

The case vehicle's impact with the Mercedes Benz enable the driver to continue forward and upward toward the 350 degree Direction of Principal Force as the case vehicle decelerated. An inspection of the driver's air bag (**Figure 9** above) revealed ice cream spots on the air bag; however, there was no visible evidence of occupant contact found on the air bag (**Figure 10** above). Also, there was no evidence of occupant contact on either of the air bag module's cover flaps. Because she was not using her available safety belt and because of her close proximity to the driver air bag module (i.e., seated between the center and forward-most positions) and the position of the tilt steering wheel (i.e., up-most position), the brunt of the deploying driver air bag's force struck her in her chest. This explains the absence of facial skin evidence on the driver's air bag and is consistent with the abrasions the driver sustained to her arms. The left knee bolster showed evidence of occupant loading and the driver sustained a self-reported "scrape" to her right knee which is consistent with the interior deformation.

According to the case vehicle's driver, her arms were knocked backwards above her head as she most likely was knocked backwards toward the right side of her seat back and the center console. As the case vehicle rotated clockwise, the driver most likely rebounded back towards the steering wheel and driver's door before coming to rest in her seat. The driver has no recollection of her exact final rest position because her concentration was on her injured son who was in the front right seat.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

According to the case vehicle's driver (i.e., mother), immediately prior to the crash the front right passenger was seated slightly reclined with his back against the seat back, both feet sticking out from the seat, an ice cream cone in his right hand--which was most likely near his mouth, and his left hand on his lap. The ice cream cone was most likely near his mouth because there was ice cream residue on the right sun visor and driver's seat, indicating that the cone was lifted upwards with the occupant by the deploying air bag. The front right passenger's seat track was located between its middle and rearmost positions, with the seat back slightly reclined. The case vehicle's front right passenger was not wearing his available, active, three-point, lap and shoulder belts. The continuous loop belt system was equipped with a pretensioner. As a result of the impact, the front right seat belt was extremely taut from the "B"-pillar's "D"-ring to the floor, indicating definite nonuse during the crash. An inspection of the front right air bag module's cover flap revealed contact (deformity) to the lower flap which further supports the fact that this occupant was unrestrained. Although this deformation was most

Figure 11: Case vehicle's deployed front right air bag showing occupant contact evidence to upper center portion of air bag, sun visor, and right front glazing (case photo #44)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS (Continued)

likely caused by one of the front right passenger's distal thighs and/or knees, no definitive injury could be associated with this contact.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of the available safety belts, the front right passenger moved forward, near the front right air bag module, just prior to impact. The case vehicle's impact with the Mercedes Benz enabled the front right passenger to continue forward and upward as the case vehicle decelerated. As the front right air bag deployed (**Figure 11** above) it engaged the front right passenger at and underneath the chin lifting him upwards into the sun visor/roof area (**Figure 12**). As the air bag continued to expand, the brunt of the bag's force struck him in the lower face, anterior neck, and chest. An inspection of the front right passenger's tethered air bag, which was located in the middle of the instrument panel, revealed and area [21 centimeters wide by 36 centimeters high (8.3 x 14.2 inches)] of skin and most likely blood to the top (**Figure 13**) and center right portion.

Figure 12: Close-up of case vehicle's front right sun visor showing evidence of contact by front right passenger (case photo #36)

At maximum engagement with the Mercedes Benz, the case vehicle rotated approximately 75 degrees clockwise, causing the front right passenger to hit the right front window glazing (smudges, **Figure 11** above) as he was falling back down from contacting the sun visor/roof area. The front right passenger rebounded back to the left where he contacted the right side of the driver's seat back (skin evidence). As the case vehicle came to an abrupt stop, the front right passenger rebounded back into his seat, probably striking the right front door again, before coming to rest. At final rest he was seated in the front right seat with his back against the seat back and his legs sticking out over the seat.

