**CRASH DATA RESEARCH CENTER**

Calspan Corporation
Buffalo, NY 14225

# CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION VEHICLE CRASH INVESTIGATION

**CASE NO: CA06-007**

**VEHICLE: 2005 VOLKSWAGEN PASSAT**

**LOCATION: NEW YORK**

**CRASH DATE: APRIL 2006**

Contract No. DTNH22-01-C-17002

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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.

# TECHNICAL REPORT STANDARD TITLE PAGE

| | | | |
|---|---|---|---|
| *1. Report No.*<br>CA06-007 | *2. Government Accession No.* | *3. Recipient's Catalog No.* | |
| *4. Title and Subtitle*<br>Calspan On-Site Side Impact Inflatable Occupant Protection Vehicle Crash Investigation<br>Vehicle: 2005 Volkswagen Passat<br>Location: State of New York | | *5. Report Date*:<br>June 2006<br>*6. Performing Organization Code* | |
| *7. Author(s)*<br>Crash Data Research Center | | *8. Performing Organization Report No.* | |
| *9. Performing Organization Name and Address*<br>Crash Data Research Center<br>Calspan Corporation<br>P.O. Box 400<br>Buffalo, New York 14225 | | *10. Work Unit No.*<br>C00410.0000.0345<br>*11. Contract or Grant No.*<br>DTNH22-01-C-17002 | |
| *12. Sponsoring Agency Name and Address*<br>U.S. Department of Transportation<br>National Highway Traffic Safety Administration<br>Washington, D.C. 20590 | | *13. Type of Report and Period Covered*<br>Technical Report<br>Crash Date: April 2006<br>*14. Sponsoring Agency Code* | |
| *15. Supplementary Note*<br>This on-site investigation focused on the performance of the seat back mounted side impact air bag and the Inflatable Curtain (IC) air bag system that deployed in a 2005 Volkswagen Passat. | | | |
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| *17. Key Words*<br>Side impact Inflatable Curtain air bag deployment<br>Side impact seatback mounted air bag deployment<br>Frontal air bag deployment | | *18. Distribution Statement*<br>General Public | |
| *19. Security Classif. (of this report)*<br>Unclassified | *20. Security Classif. (of this page)*<br>Unclassified | *21. No. of Pages*<br>10 | *22. Price* |

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**SCI CASE NO: CA06-007**
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**LOCATION: NEW YORK**
**CRASH DATE: APRIL 2006**

***BACKGROUND***

This on-site investigation focused on the performance of the seat back mounted side impact air bag and the Inflatable Curtain (IC) air bag system that deployed in a 2005 Volkswagen Passat **(Figure 1)**. The Passat was equipped with dual stage frontal air bags for the driver and front right passenger positions, front seatback mounted side impact air bags, and IC air bags at the four outboard positions of the vehicle. The 33-year-old male driver occupied the vehicle and was restrained by the manual 3-point lap and shoulder restraint. The Passat was involved in an intersection crash with a 2000 Ford Taurus that resulted in deployment of the frontal air bags, the left side seatback air bag and the left IC. The crash occurred during daylight hours in April 2006 at a four-leg intersection. The 23-year-old male driver of the Ford Taurus passed through a stop sign and was impacted by the Volkswagen Passat. The full frontal area of the Passat impacted the right passenger compartment area of the Taurus resulting in directions of force of 11 o'clock for the Passat and 2 o'clock for the Taurus. The lateral component of the Passat's impact force deployed the left side impact air bag and the IC. An unoccupied forward facing Child Safety Seat (CSS) was secured improperly by the LATCH system in the rear seat of the Passat. The 33-year-old male driver of the Passat sustained soft-tissue injuries and was transported by ambulance to a local hospital where he was treated and released. The 24-year-old male driver of the Taurus fled the scene of the crash in the damaged vehicle. The Taurus was located several blocks away at a business establishment parking lot and the driver was returned to the scene of the crash. Both vehicles were towed to a local tow yard and held by the police for this SCI investigation.

**Figure 1 - Damaged 2005 Volkswagen Passat.**

The investigating officer contacted the Calspan Special Crash Investigations team from the scene of the crash. He reported the severity of the crash and the deployment of the side impact air bag systems. The notification was immediately forwarded to NHTSA and the case was assigned for on-site investigation on April 7, 2006. The investigation involved the inspection and documentation of the vehicles and the crash site.

