CRASH DATA RESEARCH CENTER
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CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION SYSTEM CRASH INVESTIGATION
SCI CASE NO.: CA09042

VEHICLE: 2007 VOLKSWAGEN JETTA WOLFSBURG EDITION

LOCATION: NORTH CAROLINA

CRASH DATE: JUNE 2009

Contract No. DTNH22-07-C-00043

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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 are 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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An investigation of the opposite direction crash of a 2007 Volkswagen Jetta and a 2001 Dodge Ram Pickup.

16. Abstract

This on-site investigation focused on the side impact inflatable occupant protection system of a 2007 Volkswagen Jetta sedan that was involved in an angular side impact crash with the front left corner of a 2001 Dodge Ram. The Volkswagen was equipped with four-wheel anti-lock brakes, a Certified Advanced 208-Compliant frontal air bag system (CAC), front seat-mounted side impact air bags and Inflatable Curtain (IC) air bags. The manufacturer of the Volkswagen has certified that the vehicle was compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system includes dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The Volkswagen was impacted along the left side by the left front of a 2001 Dodge Ram pickup resulting in the deployment of the driver's frontal, left side impact and left Inflatable Curtain (IC) air bags in the Volkswagen. The Volkswagen was deflected to the right and came to rest on the side of the roadway. The Dodge continued forward and impacted a 2008 Buick Lucerne head-on. The 42-year old female driver of the Volkswagen sustained moderate-severity injuries and was transported by ground ambulance to a regional hospital where she was treated in the emergency department and released.

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Background

This on-site investigation focused on the side impact inflatable occupant protection system of a 2007 Volkswagen Jetta sedan **(Figure 1)** that was involved in an angular side impact crash with the front left corner of a 2001 Dodge Ram. The Volkswagen was equipped with four-wheel anti-lock brakes, a Certified Advanced 208-Compliant frontal air bag system (CAC), front seat-mounted side impact air bags and Inflatable Curtain (IC) air bags. The manufacturer of the Volkswagen has certified that the vehicle was compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system includes dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The Volkswagen was impacted along the left side by the left front of a 2001 Dodge Ram pickup resulting in the deployment of the driver's frontal, left side impact and left Inflatable Curtain (IC) air bags of the Volkswagen. The Volkswagen was deflected to the right and came to rest on the side of the roadway. The Dodge continued forward and impacted a 2008 Buick Lucerne head-on. The 42-year old female driver of the Volkswagen sustained moderate-severity injuries and was transported by ground ambulance to a regional hospital where she was treated in the emergency department and released.

Figure 1: Left front oblique view of the 2007 Volkswagen Jetta.

The crash was identified through a visit to a regional vehicle salvage facility on June 17, 2009. Based on the side impact configuration and the deployment of the left IC and left side air bags in the Volkswagen, this case was assigned for an on-site investigation on June 18, 2009. All vehicles were available for inspection. The on-site investigation was conducted on June 23-24, 2009 and involved the inspections of the involved vehicles, documentation of the crash scene, and a detailed interview with the driver of the Volkswagen.

SUMMARY

Crash Site

This crash occurred during the daylight hours of June 2009 in the northbound lanes of a five-lane north/south roadway that was divided by a center left turn lane (**Figure 2**). The roadway was straight and level in the area in which this crash occurred. The police-reported weather conditions were clear and dry. The traffic lanes were surfaced with asphalt. The outboard travel lanes measured 4.2 m (13.8 ft) in width. The center turn lane was 3.5 m (11.5 ft) in width. Both roadsides were bordered by concrete curbs that were 16 cm (6.3 in) in height. Off the east side of the roadway, in the area where the Volkswagen came to final rest, was an embankment that transitioned to a ditch area surfaced with tall grass and light brush. This area had a negative grade of 4.9 percent. Off the east side of the roadway, in the area where the Dodge and Buick came to final rest, was a grass shoulder with a negative grade of 1.6 percent. The posted speed limit was 89 km/h (55 mph). The Crash Schematic is included as **Figure 11** of this report.

