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## ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN01-028

LOCATION - Illinois

VEHICLE - 2002 VOLKSWAGEN JETTA

CRASH DATE - December 2001

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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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16. <i>Abstract</i> This report covers an on-site investigation of a crash that involved a 2002 Volkswagen Jetta (case vehicle) and a 2002 Chevrolet 2500HD pickup truck. This crash is of special interest because the case vehicle's second row right passenger (5-year-old male) was restrained by the vehicle's manual, three-point, lap-and-shoulder safety belt in a belt-positioning booster seat and sustained head, chest and abdominal injuries resulting in his death. In addition, the Chevrolet pickup was equipped with an Event Data Recorder (EDR) that recorded a near deployment event and was successfully downloaded. The case vehicle had been traveling east in the eastbound lane of a two-lane undivided local road and was stopped at a three-leg intersection, intending to turn left to travel north. The Chevrolet pickup was also traveling east in the eastbound lane of the same roadway, approaching the same intersection. According to the pickup's EDR data, the pickup was traveling at 80 km.p.h. [50 m.p.h.] when the front of the pickup impacted the back of the stopped case vehicle. The Chevrolet pickup's front bumper overrode the case vehicle's back bumper, penetrating the case vehicle's trunk and crushing the back components into the second seat row. The child was compressed against the front right seat back because of the heavy back-to-front intrusion in the right rear seat area and rearward flexing of the front right seat back. Access to the child's medical records was not permitted but his injuries were described as a fractured skull, "bleeding of the brain," a punctured lung and a ruptured spleen. He was declared dead approximately 20 hours post-crash. The case vehicle driver (28-year-old female) and the front right passenger (22-year-old male) sustained very minor injuries. The case vehicle was equipped with dual frontal air bags, seat back-mounted side impact air bags and roof rail-mounted head protection air bags, none of which deployed. The pickup was equipped with dual frontal air bags that did not deploy. Both vehicles were towed due to disabling damage.						
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This on-site investigation was brought to the NHTSA's attention on December 20, 2001 when the investigating police agency called the NHTSA Hotline. This crash involved a 2002 Volkswagen Jetta (case vehicle) and a 2002 Chevrolet Silverado 2500HD pickup truck (other vehicle). The crash occurred in December 2001, at 4:45 p.m., in Illinois, and was investigated by the applicable municipal police agency. This crash is of special interest because the case vehicle's second row right passenger (5-year-old male, white, non-Hispanic) was restrained in a belt-positioning booster seat and sustained head, chest and abdominal injuries resulting in his death. In addition, the Chevrolet pickup was equipped with an Event Data Recorder (EDR) that recorded a near deployment event and was successfully downloaded. This contractor inspected the scene and vehicles on January 2 - 3, 2002 and obtained partial interview information from the case vehicle driver's attorney in February 2002. The completed Police Crash Report was received in March 2002. The responsible parties declined to permit access to the medical records. This summary is based on the Police Crash Report, a partial interview with the case vehicle driver's attorney, discussions with the investigating police officer, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

**SUMMARY**

The case vehicle had been traveling east in the eastbound lane of a two-lane undivided local road and was stopped at a three-leg intersection, intending to turn left to travel north. The Chevrolet pickup was also traveling east in the eastbound lane of the same roadway, approaching the same intersection. The speed limit for the east-west roadway was 80 km.p.h. [50 m.p.h.], the asphalt surface was dry and free of defects, the weather was clear, it was dark but lighted by overhead street lamps, and there were no traffic controls for east-west traffic. According to the pickup's EDR data, the pickup was traveling at 80 km.p.h. [50 m.p.h.] when the front of the pickup impacted the back of the stopped case vehicle. There was no physical evidence at the scene that the driver of the pickup applied the brakes or attempted any other avoidance maneuvers. Based on the crush profiles of the two vehicles and the EDR data, the pickup's driver braked and probably attempted to steer to the right at the last moment. The Chevrolet pickup's front bumper overrode the case vehicle's back bumper, penetrating the case vehicle's trunk and crushing the back components into the second seat row. The case vehicle was pushed forward, rotated approximately 270 degrees counterclockwise while moving approximately 12.5 meters [41 feet] northeastward and came to rest heading south, with the back wheels off the northeast corner of the intersection and its front wheels in the road. The Chevrolet pickup rotated approximately 20 degrees counterclockwise while sliding approximately 29 meters [95 feet] eastward and came to rest with its right wheels off the south road edge and its left wheels on the narrow shoulder, heading essentially east. Both vehicles were equipped with air bags, but no air bags deployed in either vehicle.

The case vehicle was a front wheel drive 2002 Volkswagen Jetta GLS, four-door, five-passenger sedan (VIN: 3VWSP69M12M-----), equipped with an automatic transmission with a console-mounted selector lever and a 1.9 liter Diesel engine. The case vehicle was equipped with dual front air bags, seat back-mounted side air bags for the two front seat positions and roof rail-mounted head protection air bags, for a total of six air bags, none of which deployed. Based on

the vehicle inspection, the CDC for the case vehicle was determined to be: **06-BDAW-6 (190)**. The integrated WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the case vehicle's single impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 50 km.p.h. [31.1 m.p.h.], +49 km.p.h. [+30.4 m.p.h.], and +9 km.p.h. [+5.6 m.p.h.]. The crash severity to the case vehicle was high (greater than 40 km.p.h. [25 m.p.h.]). The case vehicle was towed due to disabling damage.

