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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-99-11-205J

LOCATION - Michigan

VEHICLE - 1998 VOLKSWAGEN NEW BEETLE

CRASH DATE - December 1999

Submitted:

September 14, 2000

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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. <i>Supplementary Notes</i> Combination SCI/NASS side air bag deployment investigation involving a 1998 Volkswagen New Beetle, with manual safety belts and dual front and side air bags, that impacted a tree.					
16. <i>Abstract</i> This report covers a SCI/NASS combination investigation of a side air bag deployment crash that involved a 1998 Volkswagen New Beetle (case vehicle) that impacted a wooden mailbox post and a tree. This crash is of special interest because the case vehicle was equipped with seat back-mounted side air bags and the driver's side air bag deployed as a result of the collision events. The case vehicle's unrestrained driver (33-year-old male) was ejected and sustained serious injuries. The case vehicle was traveling west in the westbound lane of a two-lane, undivided county roadway and was attempting to pass the vehicle in front of it by driving in the eastbound lane. The case vehicle lost control on the wet surface, began rotating clockwise and traveled off the left (south) side of the roadway. The case vehicle's right rear quarter panel impacted a wooden mailbox post. The case vehicle continued in a westerly direction while still rotating clockwise. The left side of the case vehicle impacted a tree, causing the case vehicle driver's seat back-mounted side air bag to deploy. The case vehicle was slightly redirected into a northwesterly direction as it spun off the tree in a counterclockwise rotation and came to rest heading east-northeast. At some point between the tree impact and final rest, the case vehicle driver was ejected onto the street. The case vehicle's driver was transported by ambulance to a hospital where he was hospitalized for 4 days. According to his medical records he sustained serious injuries, consisting of: a minor laceration to his liver; bilateral lung contusions; contusion to his right kidney; bilateral rib fractures; fractures of transverses processes of the lumbar vertebrae; bilateral hand abrasions; laceration to his right posterior scalp; and contusion/subgaleal hematoma right parietal scalp. The case vehicle was towed from the scene due to damage.					
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This combination SCI/NASS crash investigation concerns a 1998 Volkswagen New Beetle (case vehicle) that impacted a mailbox post and a tree. The crash occurred in December 1999, at 9:10 p.m., in Michigan, and was investigated by the applicable county police department. This crash is of special interest because the case vehicle was equipped with seat back-mounted side air bags and the driver's side air bag deployed as a result of the collision events. The unrestrained driver (33-year-old male) was completely ejected and sustained serious injuries. The NASS researcher inspected the scene and case vehicle in January 2000. This report is based on the Police Crash Report, the NASS investigator's coded forms, scene and vehicle inspections and photographs, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling west on a two-lane, undivided county roadway (one lane eastbound and one lane westbound) in a rural area and was attempting to pass a slower moving west bound vehicle by traveling west in the eastbound lane. The bituminous roadway was straight and level with no defects (**Figure 1**), and was wet, dark and not illuminated at the time of the crash. The posted speed limit was 72 km.p.h. [45 m.p.h.]. The NASS investigator's estimated coefficient of friction was 0.6 %. There were no traffic controls other than a painted solid yellow line and a dashed yellow line separating the eastbound and westbound lanes. The roadway was bordered by solid white fog lines with paved shoulders approximately 1 meter [3.3 feet] wide adjacent to a grassy incline on both sides. The case vehicle lost control on the wet surface while attempting to pass and began rotating clockwise. It is not known if the case vehicle driver attempted any avoidance maneuvers. The crash occurred off the left (south) side of the roadway.