Figure 2: Pre-crash trajectory view of the Volkswagen.

Vehicle Data

2007 Volkswagen Jetta

The 2007 Volkswagen Jetta Wolfsburg Edition four-door sedan was identified by the Vehicle Identification Number (VIN) 3VWEF71K97M (production number deleted). The vehicle was purchased new in the summer of 2008 by the driver. The vehicle had been driven approximately 27,744 km (16,000 mi) at the time of the crash

The front-wheel drive Volkswagen was powered by a 2.5 liter inline five-cylinder engine linked to a six-speed automatic transmission with a manual shift option. The braking system consisted of front and rear disc brakes with four-wheel antilock, braking assist and electronic brakeforce distribution. The Volkswagen was also equipped with Electronic Stability Control (ESC), traction control, and an indirect Tire Pressure Monitoring System (TPMS). Per the driver interview, the TPMS warning light was not on prior to the crash. The front left, rear left, rear right and sunroof glazing were closed at the time of the crash. The front right window was partially open at the time of the crash. The vehicle was equipped with four matching Bridgestone Turanza EL400 tires, Tire Identification Number (TIN) V60F PLY 1407 in tire size P205/55R16. The tires were mounted on OEM five-spoke alloy wheels. The vehicle manufacturer recommended tire sizes were P205/55R16 or P225/45R17, with a recommended

cold tire pressure of 234 kPa (34 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	Tire Flat	6 mm (7/32 in)	De-beaded, 10 cm cut in sidewall
Left Rear	Tire Flat	5 mm (6/32 in)	De-beaded, 19 cm fracture of wheel, 47 cm cut in sidewall.
Right Front	172 kPa (25 PSI)	5 mm (6/32 in)	None
Right Rear	Tire Flat	5 mm (6/32 in)	De-beaded

The interior of the Volkswagen was configured with leather-surfaced five-passenger seating. The front bucket seats were separated by a center console and equipped with adjustable head restraints. Both head restraints were in the full-down position at the time of the SCI inspection. The front left seat track was adjusted to a mid-track position 11 cm (4.3 in) forward of full-rear. The front left seat back angle was 23 degrees aft of vertical. The front right seat was in the full-rear position, with a seat back angle of 27 degrees aft of vertical. The second row non-adjustable bench seat had split (60/40) forward-folding seat backs. The three rear seating positions all had adjustable head restraints in the full-down position.

The interior occupant safety systems consisted of 3-point lap and shoulder belts for all five designated seating positions, front retractor pretensioners, dual stage frontal air bags, front seat-mounted side impact air bags and IC air bags that provided protection for the four outboard positions.

2001 Dodge Ram

The 2001 Dodge Ram 1500 extended-cab pickup truck was manufactured in June 2001 and was identified by the VIN 3B7HF13Z81G (production sequence deleted). The four-wheel drive Dodge was powered by a 5.9 liter, V-8 engine linked to a four-speed automatic transmission. The braking system consisted of front disc and rear drum brakes with four-wheel anti-lock. All windows were closed at the time of the crash. The vehicle was equipped with Cooper Zeon LTZ tires, size P375/50R20. The manufacturer recommended tire size was P245/75R16. The tires were mounted on aftermarket five-spoke alloy wheels. The left rear tire had been replaced post-crash with a spare tire to enable towing of the vehicle. This tire was a Goodyear Wrangler RT/S at 186 kPa (27 PSI) with 11 mm (14/32 in) of tread in size P265/75R16. The vehicle manufacturer recommended cold tire pressure was 241 kPa (35 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	Tire Flat	6 mm (8/32 in)	Wheel fractured, tire separated from wheel and located in pickup bed
Left Rear	Tire Flat	8 mm (10/32 in)	Wheel/tire removed to enable towing; found in pickup bed
Right Front	Tire Flat	7 mm (9/32 in)	De-beaded
Right Rear	241 kPa (35 PSI)	5 mm (6/32 in)	None

The interior of the Dodge was configured with cloth-surfaced six-passenger seating. The front bench seat was equipped with integral head restraints for the outboard seating positions and a folding back for the center seat that formed a center console when folded down. The front seat tracks were found in the full-rear position. The non-adjustable rear bench seat had a fixed back and a lower cushion that folded vertically to increase interior cargo space.