The case vehicle's initial contact with the Chevrolet pickup involved the right two-thirds of the back plane. As the pickup penetrated the case vehicle's trunk and the case vehicle began rotating counterclockwise, the leftmost portion of the back plane was pulled inward, resulting in direct contact across the entire back plane and induced damage on the left quarter panel. Maximum crush was measured as 109 centimeters [42.9 inches] at C5. The wheelbase on the case vehicle's left side was stretched 7 centimeters [2.8 inches] while the right side was shortened 3 centimeters [1.2 inches]. The case vehicle's back bumper cover was torn off and the bumper was separated from the mounting brackets, with the right end of the bumper pushed forward through the trunk space and against the back of the second row bench seat. The trunk floor and spare tire well were forced slightly downward, but were otherwise essentially undamaged as the pickup's override penetration pushed the back components forward. The trunk lid was folded double against the base of the back light, the right quarter panel was crushed forward to the right C-pillar, and the C-pillar was pushed forward resulting in the roof buckling upward 23 centimeters [9.1 inches] in the area of the right back door. The right back door was deformed outward and was jammed shut. The left quarter panel was curled and pulled inward. There was induced damage up to the left C-pillar, but the left back door remained closed and operational. The back light glazing disintegrated, but there was no other glazing damage.

Inspection of the case vehicle's interior revealed major back-to-front intrusion in the second seat row on the right, combined with rearward deformation of the front right seat back. At the inspection, the front right seat back was tilted at an angle of approximately 40 degrees rearward of vertical. The driver's seat back was also slightly deformed rearward, more on the left side. The left (outboard) edge of the driver's seat back was tilted at an angle of approximately 40 degrees rearward of vertical while the right (inboard) edge was approximately 30 degrees rearward of vertical. The pre-impact adjustments of the front seat backs are not known. The right edge of the second row seat back and the head restraint were displaced forward 34 centimeters [13.4 inches], and the right C-pillar was crushed forward 26 centimeters [10.2 inches]. Note that the foregoing intrusion measurements reflect the residual effects of the impact. The dynamic crush certainly caused intrusion of greater magnitude, probably compressing the second row right occupant against the front right seat back, which was occupied by an adult male. The front right seat back was flexed rearward by the rear impact crash pulse due to the front right occupant's inertial loading, causing a tear in the upholstery seam along the front outboard edge. The front right seat back had two areas of blood smear, in the center of the back surface directly below the head restraint and on the inboard side surface at the upper corner.

The other vehicle was a rear wheel drive 2002 Chevrolet Silverado 2500HD conventional pickup truck (VIN: 1GCHC24U92E-----), equipped with a 6.0 liter V8 gasoline engine and an automatic transmission with a column-mounted selector lever. The pickup was fitted with a heavy

steel, roofed cabinet structure over the bed and had a cargo of numerous miscellaneous construction tools, including a compressor, hoses and pneumatic tools, with a total estimated cargo weight for the cabinet and cargo of approximately 680 kilograms [1,500 pounds]. The pickup was equipped with driver and front right passenger air bags that did not deploy.

The pickup's EDR recorded a near deployment event that was successfully downloaded. The EDR indicated that the pickup was coasting with zero throttle input at 89 km.p.h. [55 m.p.h.] five seconds prior to the impact and drifted down to 85 km.p.h. [53 m.p.h.] at -2 seconds. The pickup's driver braked and the pickup was recorded as traveling at 80 km.p.h. [50 m.p.h.] one second prior to the impact. The maximum recorded velocity change was -28 km.p.h. [-17.5 m.p.h.] at 248 milliseconds [0.248 seconds] after the impact. The EDR-recorded Delta V is 3 km.p.h. [1.9 m.p.h.] greater than the WinSMASH reconstruction Delta V.

Based on the vehicle inspection, the CDC for the pickup was **12-FYEW-1 (0)**. The integrated WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the pickup's single impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 25 km.p.h. [15.5 m.p.h.], -25 km.p.h. [-15.5 m.p.h.], and 0 km.p.h. [0 m.p.h.]. The crash severity to the pickup was moderate (24 to 40 km.p.h. [15 to 25 m.p.h.]). The pickup was towed due to disabling damage.

The impact with the case vehicle involved direct contact to the left half of the pickup's front. Maximum crush was measured as 19 centimeters [7.5 inches], near the center of the bumper. The grille and left headlamp assembly were shattered, but the right headlamp was intact. There was direct contact on the leading edge of the hood from the case vehicle's right C-pillar, and the radiator support bracket was pushed rearward. The wheelbase was not changed on either side.

Immediately prior to the crash, the case vehicle's second row right occupant (5-year-old male, white, non-Hispanic, 122 centimeters, 21 kilograms [48 inches, 46 pounds]) was restrained by the vehicle's manual, three-point, lap-and-shoulder safety belt system in a Century Breverra Classic belt positioning booster seat (Century Products, model #4865RCK, date 10/08/97). The booster seat was equipped with a guide clip at the upper right corner, with the shoulder portion of the vehicle's manual safety belt system threaded through the guide. The booster seat was also equipped with a five-point integral harness system, but this was not in use (i.e., the five-year-old was sitting on the booster seat's harness webbing). According to the driver's attorney, the child was seated with his back against the booster seat back and his legs extending down onto the vehicle's seat cushion and his feet hanging over the front of the seat cushion.