The case vehicle's right side impacted a wooden mailbox post at the south edge of the roadway (**Figure 1**). This impact had little affect on the case vehicle's motion and it continued its clockwise rotation while traveling in a westerly direction. The case vehicle's left side impacted one of a group of large trees off the south side of the roadway (**Figure 2**). This impact caused the case vehicle driver's seat back-mounted side air bag to deploy. The tree impact resulted in the case vehicle being slightly redirected in a northwesterly direction. The case vehicle rotated

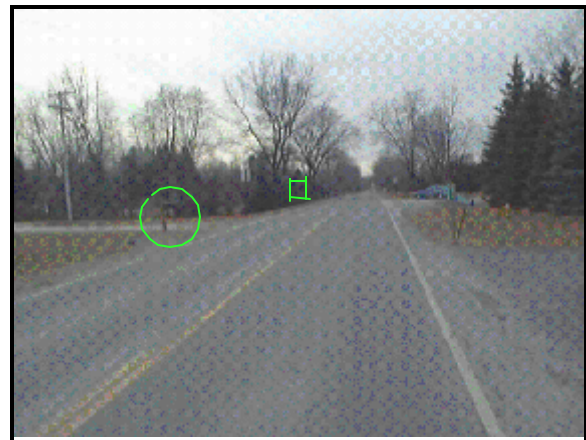


Figure 1: Case vehicle's westbound approach before losing control and striking mailbox post (circled) and tree (square); the mailbox post was replaced prior to the scene photography

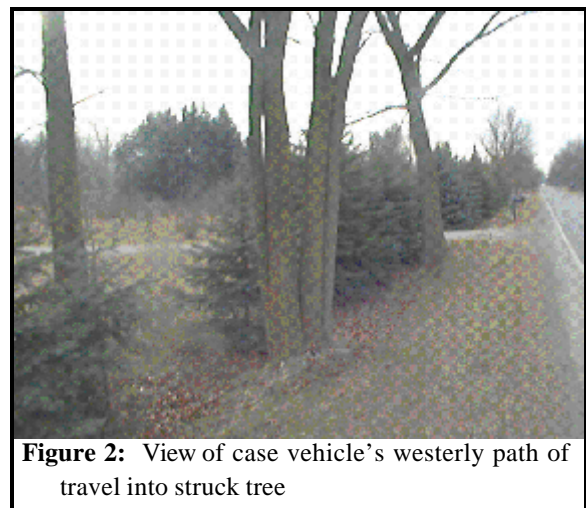


Figure 2: View of case vehicle's westerly path of travel into struck tree

counterclockwise off the tree with the case vehicle driver being completely ejected¹ through the driver's door window onto the street prior to the vehicle coming to rest. The case vehicle came to rest primarily in the eastbound lane heading east-northeast. The case vehicle was towed from the scene due to disabling damage. The crash severity for the case vehicle was moderate (24 - 40 km.p.h. [15 - 20 m.p.h.]

CASE VEHICLE

The case vehicle was a front wheel drive 1998 Volkswagen New Beetle, four-passenger, two-door sedan (VIN: 3VWBB61C0WM-----) equipped with a 2.0 liter I4 engine and a 5-speed manual transmission with a console mounted shift lever. Anti-lock brakes were an option for this model, but it is not known if the case vehicle was so equipped. The case vehicle's wheelbase was 251 centimeters [98.9 inches]. The case vehicle's odometer reading is unknown due to the nonfunctional electronic instrument panel.



Figure 3: Minor damage on case vehicle's right rear quarter panel

CASE VEHICLE DAMAGE

The case vehicle's initial contact with the wooden mailbox post involved minor damage to the vehicle's right rear quarter panel (**Figure 3**). Maximum crush for this first impact was limited to surface scratches and apparently causing the plastic quarter panel to crack. The case vehicle's highest severity impact with the tree, which deployed the driver's side seat back-mounted side air bag, was centered just behind the vehicle's left B-pillar (**Figure 4**). The direct damage started 36 centimeters [14.2 inches] forward of the left rear axle and extended 79 centimeters [31.1 inches] forward. The maximum crush to the case vehicle's left side was a measured 41 centimeters [16.1 inches] and was located at C2. The wheel base on the left side was shortened 3 centimeters [1.2 inches] with the right side being extended 7 centimeters [2.8 inches]. The left rear tire was the only tire which was restricted, with none of the tires being deflated.