The interior occupant safety systems consisted of 3-point lap and shoulder belts for the four outboard seating positions, and a lap belt for each center position. Frontal air bags for the driver and front right passenger were available as supplemental protection.

2008 Buick Lucerne

The 2008 Buick Lucerne CXL four-door sedan was identified by the VIN 1G4HD57238U (production number deleted). The front-wheel drive Buick was powered by a 3.9 liter, V-6 engine linked to a four-speed automatic transmission. The braking system consisted of front and rear disc brakes with four-wheel anti-lock and electronic brake force distribution. The Buick was also equipped with traction control and an indirect Tire Pressure Monitoring System (TPMS). The Buick was equipped with four matching Michelin Energy MXV4 tires, TIN B9JJ ENXX 2507. The tires were mounted on OEM nine-spoke alloy wheels. The tire size was P235/55R17 matching the manufacturer's recommended tire size. The vehicle manufacturer's recommended cold tire pressure was 207 kPa (30 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	Tire Flat	4 mm (5/32 in)	Sidewall holed
Left Rear	Tire Flat	5 mm (6/32 in)	None
Right Front	Tire Flat	5 mm (6/32 in)	De-beaded
Right Rear	Tire Flat	4 mm (5/32 in)	De-beaded

The interior of the Buick was configured with leather-surfaced five-passenger seating. The front bucket seats were equipped with adjustable head restraints and separated by a center console. The rear seat consisted of a fixed bench with integral head restraints for the outboard seating positions.

The interior occupant safety systems consisted of 3-point lap and shoulder belts for the five designated seating positions, front safety belt pretensioners, CAC dual-stage frontal air bags, front seat-mounted side air bags, and IC air bags that provide protection for the four outboard seating positions.

Crash Sequence

Pre-Crash

The driver of the Volkswagen was operating the vehicle north in lane two at a driver-estimated speed of 89 km/h (55 mph). The Volkswagen driver was on her way to work and was not abnormally rushed. She had left on time and was driving in a familiar area. The Dodge Ram pickup was traveling south in lane two of the same roadway at a police-estimated speed of 89 km/h (55 mph). The 2008 Buick Lucerne was northbound on the same roadway traveling behind and one lane to the right of the Volkswagen. The Buick was traveling at a police-estimated speed of 89 km/h (55 mph). The driver of the Dodge initiated a steering input to the left for unknown reasons and the Dodge crossed the center turn lane at an angle approximately ten degrees counterclockwise of its original heading. The Dodge continued this errant trajectory into the inboard northbound lane and approached the Volkswagen. Immediately prior to the impact, the Volkswagen driver initiated a right steering input in an attempt to avoid the crash.

Crash

The front left corner area of the Dodge impacted the left side of the Volkswagen immediately aft of the vehicle's left front corner (Event 1). The front and left side of the Dodge then engaged the left side of the Volkswagen. The impact resulted in damage to the Volkswagen's left wheels, left doors and the left quarter panel. This impact also resulted in the separation of the front left wheel of the Dodge. The direction of force to both vehicles was within the 12 o'clock sector. The force of the impact resulted in the pretensioner actuation and the deployment of the driver frontal air bag, the driver seat-mounted side impact air bag and the left IC. The frontal air bags in the Dodge deployed. The non-central impact configuration and violation of the common velocity assumption precluded analysis of the impact by the WINSMASH program.