Inspection of the booster seat showed that it had been heavily used but was in essentially good condition. The booster seat's harness webbing was creased against the body of the booster seat, indicating that it had not been used to buckle the child into the booster seat recently. The body of the booster seat was a single piece of molded, thick, vinyl-like plastic, without excessive wear. There was a small dent in the plastic at the front right edge of the booster seat's cushion.

The case vehicle driver did not make any avoidance maneuvers and the second row right occupant's posture did not change. As a result of the impact on the right two-thirds of the case

vehicle's back plane, the case vehicle was pushed forward and began rotating counterclockwise. The child moved back and slightly to the left, toward the 190 degree direction of force. Almost immediately, the intrusion through the trunk and into second seat row pushed the booster seat forward, causing the child to load more heavily rearward into the booster seat, with the booster seat rotating to the left as the intrusion pushed the right side of the vehicle's seat back forward. The front right corner of the booster seat probably contacted the vehicle's right interior surface, causing an indentation. As the intrusion reached its maximum penetration, the child was probably compressed between the booster seat and the front seat back (which was occupied by a large adult male whose inertial loading caused the front seat back to flex rearward). As the case vehicle rotated to final rest, the dynamic maximum intrusion relaxed and the child and the booster seat rebounded rearward. His posture at final rest is not known. According to the driver's statement through her attorney, the vehicle's safety belt system was holding the child tightly. Because the vehicle's seat back was deformed by being pushed forward, the buckle mechanism was wedged into the crack between the seat back and seat cushion and it was difficult to release the buckle to remove the child. The child was taken by ambulance to a local hospital, whereupon he was airlifted to a trauma center. He sustained injuries described as a fractured skull, bleeding of the brain, a punctured lung, and a ruptured spleen. He was declared dead approximately 20 hours post-crash.

The case vehicle driver (28-year-old female, white, non-Hispanic, 165 centimeters, 57 kilograms [65 inches, 126 pounds]) was restrained by the available manual, three-point, lap-and-shoulder safety belt system. She was transported to a hospital where she was treated and released. According to her attorney, she sustained very minor bumps and bruises and felt sore.

The case vehicle front right passenger (22-year-old male, white, non-Hispanic, 191 centimeters, 79 kilograms, [75 inches, 175 pounds]) was not restrained by the available manual, three-point, lap-and-shoulder safety belt system. He was transported via ambulance to a hospital where he was treated and released. According to the driver's attorney, he was not injured but felt sore.

## CRASH CIRCUMSTANCES

The case vehicle had been traveling east in the eastbound lane of a two-lane undivided local road and was stopped at a three-leg intersection, intending to turn left to travel north. The Chevrolet pickup was also traveling east in the eastbound lane of the same roadway, approaching the same intersection (**Figure 1**). The speed limit for the east-west roadway was 80 km.p.h. [50 m.p.h.], the asphalt surface was dry and free of defects, the weather was clear, it was dark but lighted by overhead street lamps, and there were no traffic controls for east-west traffic. The paved surface was 7.4 meters [24.3 feet] wide on the



**Figure 1:** Eastbound view of the intersection where the case vehicle was stopped, waiting to turn left, as the other vehicle approached from behind (case photo #01)



eastbound approach to the intersection. The travel lanes were separated by dashed yellow lines, with solid white edge lines. There was a right turn lane for westbound traffic on the east leg of the intersection. According to the pickup's EDR data (**Figures 10, 11 and 12**), the pickup was traveling at 80 km.p.h. [50 m.p.h.] when the front of the pickup impacted the back of the stopped case vehicle. There was no physical evidence at the scene that the driver of the pickup applied the brakes or attempted any other avoidance maneuvers. Based on the EDR data and the crush profiles of the two vehicles, the pickup's driver braked and probably attempted to steer to the right at the last moment. The Chevrolet pickup's front bumper overrode the case vehicle's back bumper, penetrating the case vehicle's trunk and crushing the back components into the second seat row. The case vehicle was pushed forward, rotated approximately 270 degrees counterclockwise while moving approximately 12.5 meters [41 feet] northeastward and came to rest heading south, with the back wheels off the northeast corner of the intersection and its front wheels in the road. The Chevrolet pickup rotated approximately 20 degrees counterclockwise while sliding approximately 29 meters [95 feet] eastward and came to rest with its right wheels off the south road edge and its left wheels on the narrow shoulder, heading essentially east. Both vehicles were equipped with air bags, but no air bags deployed in either vehicle.

#### CASE VEHICLE

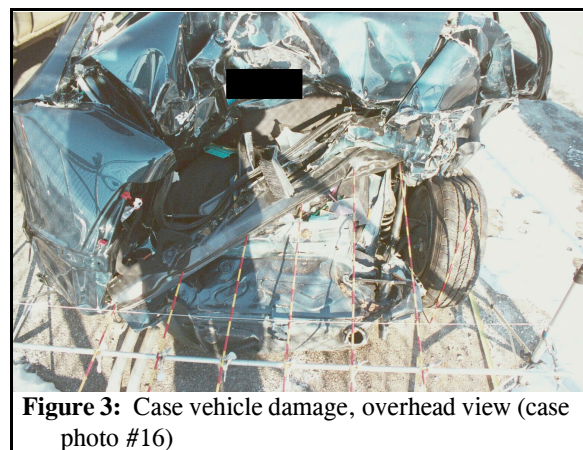
The case vehicle was a front wheel drive 2002 Volkswagen Jetta GLS, four-door, five-passenger sedan (VIN: 3VWSP69M12M-----), equipped with an automatic transmission with a console-mounted selector lever, a 1.9 liter Diesel engine and four-wheel anti-lock brakes. The wheelbase was 251 centimeters [98.9 inches]. The odometer reading was 10,969 kilometers [6,816 miles].