Figure 4: Case vehicle's left side damage from tree impact

Based on the vehicle inspection, the case vehicle's CDC for the most severe impact was determined to be: **09-LPAW-3 (280)**. The

¹The NASS case coding indicates no ejection for the case vehicle driver, but does attribute several injuries to contacting the ground. It is this contractor's opinion that the driver was completely ejected through the driver's door window.

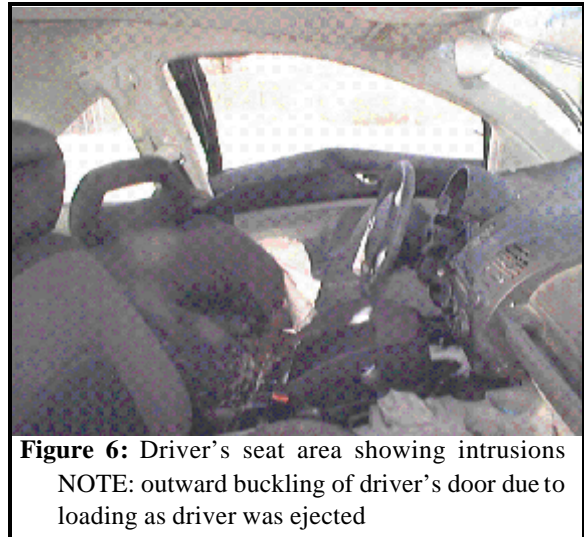
WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta V's are, respectively: 24 km.p.h. [13 m.p.h.], -4 km.p.h. [-2 mph], and 23 km.p.h. [14 m.p.h.]. The NASS investigator wrote an incomplete CDC for the minor impact with the mailbox post, given as **99-RBEN-1** (direction of principal force unknown). The mailbox post impact was a swiping-type impact, with the direction of principal force probably in the 5 or 6 o'clock region and with visually estimated severity 2 - 5 km.p.h. [1 - 3 m.p.h.].

The case vehicle sustained integrity loss when the left front and left rear windows disintegrated from impact forces. The case vehicle's windshield was cracked from impact forces but remained in place.

An examination of the case vehicle's interior showed visible evidence of contact to the windshield, left B-pillar, left roof side rail, and the steering column. There were dark smudges on the left B-pillar, suggesting that the driver's shoes may have made contact as he was being ejected. The driver's seat cushion was deformed and the seat back was twisted and pushed rightward and rearward by the intruding left B-pillar. The case vehicle driver and front right passenger's knee bolsters showed no evidence of scuffing or deformation. Intrusion by numerous components was noted (**Figures 5 and 6**). The greatest intrusion was 45 centimeters [17.7 inches] by the left B-pillar. The left front door panel, the left roof side rail and the left side body panels in the front and back seat positions all intruded between 20 - 24 centimeters [7.9 - 9.5 inches]. The left front floor pan intruded 18 centimeters [7.1 inches] and the left back floor pan 9 centimeters [3.5 inches].

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with dual front air bags and seat back-mounted side air bags at the driver and front right passenger seat positions, for a total of four air bags. Only the driver's seat back-mounted side air bag deployed. The case vehicle driver's front air bag was located in the steering wheel hub and the front right passenger air bag was located in the top of the right instrument panel. Neither of the front air bags deployed.



Automatic Restraint System (continued)

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The case vehicle driver's side air bag deployed from along the outside seam of the driver's bucket seat back where it was mounted (**Figure 7**). The side air bag's dimensions were 23 centimeters [9.1 inches] horizontally and 52 centimeters [20.5 inches] vertically and was not tethered or vented. There was no visible evidence of direct contact from the case vehicle driver, nor was there any evidence that the air bag was damaged. The front right side air bag did not deploy (**Figure 8**).



Figure 7: Deployed driver's seat back-mounted side air bag showing no evidence of contact

CASE VEHICLE DRIVER

The case vehicle driver (33-year-old male, unknown race and ethnicity, 70 kilograms, 175 centimeters [155 pounds, 69 inches])² was not restrained by his available, active, three-point, lap-and-shoulder safety belt system. The driver was transported via ambulance to a medical facility where he was hospitalized for four days. There was no other occupant in the case vehicle.