The Dodge continued its forward trajectory and initiated a counterclockwise yaw as it traveled into the outboard northbound lane. The front right of the Dodge impacted and overrode the front left corner of the Buick (Event 2). The front bumper of the Dodge engaged the hood and A-pillars of the Buick. The direction of force for the Dodge was within the 2 o'clock sector. The direction of force was in the 11 o'clock sector the Buick. The override-type damage in this event

was outside the scope of the WINSMASH program. The Buick was redirected rearward and to the right, initiating a clockwise yaw as it traveled over the curb and departed the roadway to the east. The Dodge continued its forward trajectory and counterclockwise yaw as it traveled over the curb and departed the roadway to the east. The Dodge came to rest facing east partially in a grass yard, east of the roadway. The Buick came to rest facing east completely in the same grass yard.

Subsequent to the initial impact, the Volkswagen was redirected to the right and into a counterclockwise yaw. The vehicle rotated approximately 40 degrees and the right rear wheel of the Volkswagen impacted the curb on the east side of the roadway (Event 3). The damage from this impact was limited to the right rear wheel and the direction of force was within the 3 o'clock sector. The Volkswagen continued to yaw counterclockwise and departed the roadway. The vehicle came to rest facing west with its right front wheel on the roadway and the remaining three wheels off the roadway at the top of an embankment on the east side of the roadway.

Post-Crash

Witnesses to the crash placed calls to the 9-1-1 emergency response system. Police, fire, emergency medical and tow personnel responded to the crash site. The 42-year old female driver of the Volkswagen was assisted from her vehicle by the first responders. It is unknown how the 34-year old male driver of the Dodge exited his vehicle. The 56-year old female driver of the Buick had to be extricated from her vehicle. This extrication involved removing the left front door and the roof.

The driver of the Volkswagen was transported by ground ambulance to a regional hospital where she was treated for facial fractures and lacerations, multiple soft tissue injuries to her face and left side and a laceration to her left palm. She was treated in the emergency department and released the same day. The driver of the Dodge sustained moderate severity injuries and was transported by ground ambulance to a local hospital. The driver of the Buick was pronounced deceased at the scene.

2007 Volkswagen Jetta

Exterior Damage

The left side and the right rear wheel of the Volkswagen were damaged in this multiple event crash. The initial impact (Event 1) involved moderate-severity damage to the left side of the Volkswagen **(Figure 3)**. The direct contact damage began on the left side 66 cm (26 in) aft of the left rear axle and extended forward 390 cm (153.5 in) to slightly aft of the left front bumper corner. The combined direct and induced damage (Field L) began 84 cm (33.1 in) rear of the left rear axle and extended forward 408 cm (160.6 in). Lateral crush was present on the left doors, the A, the B and the C-pillars. The front and rear left door hinges were intact and remained attached to the A- and B-pillars, respectively. Both left side door latches remained engaged as

both side doors remained closed during the crash. The windshield was cracked but remained in place during the crash. The left side windows all disintegrated as a result of the impact with the Dodge. The right side windows, backlight and sunroof glazing were not damaged in this crash. The front and rear left wheels and tires were engaged by the Dodge Ram and were damaged but did not separate from the suspension components. Vertically, the direct damage extended from the sill level to the A- and B-pillars above the belt line. The residual crush profile was measured at the mid door elevation and was as follows: C1 = 0 cm, C2 = 15 cm (5.9 in), C3 = 6 cm (2.4 in), C4 = 9 cm (3.5 in), C5 = 13 cm (5.1 in), C6 = 7 cm (2.8 in). The maximum crush was located at C2, 10 cm (3.9 in) aft of the left rear axle and measured 15 cm (5.9 in). The elevation of the maximum crush was 66 cm (26 in), which was consistent with the front bumper height of the Dodge. The Door Sill Differential (DSD) was 12 cm (4.7 in). The left roof side rail deformed laterally and buckled the left side of the roof slightly upward. The Collision Deformation Classification (CDC) of this impact was 12LDAW2.