#### CASE VEHICLE DAMAGE

The case vehicle's initial contact with the Chevrolet pickup involved the right two-thirds of the back plane (**Figures 2 and 3**), but as the pickup penetrated the case vehicle's trunk and the case vehicle began rotating counterclockwise, the leftmost portion of the back plane was pulled inward, resulting in direct contact across the entire back plane and induced damage on the left quarter panel. Maximum crush was measured as 109 centimeters [42.9 inches] at C5. The wheelbase on the case vehicle's left side was stretched 7 centimeters [2.8 inches] while the right side was shortened 3 centimeters [1.2 inches]. The case vehicle's back bumper cover was torn off and the



**Figure 2:** Case vehicle damage, view from right rear (case photo #12)



**Figure 3:** Case vehicle damage, overhead view (case photo #16)

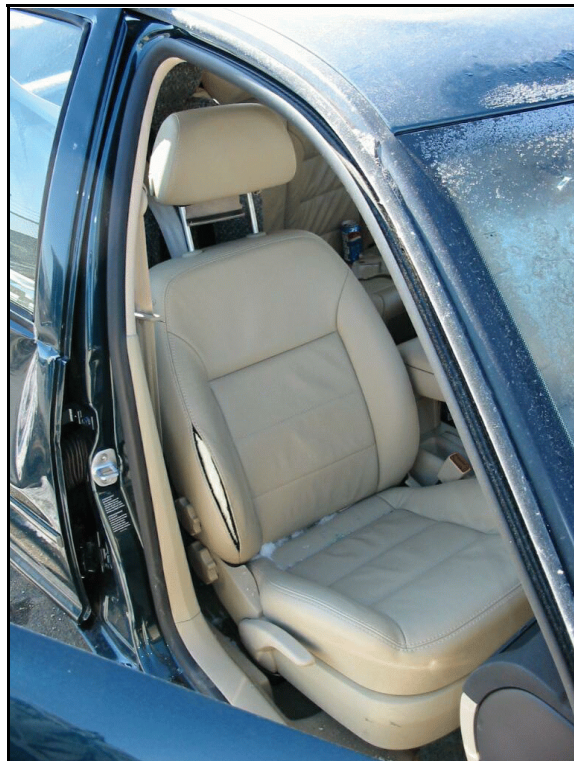
bumper was separated from the mounting brackets, with the right end of the bumper pushed forward through the trunk space and against the back of the second row bench seat. The trunk floor and spare tire well were forced slightly downward, but were otherwise essentially undamaged as the pickup's override penetration pushed the back components forward. The trunk lid was folded double against the base of the back light, the right quarter panel was crushed forward to the right C-pillar, and the C-pillar was pushed forward resulting in the roof buckling upward 23 centimeters [9.1 inches] in the area of the right back door. The right back door was deformed outward and was jammed shut. The left quarter panel was curled and pulled inward. There was induced damage up to the left C-pillar, but the left back door remained closed and operational. The two rear tires were both deflated and restricted by deformed body panels. The back light glazing disintegrated, but there was no other glazing damage.

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **06-BDAW-6 (190)**. The integrated WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the case vehicle's single impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 50 km.p.h. [31.1 m.p.h.], +49 km.p.h. [+30.4 m.p.h.], and +9 km.p.h. [+5.6 m.p.h.]. The crash severity to the case vehicle was high (greater than 40 km.p.h. [25 m.p.h.]). The case vehicle was towed due to disabling damage.

Inspection of the case vehicle's interior revealed major back-to-front intrusion in the second seat row on the right, combined with rearward deformation of the front right seat back (**Figure**



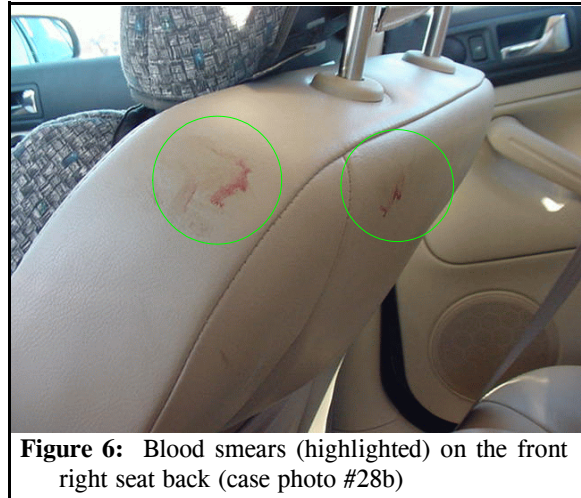
**Figure 4:** Case vehicle's second seat row, showing intrusion in the area where the booster seat was positioned (case photo #26)



**Figure 5:** Front right passenger's seat, showing torn upholstery seam due to rearward flexing of the seat back (case photo #24)



4). At the inspection, the front right seat back was tilted at an angle of approximately 40 degrees rearward of vertical. The driver's seat back was also slightly deformed rearward, more on the left side. The left (outboard) edge of the driver's seat back was tilted at an angle of approximately 40 degrees rearward of vertical while the right (inboard) edge was approximately 30 degrees rearward of vertical. The pre-impact adjustments of the seat backs are not known. The front right seat back was flexed rearward by the rear impact crash pulse due to the front right occupant's inertial loading, causing a tear in the upholstery seam along the front outboard edge (**Figure 5**).