The case vehicle driver was probably seated in a normal driving posture, with his back against the seat back, his left foot on the floor, his right foot on the accelerator or brake pedal, and both hands on the steering wheel as he attempted a passing maneuver. His seat track was located between the forward-most and middle position. The seat back position is unknown due to intrusion and deformation of the seat back, and the tilt steering wheel was in the full-down position. The case vehicle sustained at least one-and-a-quarter complete clockwise rotations. This rotational motion caused the unrestrained driver to move toward the left. The tree impact caused him to be move toward the 9 o'clock direction of principal

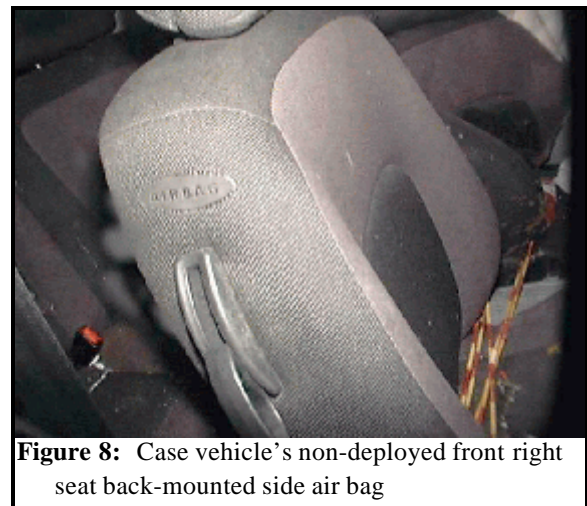


Figure 8: Case vehicle's non-deployed front right seat back-mounted side air bag

force and he encountered the intruding left side components, causing bilateral fractured ribs, bilateral pulmonary contusions, and lacerations to his liver. He was ejected through the driver's door window after the impact forces had caused the glazing to shatter. As he was passing through the window opening, his head struck the top of the window frame and/or the roof side rail, causing a laceration on his scalp and a subgaleal hematoma. His impact with the ground resulted in fractures of the transverse processes of at least two lumbar vertebrae, a contusion to his right kidney and abrasions on the dorsum of both hands. The police crash report indicates that the driver was found laying in the roadway, with no further details.