The secondary impact damage involved the right rear wheel of the Volkswagen **(Figure 4)**. This component was damaged as the wheel impacted the east concrete curb (Event 3). The right rear tire was de-beaded and the wheel was deformed inboard. The plane wheel was canted approximately 15 degrees from its lower to upper aspect. The CDC assigned for this impact was 03RBWN1.

Figure 3: Impact damage to the left side of the Volkswagen.

Figure 4: Secondary damage to right rear wheel and tire of the Volkswagen.

Interior Damage

The Volkswagen Jetta sustained moderate severity interior damage that was attributed to occupant contact and passenger compartment intrusion. The front and rear left doors intruded laterally, as did the left B- and C-pillars. The left C-pillar intrusion compressed the rear left seat back, causing the folding back to intrude longitudinally forward.

The intrusion of the Volkswagen is listed on the following table:

Position	Component	Direction	Magnitude
Row 1 Left	Door Rear Lower Quadrant (RLQ)	Lateral	5 cm (2 in)
Row 1 Left	B-pillar	Lateral	4 cm (1.6 in)
Row 2 Left	Door Rear Upper Quadrant (RUQ)	Lateral	4 cm (1.6 in)
Row 2 Left	C-pillar	Lateral	4 cm (1.6 in)
Row 2 Left	Second seat back	Longitudinal	6 cm (2.4 in)

Manual Restraint Systems

The Volkswagen Jetta was equipped with manual 3-point lap and shoulder belt systems for the five designated seating positions. All belt systems utilized continuous loop webbing with sliding latch plates. The driver's belt retracted into an Emergency Locking Retractor (ELR) with a retractor pretensioner. The upper D-ring was height adjustable and set to the full-down position. The driver was using the safety belt at the time of the crash, which was supported by evidence on the belt webbing. This evidence consisted of two frictional abrasions on the belt webbing, and an area of body fluid and abrasion on the belt webbing. Specifically, the abrasion attributed to the latch plate was located 86 cm (33.9 in) above the floor anchor. The abrasion attributed to the upper D-ring was 142 cm (55.9 in) above the floor anchor. The abraded webbing and body fluid were located 39-127 cm (15.4 – 50 in) above the floor anchor. The pretensioner did not lock the safety belt in the worn position. The total length of the spooled out webbing was 202 cm (79.5 in).

The front right and second row belt systems all utilized a switchable ELR/Automatic Locking Retractor (ALR). In addition, the front right belt system contained a retractor mounted pretensioner which did not actuate during this crash. These positions were not occupied at the time of this crash.

Frontal Air Bag System

The Volkswagen was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system. The driver's air bag was concealed within the center hub of the three-spoke steering wheel by four cover flaps. The top flap was 5 cm (2 in) in height and 6 cm (2.4 in) in width at the horizontal tear seam and 11 cm (4.3 in) in width at its top aspect. The two side flaps were mirrored symmetrically and were 4 cm (1.6 in) in width at the tear seam and 6 cm (2.4 in) in height. The lower flap was 8 cm (3.1 in) in height and 6 cm (2.4 in) in width at the horizontal tear seam. The air bag **(Figure 5)** measured 60 cm (23.6 in) in diameter in its deflated state. The air bag was vented by one port

Figure 5: Deployed driver's frontal air bag.

at the 12 o'clock position at the rear aspect of the membrane. The air bag was tethered by two straps attached to the face of the bag at the 12 and 6 o'clock positions with an 18 cm (7.1 in) diameter seam.

There were no occupant contact points on the air bag; however, the face of the air bag was covered by small drops of body fluid and coffee. There were two 3 cm (1.2 in) cuts in the face of the air bag attributed to fragments of the tempered side glazing. The first cut was nearly horizontal and located 5 cm (2 in) below the center point of the face of the bag. The second cut was oriented diagonally up from left to right and was located 10 cm (3.9 in) below and 12 cm (4.7 in) to the right of the center point of the bag's face. There were three small holes less than 1 cm (0.4 in) in diameter located on the upper rear aspect of the air bag located 9 cm (3.5 in) above and 3 cm (1.2 in) to the left of the vent port.