***SUMMARY***

***Vehicle Data – 2005 Volkswagen Passat***

The 2005 Volkswagen Passat was identified by the Vehicle Identification Number (VIN): WVWBD63B55P (sequence number omitted). The vehicle odometer read 22,213 km (13,803 miles) at the time of the inspection. The Passat was a four-door sedan that was equipped with a conventionally mounted, 1.8-liter, 4-cylinder turbo-charged engine linked to an all-wheel-drive 5-speed automatic transmission. It was outfitted with four-wheel disc brakes with ABS, electronic stability control (ESC), daytime running lamps, a tilt and telescoping steering column, and anti-whiplash front head restraints. The Passat was equipped with Continental Conti Touring Contact P205/55R16 tires. The manufacturer's recommended tire pressure was 248 kPa (36 PSI) for the front tires and 303 kPa (44 PSI) for the rear tires. The specific tire information at the time of the SCI inspection was as follows:

| Position | Measured Pressure | Measured Tread Depth | Damage |
|---|---|---|---|
| LF | 228 kPa (33 PSI) | 8 mm (10/32") | None |
| LR | 214 kPa (31 PSI) | 6 mm (7/32") | None |
| RF | 214 kPa (32 PSI) | 6 mm (7/32") | None |
| RR | 221 kPa (31 PSI) | 6 mm (8/32") | None |

The seating positions in the Passat were configured with front bucket seats with adjustable head restraints, and a rear bench seat with adjustable head restraints in the three designated positions. The head restraints for the second row center and right positions were not in the vehicle at the time of the inspection. Both front seatbacks were slightly reclined.

***Vehicle Data – 2000 Ford Taurus***

The 2000 Ford Taurus was identified by the VIN: 1FAFP55SYG (production number omitted). The Taurus was a four-door sedan configured with a transverse mounted 3.0-liter, 6-cylinder engine linked to a four-speed automatic transmission. The front wheel drive sedan was equipped with four-wheel disc brakes with ABS, a tilt steering wheel, and an Event Data Recorder (EDR). The EDR was not downloaded since there was no air bag deployment. The Taurus was equipped with 41 cm (16") steel wheels and the manufacturer recommended tire pressure was 207 kPa (30 PSI). The specific tire information at the time of the SCI inspection was as follows:

| Position | Tire Manufacturer | Size | Measured Pressure | Measured Tread | Damage |
|---|---|---|---|---|---|
| LF | Bridgestone Insignia SE 200 | P225/60R16 | 221 kPa (32 PSI) | 9 mm (11/32") | None |
| LR | Kelly Explorer | P215/60R16 | 145 kPa (21 PSI) | 6 mm (7/32") | None |
| RF | Kelly Explorer | P215/60R16 | 207 kPa (30 PSI) | 6 mm (7/32") | None |
| RR | Kelly Explorer | P215/60R16 | 207 kPa (30 PSI) | 6 mm (7/32") | None |

***Crash Site***

This two-vehicle crash occurred at the northeast quadrant of a four-leg intersection during daylight conditions. At the time of the crash, the weather was clear and the asphalt roadway was dry. The north/south roadway was configured with two travel lanes, one in each direction, and was separated by a double yellow painted centerline. The northbound and southbound lanes were 6.5 meters (21.3') and 6 meters (19.7') in width, respectively. The east leg of the east/west roadway consisted of a two-lane unmarked asphalt roadway that was 9.4 m (30.8') in width. The west leg consisted of a two-lane asphalt roadway separated by center grassy median enclosed by mountable concrete curbs. The west leg of the roadway was offset of the intersection at an angle of –15 degrees. Each lane was 6 m (19.7') in width and the center median was 2.2 m (7.2') wide. The east/west roadway was controlled by stop signs and the posted speed limit was 48 km/h (30 mph). The posted speed limit for the north/south roadway was 56 km/h (35 mph). The roadside environment consisted of residential properties and natural growth. The scene schematic is included as **Figure 11** at the end of this narrative report.

***Crash Sequence***

***Pre-Crash***

The 2005 Volkswagen Passat was traveling on the northbound lane and passing through the intersection (**Figure 2**). The 24-year-old driver of the Taurus was traveling eastbound and disregarded the stop sign and entered the intersection **(Figure 3)**. The driver of the Taurus claimed that he was being chased by an unknown vehicle and ran the stop sign out of fear for his safety. The driver of the Passat reported that he saw the Taurus approaching a second prior to the impact but did not have sufficient time to attempt any avoidance measures.