**Figure 6:** Blood smears (highlighted) on the front right seat back (case photo #28b)

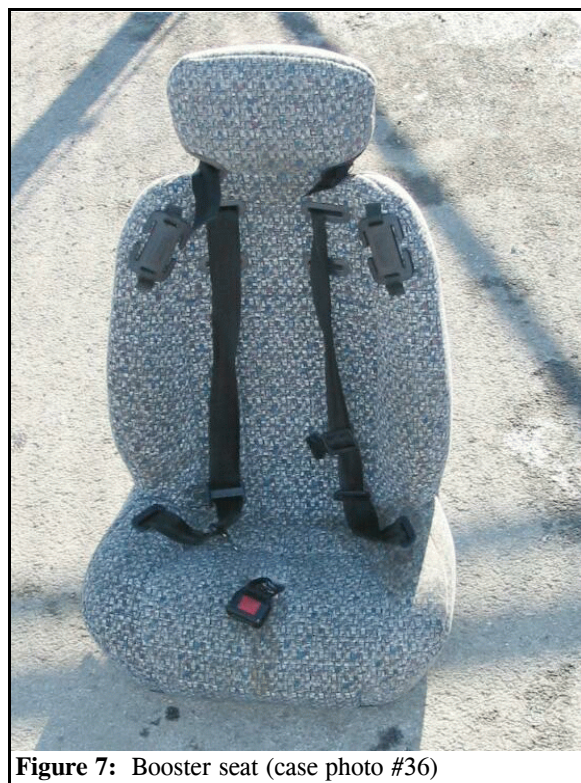
The right edge of the second row seat back and the head restraint were displaced forward 34 centimeters [13.4 inches], and the right C-pillar was crushed forward 26 centimeters [10.2 inches]. Note that the foregoing intrusion measurements reflect the residual effects of the impact. The dynamic crush certainly caused intrusion of greater magnitude, probably compressing the second row right occupant against the front right seat back, which was occupied by an adult male. The front right seat back had two areas of blood smear (**Figure 6**). One, in the center of the back surface directly below the head restraint, was probably the result of contact by the second row right occupant during the crash. The other, on the inboard side surface at the upper corner, probably occurred when the second row right occupant was removed from the vehicle.

#### AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with dual front air bags, with the driver's air bag located in the steering wheel hub and the front right passenger's air bag in the mid-instrument panel location. The Volkswagen was also equipped with seat back-mounted side air bags for the two front seat positions and roof rail-mounted head protection air bags, for a total of six air bags. None of the air bags deployed. The two front seats were also equipped with retractor pretensioners that did not actuate.

#### CHILD SAFETY SEAT

The second row right passenger was seated in a Century Breverra Classic belt-positioning booster seat (Century Products, model #4865RCK, date 10/08/97) (**Figure 7**). The



**Figure 7:** Booster seat (case photo #36)

booster seat was equipped with a five-point integral harness system, but this was not in use (i.e., the five-year-old was sitting on the booster seat's harness webbing). Inspection of the booster seat showed that it had been heavily used but had no obvious defects. The harness webbing was creased against the body of the booster seat, indicating that it had not been used to buckle the child into the booster seat recently. The body of the booster seat was a single piece of molded, thick, vinyl-like plastic, without excessive wear. There was a small dent in the plastic at the front right edge of the booster seat's cushion.

The booster seat was positioned in the second row right position in the case vehicle. This seat position was fitted with the Lower Anchor and Tethers for Children (LATCH) system and a continuous loop, three-point safety belt with a sliding latch plate and a switchable retractor. The four-year-old booster seat did not include the LATCH components, no tether was added and the LATCH system features in this vehicle were not in use. Because the retractor was crushed as a result of the impact, it is not known if the switchable retractor was in ALR or ELR mode. At the time of the vehicle inspection, a substantial length of the safety belt webbing was drawn out off the spool, laying on the seat with the latch unbuckled. The damage to the retractor and/or deformation of the chassis along the belt's path through the C-pillar to the retractor probably prevented the spool from reeling in this slack webbing. The booster seat was equipped with a belt positioning guide clip at the upper right corner, with the shoulder portion of the vehicle's manual safety belt system threaded through the guide at the time of the crash (**Figure 8**). The driver indicated (through her attorney) that the child was restrained by the vehicle's safety belt system, but there was no evidence to support or refute this assertion. The absence of evidence is, however, not conclusive because the rear-impact configuration of this crash did not result in any loading of the safety belt system as is seen in frontal collisions. There is no reason to doubt the driver's assertion and this contractor concludes that the child was restrained by the vehicle's safety belt system.



**Figure 8:** On-scene view of right rear seat position, looking through right rear door window; note vehicle's shoulder belt threaded through booster seat's positioning guide clip (highlighted) (case photo #63)

## SECOND ROW RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's second row right occupant (5-year-old male, white, non-Hispanic, 122 centimeters, 21 kilograms [48 inches, 46 pounds]) was seated in a belt-positioning booster seat, restrained by the vehicle's manual three-point, lap-and-shoulder safety belt system. According to the driver (through her attorney), the child was seated with his back against the booster seat back and his legs extending down onto the vehicle's seat cushion and his feet hanging down over the front of the seat cushion.