The front right air bag was mounted within the top aspect of the right instrument panel. The front right seat was not occupied during the crash; therefore, the CAC system suppressed the deployment of the air bag, as designed.

Side Impact Air Bag System

The Volkswagen was equipped with front seat-mounted side impact air bags and roof side rail mounted IC air bags. The left IC and side impact air bags deployed in this left side crash sequence. The right IC and side impact air bag did not deploy.

The left IC air bag deployed from the left roof side rail. The air bag measured 174 cm (68.5 in) in length. At the front and rear seating positions, the IC was 34 cm (13.4 in) in height. The air bag was tethered to the A-pillar by a 6 cm (2.4 in) long strap. The IC provided complete longitudinal coverage across the entire left side glazing. Vertically, the IC extended below the belt line at each outboard position. **Figure 6** depicts the left IC air bag at the driver's position.

Figure 6: Left IC air bag at the driver's position.

The forward inboard aspect of the IC was covered with numerous small droplets of coffee but was free of occupant contact.

A 5 cm (1.2 in) cut was observed on the central aspect outboard surface of the IC air bag. The cut of the air bag's fabric was attributed to the front structure of the Dodge Ram. This cut was located 17 cm (6.7 in) below the roof side rail and extended from 57 to 62 cm (22.4 to 24.4 in) rear of the front edge of the IC.

The left side impact air bag deployed from a panel in the outboard aspect of the left seat back. The air bag measured 20 cm (7.9 in) in width and 54 cm (21.3 in) in height. It contained one vent port at the three o'clock position and no tethers. There was smeared body fluid on the entire outboard aspect of the membrane. There was no damage to the membrane or contact evidence on the inboard side. **Figure 7** depicts the front left side air bag.

Figure 7: Left side impact air bag.

2001 Dodge Ram

Exterior Damage

The front of the Dodge Ram sustained moderate severity damage as a result of the multiple impact crash. The front plane sustained two impacts with overlapping damage. The first region of damage was located at the front left corner from the initial impact with the Volkswagen (**Figure 8**). This initial impact damage wrapped around the left corner and extended along the left plane to the left front door area. This damage pattern was overlapped by the damage from the Event 2 impact with the Buick. The partial CDC assigned for the Event 1 impact was 12FLEE6. The direction of force for the initial impact was within the 12 o'clock sector.

Figure 8: Left oblique view of the Dodge.

The secondary impact to the front right corner caused the bumper to shift downward and to the left (**Figure 9**). The direction of force for the secondary impact was within the 2 o'clock sector. The bumper was displaced 36 cm (14.2 in) to the left and 28 cm (11 in) downward. The direct damage was located from bumper corner to bumper corner and measured 133 cm (52.4 in). The maximum crush was located at C6, the front right bumper corner and measured 53 cm (20.9 in). A crush profile which combined the overall residual crush from the two impacts was documented along

Figure 9: Overall view of the frontal damage to the Dodge.

the width of the bumper. The crush profile was as follows: C1 = 25 cm (9.8 in), C2 = 37 cm (14.6 in), C3 = 46 cm (18.1 in), C4 = 50 cm (19.7 in), C5 = 53 cm (20.9 in), C6 = 53 cm (20.9 in). The CDC assigned for the secondary impact was 82FDEW3, considering the bumper shift to the left is greater than the vertical shift downward.