**Figure 2 - Northbound approach of the 2005 Volkswagen Passat.**

**Figure 3 - Eastbound approach of the 2000 Ford Taurus.**

***Crash***

The front of the Passat impacted the right passenger compartment area of the Taurus. The directions of force for the Passat and Taurus were in the 11 and 2 o'clock sectors, respectively. The damage algorithm of the WinSMASH program computed a total delta-V of 14 km/h (8.7 mph) for the Passat and 15 km/h (9.3 mph) for the Taurus, based on the vehicles frontal crush profiles. The longitudinal and lateral components for the Passat were –12 km/h (-7.4 mph) and 7 km/h (4.3 mph) and –5 km/h (3.1 mph) and –14 km/h

(8.7 mph) for the Taurus. After the impact, the Passat was redirected longitudinally and laterally and came to final rest facing northeast. The impact severity was moderate and resulted in the deployment of the frontal, left side seat, and left side IC air bags in the Passat. The final rest position of the Taurus is not known.

***Post-Crash***

The driver of the Passat sustained soft-tissue injuries to his left knee and hand. He was transported by ambulance to a local hospital for evaluation and released. The status of this occupant will be updated upon receipt of the medical records. The driver of the Taurus fled the scene of the crash in his damaged vehicle. The vehicle was located at a local business parking lot several blocks from the crash site. The driver returned to the scene and explained that he fled the scene due to being chased by another vehicle. The driver of the Taurus was not injured during the impact.

***Vehicle Damage***

***Exterior Damage – 2005 Volkswagen Passat***

**Figure 3 - Frontal damage on 2005 Volkswagen Passat.**

The 2005 Volkswagen Passat sustained moderate frontal damage (**Figure 4)** as a result of the impact with the right side of the 2000 Ford Taurus. The direct contact damage began 4 cm (1.5") right of the vehicle's centerline and extended 58 (22.8") cm to the left front corner of the upper radiator support. Direct contact damage on the hood began 8 cm (3.0") left of the vehicle's centerline and extended 66 cm (26") to the left. The vehicle's Principal Direction of Force (PDOF) was 330 degrees. Due to the 11 o'clock direction of force, both front bumper energy-absorbing devices (EAD) shifted to the right. The right EAD displaced laterally 17 cm (6.5") and the left 22 cm (8.5"). The left EAD separated from the frame rail. The maximum crush was located 34 cm (13.4") left of the vehicle's centerline and measured 9 cm (3.5") in depth. The combined direct and induced damage measured 115 cm (45.5"), began at the left outermost point of the radiator support and terminated at the right outermost point of the same component. The Collision Deformation Classification (CDC) for the impact with the Taurus was 11-FDEW-1. Six equidistant crush measurements were documented along the upper radiator support and were as follows: C1 = 5 cm (2.0"), C2 = 9 cm (3.5"), C3 = 2 cm (0.8"), C4 = 4 cm (1.5"), C5 = 2 cm (0.8"), C6 = 1 cm (0.3").

A second crush profile was documented at the level of the bumper beam of the Passat. The bumper beam was partially detached due to the separation of the left EAD; therefore, the crush profile was not a true representation of the crush and not used to generate a delta-V. The direct contact damage on the bumper beam began 22 cm (8.5") right of the vehicle's centerline and extended 99 cm (39") to the left front bumper corner. Due to bumper beam shifting to the right, the maximum crush was located at the right front bumper corner and measured 21 cm (8.3") in depth. The combined direct and induced

damage measured 127 cm (50”). Six crush measurements were documented at the bumper level and were as follows: C1 = 0 cm, C2 = 0 cm, C3 = 1 cm (0.3”), C4 = 4 cm (1.5”), C5 = 10 cm (3.8”), C6 = 22 cm (8.5”).

***Interior Damage – 2005 Volkswagen Passat***

There were no intrusions or discernable contact points within the interior of the Passat. The front right air bag module cover flap housing the passenger’s air bag struck the windshield resulting in two fractures. The first crack was 8 cm (3.1”) in diameter located 34 cm (13.5”) below the header and 3 cm (1.0”) to 10 cm (4.0”) inboard of the right A-pillar. The second crack was 32 cm (12.6”) below the header and 25 cm (9.8”) inboard of the right A-pillar. The Passat was equipped with a four-spoke tilt steering column that was situated between center and full-up position.