The case vehicle driver did not make any avoidance maneuvers and the second row right occupant’s posture did not change. As a result of the impact on the right two-thirds of the case vehicle’s back plane, the case vehicle was pushed forward and began rotating counterclockwise. The child moved back and slightly to the left, toward the 190 degree direction of force. Almost immediately, the intrusion through the trunk and into second seat row pushed the booster seat forward, causing the child to load more heavily rearward into the booster seat, with the booster seat rotating to the left as the intrusion pushed the right side of the vehicle’s seat back forward. The front right corner of the booster seat probably contacted the vehicle’s right interior surface, causing an indentation in the molded plastic body of the booster seat. As the intrusion reached its maximum penetration, the child was probably compressed between the booster seat and the front seat back (which was occupied by an adult male whose own inertial loading caused the front seat back to flex rearward). As the case vehicle rotated to final rest, the dynamic maximum intrusion relaxed and the child and the booster seat rebounded rearward. His posture at final rest is not known. According to the driver’s statement through her attorney, the vehicle’s safety belt system was holding the child tightly. Because the vehicle’s seat back was deformed by being pushed forward, the buckle mechanism was wedged into the crack between the seat back and seat cushion and it was difficult to release the buckle to remove the child.

**SECOND ROW RIGHT PASSENGER INJURIES**

The child was taken by ambulance to a local hospital, whereupon he was airlifted to a trauma center. Access to his medical records was not permitted. He sustained injuries described by the driver’s attorney as a fractured skull, bleeding of the brain, a punctured lung, and a ruptured spleen. He was declared dead approximately 20 hours post-crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Fractured skull, NFS	150400.2 moderate	Front right seat back	Probable	Interviewee
2.	Blunt head/brain injury, NFS (“Bleeding of the brain”)	115099.7 unknown	Front right seat back	Probable	Interviewee
3.	Lacerated (“punctured”) lung, NFS	441414.3 serious	Front right seat back	Probable	Interviewee
4.	Ruptured spleen, NFS	544240.3 serious	Front right seat back	Probable	Interviewee

**CASE VEHICLE DRIVER KINEMATICS**

The case vehicle driver (28-year-old female, white, non-Hispanic, 165 centimeters, 57 kilograms [65 inches, 126 pounds]) was restrained by the available manual, three-point, lap-and-shoulder safety belt system. She was transported to a hospital where she was treated and released.

Her specific injuries are not known. According to her attorney, she sustained very minor bumps and bruises and felt sore.

Immediately prior to the impact, the driver was seated in a normal driving posture with her back against the seat back, her feet on the floor or foot controls and at least one hand on the steering wheel. The seat back was in an upright position and the seat track was adjusted at the forward most position. She did not attempt any avoidance maneuvers and her posture did not change. At the moment of impact, she move rearward and slightly leftward, toward the 190 degree direction of force, loading the left side of her seat back and causing the driver's seat back to be deformed slightly rearward on the left side. As the case vehicle rotated counterclockwise, she moved further leftward and rearward, further loading the seat back. As the case vehicle rotated and slid to final rest, she probably rebounded to an approximately normal seated posture, but her exact position is not known.

#### **FRONT RIGHT PASSENGER KINEMATICS**

The case vehicle front right passenger (22-year-old male, white, non-Hispanic, 191 centimeters, 79 kilograms [75 inches, 175 pounds]) was not restrained by the available manual, three-point, lap-and-shoulder safety belt system. He was transported via ambulance to a hospital where he was treated and released. His specific injuries are not known. According to the driver's attorney, he was not injured but felt sore.

Immediately prior to the impact, the front right passenger was seated in a normal passenger's posture, with his back against the seat back, his hands in an unknown position and his feet on the floor. The seat back was upright and the seat track was adjusted between the middle and rear most positions. The driver did not attempt any avoidance maneuvers and the front right passenger's posture did not change. At the moment of impact, he moved rearward and slightly leftward, toward the 190 degree of force, loading the seat back and causing it to flex rearward. As the case vehicle rotated counterclockwise and slid to final rest, he moved further rearward and leftward, further loading the seat back. His posture at final rest is not known, but he probably rebounded into an approximately normal seated position.

#### **OTHER VEHICLE**

The other vehicle was a rear wheel drive 2002 Chevrolet Silverado 2500HD conventional pickup truck (VIN: 1GCHC24U92E-----), equipped with a 6.0 liter V8 gasoline engine and an automatic transmission with a column-mounted selector lever. The pickup was fitted with a heavy steel-roofed cabinet structure over the bed and had a cargo of numerous miscellaneous construction tools, including a compressor, hoses and pneumatic tools, with a total estimated cargo weight for the cabinet and cargo of approximately 680 kilograms [1,500 pounds]. The pickup was equipped with driver and front right passenger air bags that did not deploy.

The pickup's EDR recorded a near deployment event that was successfully downloaded (**Figures 10, 11 and 12**). The EDR indicated that the pickup was coasting with zero throttle input at 89 km.p.h. [55 m.p.h.] five seconds prior to the impact and drifted down to 85 km.p.h. [53



m.p.h.] at -2 seconds. The pickup's driver braked and the pickup was recorded as traveling at 80 km.p.h. [50 m.p.h.] one second prior to the impact. The maximum recorded velocity change was -28 km.p.h. [-17.5 m.p.h.] at 248 milliseconds [0.248 seconds] after the impact. The EDR-recorded Delta V is 3 km.p.h. [1.9 m.p.h.] greater than the WinSMASH reconstruction Delta V.