2008 Buick Lucerne

Exterior Damage

The front plane of the Buick sustained severe damage as a result of its impact with the Dodge. The direct contact damage at the bumper elevation began 38 cm (15 in) right of the centerline and extended left 112 cm (44.1 in) to the front left corner. The combined direct and induced damage (Field L) extended from bumper corner to bumper corner. The residual crush profile measured at the bumper level was as follows: C1 = 23 cm (9.1 in), C2 = 22 cm (8.7 in), C3 = 18 cm (7.1 in), C4 = 12 cm (4.7 in), C5 = 9 cm (3.5 in), C6 = 1 cm (0.4 in). The front bumper of the Dodge overrode the front bumper of the Buick and the direct damage to the Buick extended up the hood, over the top of the engine and ended at the A-pillars 167 cm (65.7 in) rearward of the front of the front bumper. The resultant deformation to the left A-pillar was 51 cm (20.1 in) longitudinally. The CDC assigned for this impact was 11FDAW7. **Figure 10** is an overall view of the damage to the Buick.

Figure 10: Front left view of the damage to the Buick.

2007 Volkswagen Jetta Driver

Demographics/Data

Driver Age/Sex:	42-year old / Female
Height:	170 cm (67 in)
Weight:	54 kg (119 lb)
Eyewear:	None
Seat Track Position:	Mid track – 11 cm (4.3 in) fwd. of full-rear
Manual Safety Belt Use:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Removed by EMS while unconscious
Mode of Transport From Scene:	Ground ambulance
Type of Medical Treatment:	Treated in emergency department and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Comminuted fracture of the nasal spine	Moderate (251004.2,4)	Air bag and object held
Fractured nasal processes of maxilla (minimally displaced)	Moderate (250800.2,9)	Air bag and object held
3 cm laceration to right forehead and 2 cm superficial laceration to right eyebrow	Minor (290602.1,7)	Air bag and object held
Right scalp hematoma	Minor (190402.1,1)	Air bag and object held
2 cm through and through laceration to upper lip	Minor (290602.1,8)	Air bag and object held
Right eyebrow abrasion	Minor (290202.1,7)	Air bag and object held
2 cm (1 in) laceration to palm of left hand	Minor (790602.1,2)	Unknown
Left eyelid contusion	Minor (297402.1,2)	Left hand (air bag related)
Left shoulder contusion	Minor (790402.1,2)	Safety belt webbing

Source = Hospital Records

Driver Kinematics

The 42-year old female driver was seated in a mid-track position and was restrained by the manual three-point lap and shoulder belt system. Prior to the crash, the driver reported that she was drinking coffee and was holding the heavy ceramic mug in her right hand. A fractured ceramic mug was found in the vehicle at the time of the SCI inspection. The driver detected the Dodge Ram as it entered her lane of travel. She initiated a right steering input (using her left hand) in an attempt to avoid the crash. In the interview the driver stated that the steering input made only a small adjustment to the heading of the vehicle prior to the impact. The impact of the Dodge to the left side of the Volkswagen resulted in the actuation of the safety belt pretensioner and the deployment of the frontal air bag, the left side impact air bag and the left IC. The driver's torso responded to the frontal impact by initiating a forward trajectory and loading the safety belt.

The deployment of the frontal air bag displaced the driver's hands rearward from the steering wheel. The right hand and coffee mug were displaced into the driver's face resulting in the nasal fractures and the facial abrasion, contusion, and lacerations. The coffee mug fractured as a result

of the facial impact and coffee was displaced about the interior and onto the deployed frontal and IC air bags. The displaced left hand struck the driver in the face and resulted in a left eyelid contusion. The driver loading of the pretensioned safety belt resulted in the left shoulder contusion.

The engagement of the Dodge along the left side of the Volkswagen redirected the vehicle to the right and it began yaw counterclockwise. The Volkswagen impacted the curb with its right rear wheel. This impact resulted in minimal displacement of the driver. The Volkswagen came to rest on the right roadside. The driver was removed from the vehicle by the first responders and was transported by ground ambulance to a regional hospital. She was treated in the emergency department and released.