***Exterior Damage – 2000 Ford Taurus***

The 2000 Ford Taurus sustained moderate severity right side damage (**Figure 5**) as a result of the impact with the frontal aspect of the 2005 Volkswagen Passat. The direct contact damage began 130 cm (51.2”) forward of the right rear axle and measured 105 cm (41.3) in length. The maximum crush was located 217 cm (85.4”) forward of the right rear axle and measured 21 cm (8.3”) in depth. The combined direct and induced damage began 72 cm (28.3”) forward of the right rear axle and measured 217 cm (85.4) in length. The PDOF for the Taurus was 290 degrees. The CDC for the impact with the Passat was 02-RYEW-2. Six equidistant measurements were documented at the mid-door level and were as follows: C1 = 0 cm, C2 = 3 cm (1.2”), C3 = 19 cm (7.5”), C4 = 17 cm (6.7”), C5 = 3 cm (1.2”), C6 = 0 cm.

**Figure 5 - Right side damage 2000 Ford Taurus.**

***Manual Restraints – 2005 Volkswagen Passat***

The 2005 Volkswagen Passat was equipped with a continuous loop, manual 3-point lap and shoulder belts with adjustable D-rings and sliding latch plates for the frontal outboard seating positions. The driver’s safety belt was configured with a belt-sensitive Emergency Locking Retractor (ELR) and the front right position was equipped with belt-sensitive, switchable ELR/Automatic Locking Retractor (ALR). The front belt systems were configured with safety belt retractor pretensioners. Both pretensioners fired as a result of the crash; however, the retractors did not remain locked post-crash. The driver’s and front right passenger D-rings were found to be in the full-down positions. Loading evidence from the latch plate was present on the driver shoulder belt and was located on the webbing 76 cm (30”) to 78 cm (30.8”) above the belt’s floor anchor. A similar loading pattern was present on the unused front right passenger shoulder belt webbing and was located 70 cm (27.5”) to 71 cm (28”) above the belt’s floor anchor. The driver’s plastic-coated latch plate exhibited minor abrasions consistent with loading. The frontal belt buckles were mounted to the seat frame with a steel cable.

The rear seats were configured with manual 3-point lap and shoulder belts with switchable ELR/ALR systems and sliding latch plates.

***Frontal Air Bag System – 2005 Volkswagen Passat***

The 2005 Volkswagen Passat was equipped with redesigned frontal air bags for the driver and front right passenger positions (**Figure 6)**. The driver's air bag was housed in the center of steering wheel hub and deployed through H-configuration module cover flaps. The symmetrical flaps were 17 cm (6.6") in width and 7 cm (2.8") in height. The driver's air bag measured 58 cm (22.8") in diameter in its deflated state. The air bag was internally vented and was tethered by four straps fixed in the 12, 3, 6, and 9 o'clock positions to a circular stitch pattern on the air bag that measured 18 cm (7") in diameter. Vinyl striations were present around the entire perimeter of the air bag from expansion against the module assembly.

**Figure 6 - Frontal air bag deployment - 2005 Volkswagen Passat.**

The driver's air bag was identified by the following nomenclature that was stamped on the top surface of the air bag membrane:

**>PA6.6<**
**02000010006699801**

The front right passenger air bag deployed from a mid-mount module with a rectangular cover flap that was hinged at the forward aspect. The module cover flap measured 34 cm (13.3") in width and 20 cm (8") in height. The deployed front right passenger's air bag measured 46 cm (18") in width and 79 cm (31") in height in its deflated state. The air bag was internally vented and tethered. The cover flap was tethered by two straps 8 cm (3") in length and 4 cm (1.5") in width. The cover flap contacted and fractured the windshield. Damage was present on the flap at the bottom left corner and also 16 cm (6.3") inboard of the bottom left corner along the lower edge. Vinyl striations were present around the outer edge of the air bag with a heavy vinyl distribution on the underside of the bag.

The passenger's air bag was identified by the following nomenclature that was stamped on the top surface of the air bag membrane:

**B5PG Authrazit 19-19-0**
**Polds 1.60 kg 16/09/04 0053**
**Produlт No: Eq NUIT Lot: 74981**
**238 862**
**17/09/04**

***Side Impact Occupant Protection System – 2005 Volkswagen Passat***

The 2005 Volkswagen Passat was equipped with seatback mounted side impact air bags for the driver and front right passenger positions. The Passat was also equipped with left and right side 2-chamber Inflatable Curtain (IC) air bags that were designed to deploy from the roof side rail and inflate within 15 milliseconds of the impact. The inflators for each IC were located in the upper aspects of the left and right C-pillars.