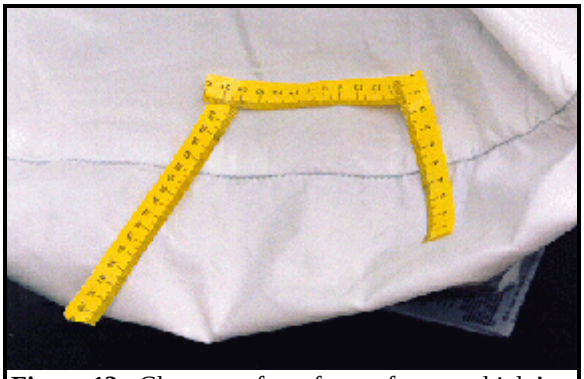
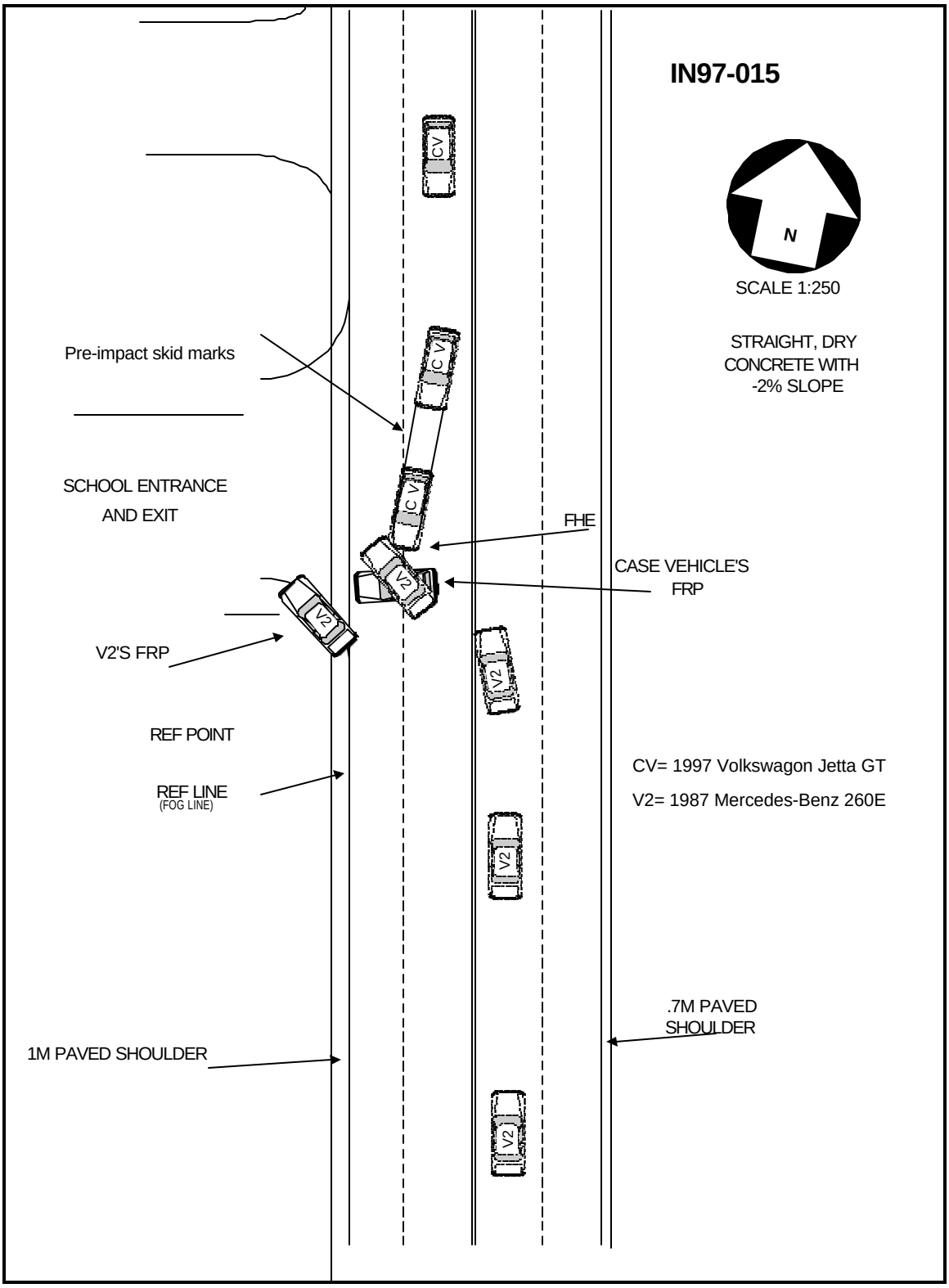


Figure 13: Close-up of top front of case vehicle's front right air bag showing occupant contact evidence (case photo #39)

CASE VEHICLE AIR BAG SYSTEM

	DRIVER AIR BAG	**FRONT RIGHT AIR BAG**
Air Bag Diameter (seam-to-seam, deflated):	Width: 68 cm (26.8 in) Height: 63 cm (24.8 in)	Width: 72 cm (28.3 in) Height: 74 cm (29.1 in)
Number of Vent Holes:	Two	Two
Vent Hole Diameter:	3 cm (1.2 in)	5 cm (2.0 in)
Vent Hole Clock Positions:	Approximately 10:30 and 1:30 o'clock positions	Approximately 2 and 10 o'clock
Number of Air Bag Tethers:	Two	None
Number of Air Bag Module Cover Flaps:	Two	Two
Upper Cover Flap Dimensions:	Width: 19 cm (7.5 in) Height: 20 cm (7.9 in)	Width: 37 cm (14.6 in) Height: 8 cm (3.1 in)
Lower Cover Flap Dimensions:	Width: 19 cm (7.5 in) Height: 18 cm (7.1 in)	Width: 37 cm (14.6 in) Height: 11 cm (4.3 in)
Distance between Dash and leading (i.e., closest) edge of Module's Cover Flap:	**Not applicable**	0 cm (0.0 in) 88 cm (34.6 in) from dash to center of front right seat back
Mount Location:	Steering wheel hub	Front mounted
Generant Residue:	No unusual amount found	No unusual amount found

CRASH DIAGRAM



SELECTED PHOTOGRAPHS

Figure 14: Reference line view of case vehicle's frontal damage from right; Note: crush primarily to front right corner (case photo #22)

Figure 15: Mercedes Benz's right side damage view-ed from back of right; Note: vertical yellow tape marks width of direct damage (case photo #59)

Figure 16: Mercedes Benz's right side damage viewed from right of front; Note: yellow tape marks width of direct contact (case photo #61)