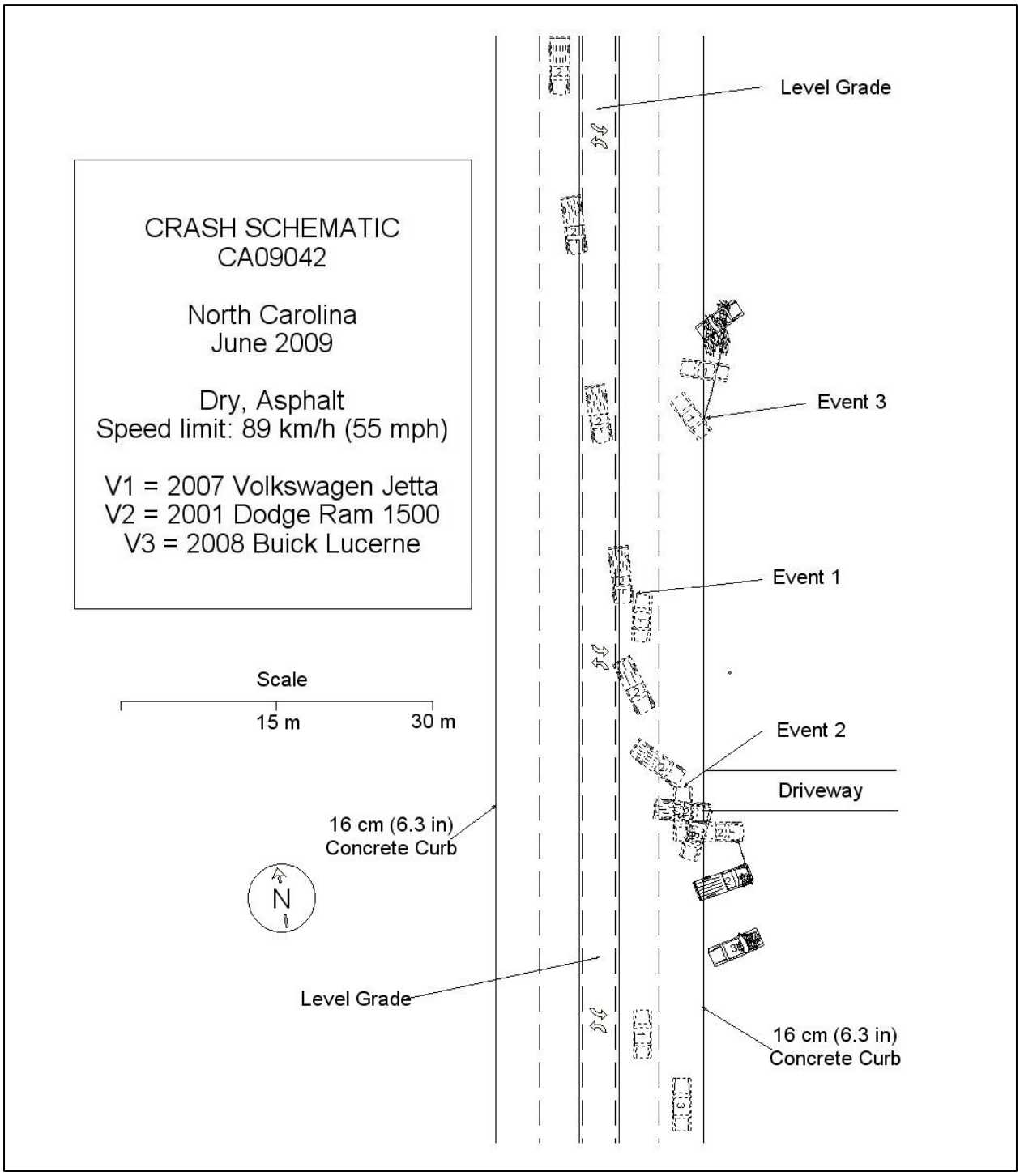

Figure 11: Crash Schematic