The driver's side impact air bag and left IC deployed as a result of the frontal impact with the 2000 Ford Taurus. The driver's side air bag deployed from the outboard aspect of the driver's seatback (**Figure 7**). The tear seam began at the top aspect of the seat back and descended vertically 53 cm (21") down the seatback. The vinyl fabric tear seam measured 51 cm (20") in height and 15 cm (5.8") in width. The underlying plastic flap beneath the vinyl fabric on the outboard plane of the seatback measured 22 cm (8.6") in height and 7 cm (2.8") in width. The driver's side impact air bag was semi-circular in shape and measured 58 cm (23") in height and 27 cm (10.5") in width. There was no occupant contact evidence on the side impact air bag. As the side impact air bag deployed, it contacted and fractured the plastic cover panel trim housing the B-pillar **(Figure 8)**. The crack was linear in nature and was approximately 10 cm (4") rear of the panel's leading edge. The crack began 3 cm (1.2") below the beltline and extended 34 cm (13.5") downward. There was discernable contact evidence on the side impact air bag.

The side impact air bag was identified by the following nomenclature that was stamped on the top surface of the air bag membrane at the 12 o'clock position:

**PA66 + Si**
**240504**
**PH04511J02T**
**61582.01/07**
**TPC S**
**1328032**

**Figure 7 - Deployed side impact seat bag - 2005 Volkswagen Passat.**

**Figure 8 - Fractured plastic trim - 2005 Volkswagen Passat.**

The left side IC deployed downward from the left roof side rail. The IC was rectangular at the C-pillar aspect and trapezoidal to the contour of the A-pillar at the forward aspect. The separation of the headliner measured 183 cm (72") between the left A-pillar and C-pillar. The left IC measured 184 cm in length and 32 cm (12.5") in height. Two 1.3 cm (0.5") diameter rope tethers secured the air bag. The front tether was 10 cm (4") in length and was affixed to the A-pillar, secured to the bottom aspect of the air bag. The rear tether was 18 cm (7") in length and was located 10 cm (4") below the roof side rail and 12 cm (4.7") above the beltline at the C-pillar. There was no occupant contact evidence on the IC. **Figure 9** illustrates the IC in its deflated state.

**Figure 9 – Deployed IC 2005 Volkswagen Passat.**

The side impact air bag was identified by the following nomenclature that was stamped on the bottom surface of the air bag membrane at the 6 o'clock position:

**Serit # 0204000004286916**
**>PAC 6+ UMQ<**

***Child Safety Seat (CSS)***

An unoccupied Cosco Eddie Bauer Dorel Juvenile Group forward-facing CSS was installed in the right rear seating position of the Passat (**Figure 10)**. The Model Number was 22-859-HML HB4rA and the Date of Manufacture was 11/21/02. The CSS was designed for forward-facing use only. The CSS can be used for children weighing 10 kg (22 lb) to 18 kg (40 lb) utilizing the internal harness, and for children up to 132 cm (52") in height and between 14 kg (30 lb) and 36 kg (80 lb) as a belt positioning booster seat.

The CSS was installed using the lower anchor hooks of the Lower Anchors and Tethers for Children (LATCH) system, but not utilizing the top tether. A bath towel was placed under the leather seat for frictional purposes. The integral 5-point harness straps were routed through the top slots and a retainer clip was positioned 18 cm (7") below the same. The harness excursion was 67 cm (26.5") for the right strap and 53 cm (21") for the left. Lateral excursion of the CSS was 3 cm (1.2") to each side with no forward travel. The unused top tether was tucked between the child seat's internal seat cushion and its outer shell. The seat was also equipped with OEM armrests. The CSS was not damaged during the crash events.

**Figure 10 - Forward-facing Child Safety Seat.**

***Occupant Demographics – 2005 Volkswagen Passat***

***Driver***

| | |
|---|---|
| Age/Sex: | 33-year-old/Male |
| Height: | 188 cm (74”) |
| Weight: | 95 kg (210 lb) |
| Seat Track Position: | Full rear |
| Safety Belt Usage: | Manual 3-point lap and shoulder belt |
| Usage Source: | Vehicle inspection |
| Eyewear: | Prescription eyeglasses |
| Type of Medical treatment: | Transported by ambulance to local hospital for evaluation and released |

***Driver Injuries***

| Injury | Injury Severity (AIS 90/Update 98) | Injury Source |
|---|---|---|
| Left knee contusion | Minor (890402.1,2) | Left door panel |
| Left hand laceration | Minor (790602.1,2) | Left door panel hardware |

*Source: Driver interview.*

***Driver Kinematics***

The 33-year-old male driver was seated in an upright posture and was restrained by the manual 3-point lap and shoulder restraint. At impact with the 2000 Ford Taurus, the driver responded to the 11 o’clock direction of force by initiating a minimal forward and lateral trajectory to the left. The driver’s safety belt retractor pretensioner fired and limited occupant movement within the interior space. As the driver loaded the IC, the lateral aspect of his left knee contacted the front left door panel resulting in a contusion. Simultaneously, the dorsal aspect of his left hand contacted the door panel hardware resulting in a small laceration. The driver was transported by ambulance to a local hospital where he was treated for his injuries and released.