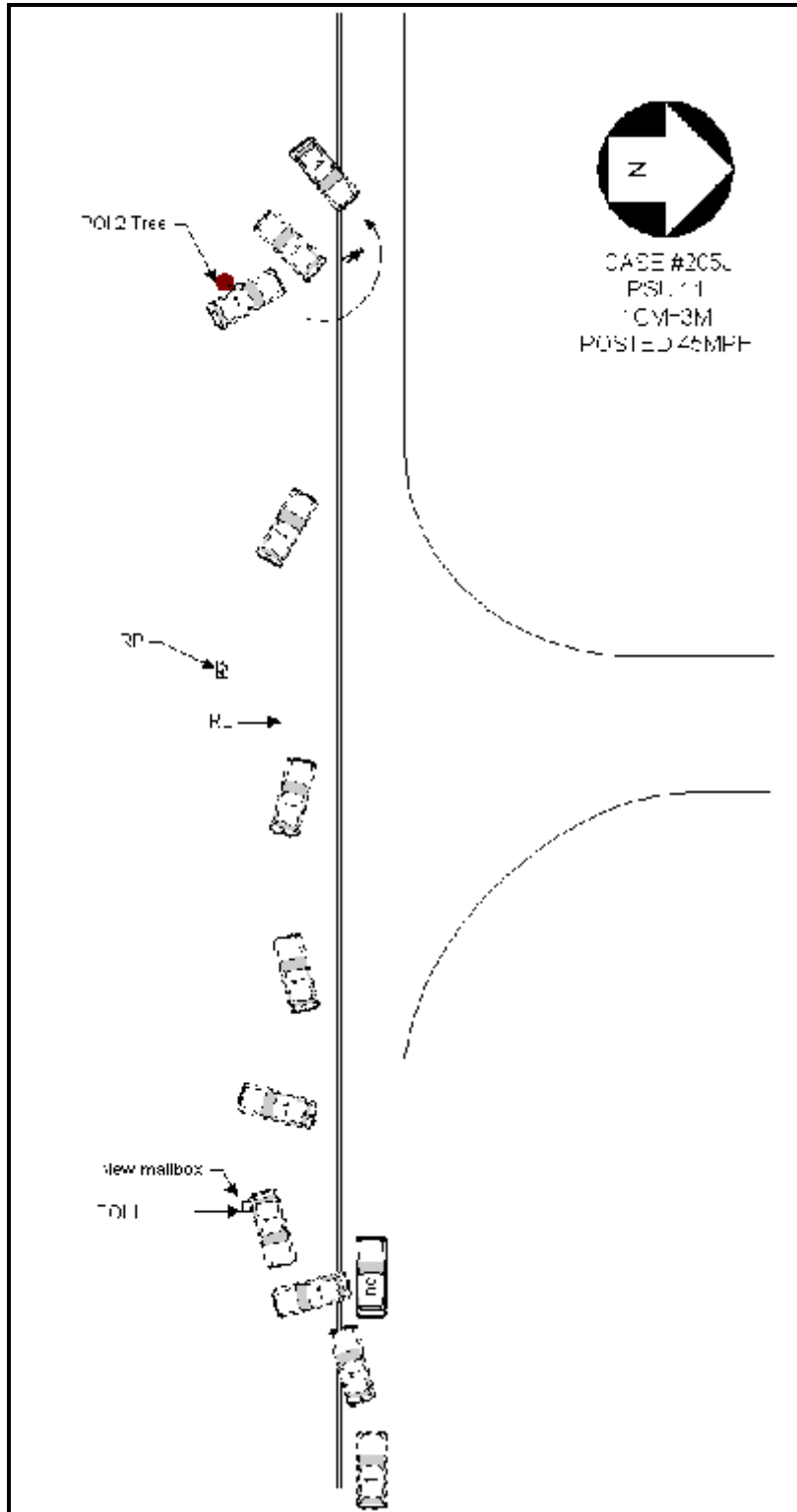
²The hospital emergency room records report height and weight as "estimated". The NASS case coding indicates height and weight unknown.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Contusion/subgaleal hematoma, right scalp	190402.1 minor	Left roof side rail ³	Probable	Discharge Summary
2.	Contusion, right kidney NFS	541610.2 moderate	Ground	Probable	Discharge Summary
3.	Laceration, right scalp	190600.1 minor	Left roof side rail ³	Probable	Discharge Summary
4.	Laceration, liver	541822.2 moderate	Left side interior surface ³	Probable	Discharge Summary
5.	Fractures, transverse processes, lumbar vertebrae, NFS	650620.2 moderate	Ground	Probable	Discharge Summary
6.	Rib fractures, multiple left, single right (bilateral)	450220.2 moderate	Left side interior surface	Certain	Discharge Summary
7.	Contusion, bilateral lungs	441410.4 severe	Left side interior surface	Certain	Discharge Summary
8.	Abrasion, dorsum of hands bilateral	790202.1 minor	Ground	Probable	E.R records

OBJECTS CONTACTED

The case vehicle first sustained a minor impact with a wooden mail box post. The post was replaced prior to the scene inspection and there is no knowledge of its size and whether it was broken off or simply knocked over (**Figure 1**). The most severe impact was with a tree that was part of a group of trees, with a diameter of approximately 30 centimeters [1 foot]. There was no damage apparent on the tree (**Figure 2**).

³The NASS case coding attributes this injury to contact with the ground.



⁴The NASS scene diagram depicts a highly unlikely pattern of rotation. The location of the ejected occupant is not known.