Based on the vehicle inspection, the CDC for the pickup was **12-FYEW-1 (0)**. The integrated WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the pickup's single impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 25 km.p.h. [15.5 m.p.h.], -25 km.p.h. [-15.5 m.p.h.], and 0 km.p.h. [0 m.p.h.]. The crash severity to the pickup was moderate (24 to 40 km.p.h. [15 to 25 m.p.h.]). The pickup was towed due to disabling damage.

The impact with the case vehicle involved direct contact to the left half of the pickup's front (**Figure 9**). Maximum crush was measured as 19 centimeters [7.5 inches] at C3, near the center of the bumper. The grille and left headlamp assembly were shattered, but the right headlamp was intact. There was direct contact on the leading edge of the hood from the case vehicle's C-pillar, and the radiator support bracket was bent and pushed rearward. The wheelbase was not changed on either side.



**Figure 9:** Front damage on pickup (case photo #47)

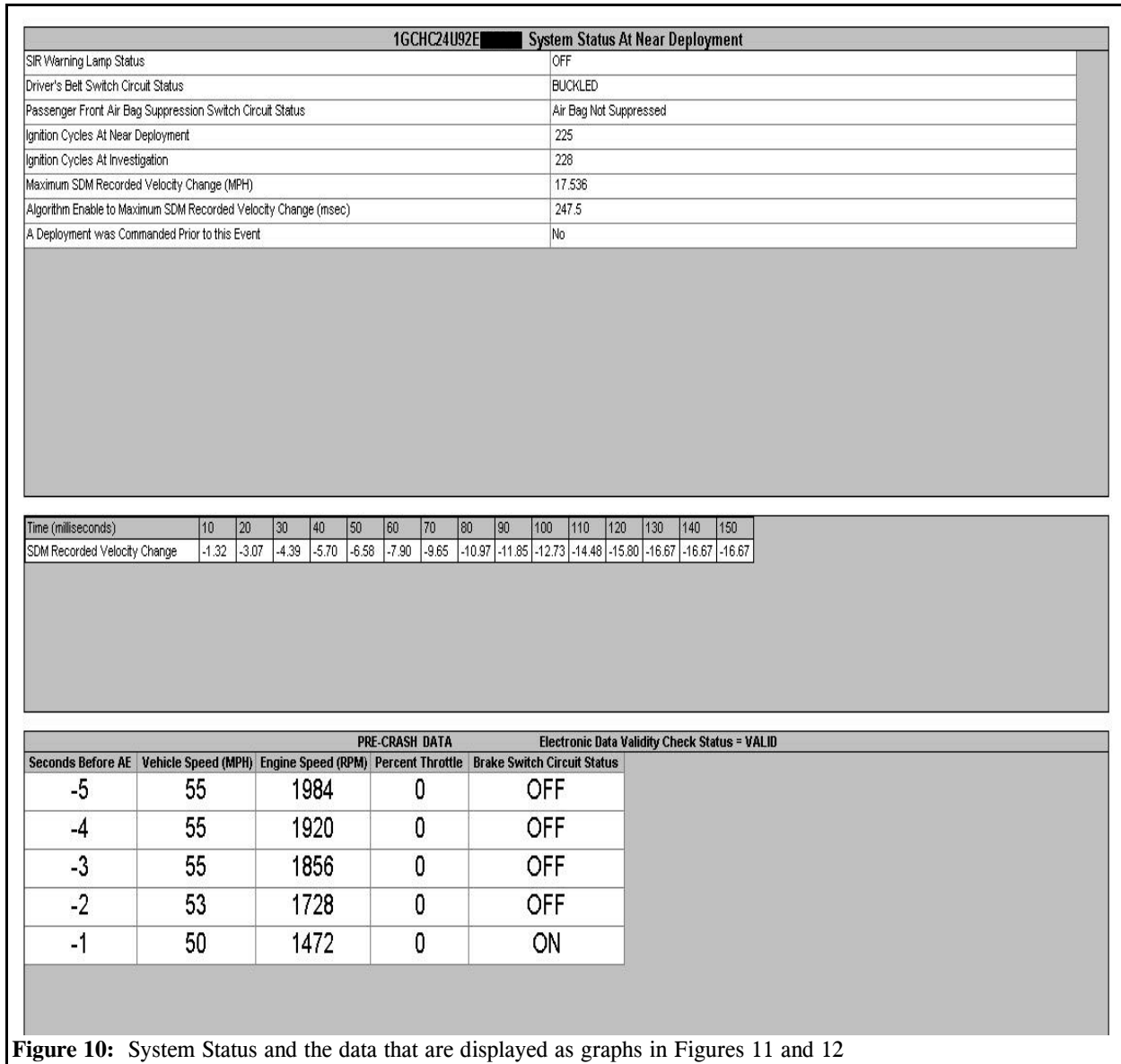
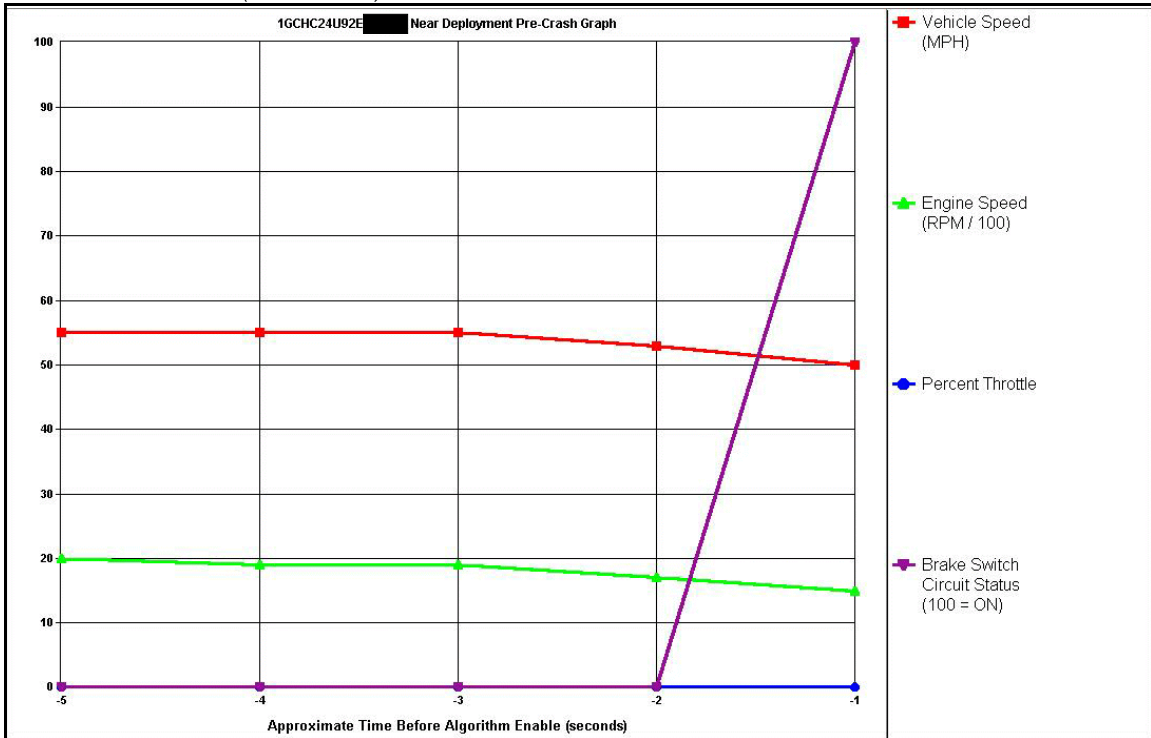
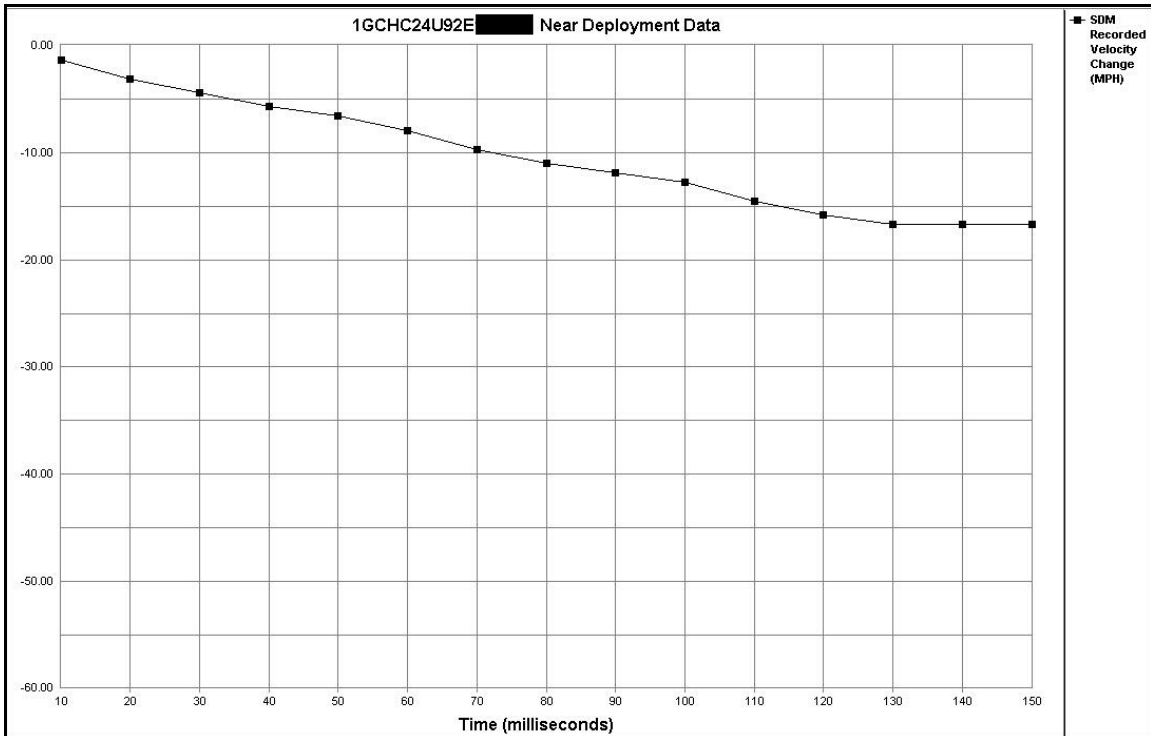


Figure 10: System Status and the data that are displayed as graphs in Figures 11 and 12





**Figure 11:** The pickup was coasting with zero throttle input at 89 km.p.h. [55 m.p.h.] five seconds prior to the impact and drifted down to 85 km.p.h. [53 m.p.h.] when the driver applied the brakes two seconds prior to the impact



**Figure 12:** The pickup sustained -27 km.p.h. [-16.7 m.p.h.] Delta V at 150 milliseconds, with maximum Delta V of -28 km.p.h. [-17.5 m.p.h.] at 248 milliseconds (see Figure 10)