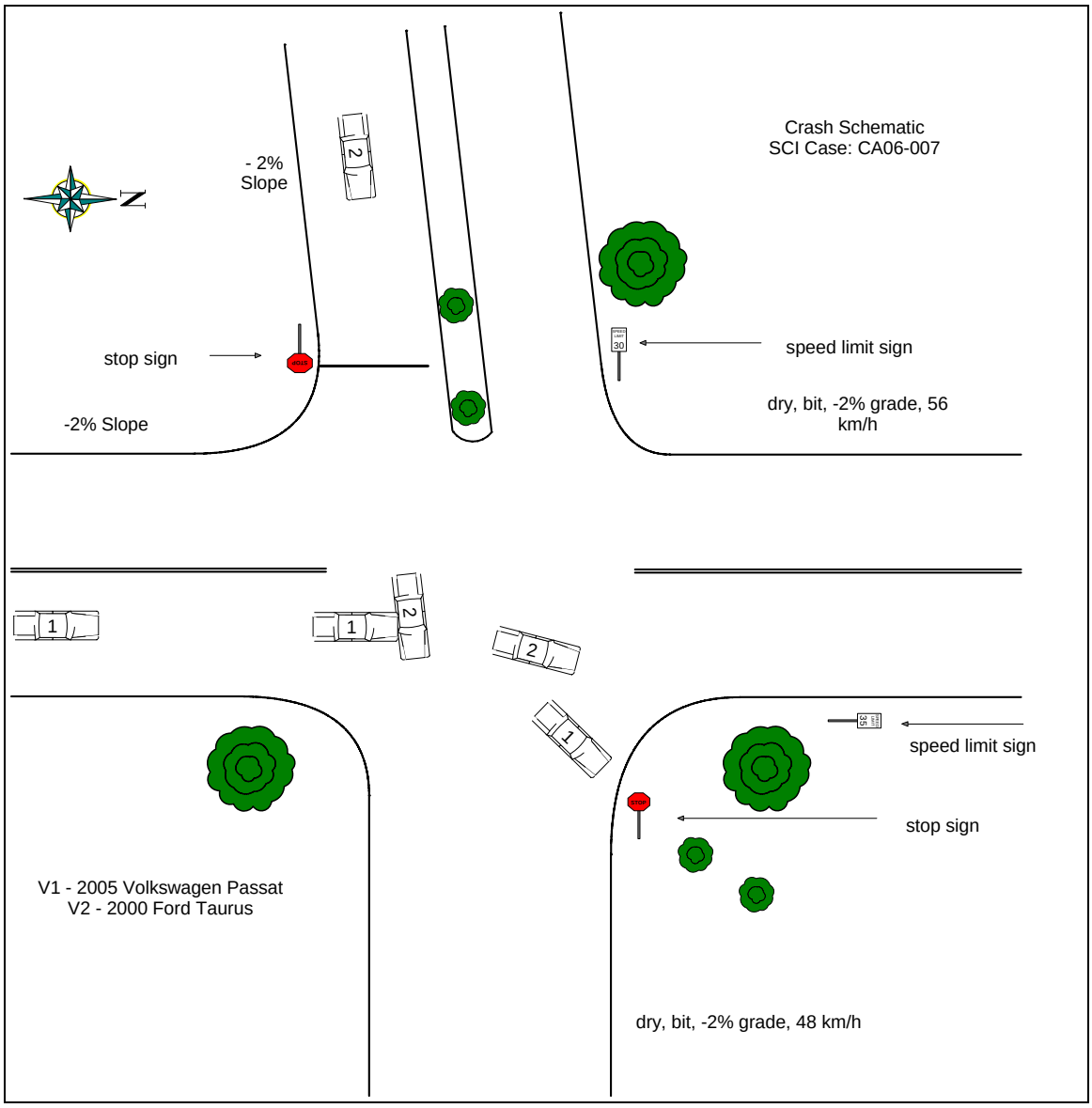


***Figure 11 – Scene Schematic***