

**CRASH DATA RESEARCH CENTER**

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**CALSPAN ON-SITE ROLLOVER CRASH INVESTIGATION  
SCI CASE NO.: CA09037**

**VEHICLE: 2007 CHRYSLER ASPEN**

**LOCATION: NORTH CAROLINA**

**CRASH DATE: MAY 2009**

Contract No. DTNH22-07-C-00043

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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.

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**SCI CASE NO.: CA09037**  
**VEHICLE: 2007 CHRYSLER ASPEN**  
**LOCATION: NORTH CAROLINA**  
**CRASH DATE: MAY 2009**

**BACKGROUND**

This on-site investigation focused on a 2007 Chrysler Aspen (**Figure 1**) that was involved in an intersection crash with a subsequent rollover event. The vehicle was equipped with a four-wheel Anti-lock Brake System (ABS), Electronic Stability Control (ESC), a Certified Advanced 208-Compliant (CAC) frontal air bag system, and side impact Inflatable Curtain (IC) air bags with rollover sensing. The manufacturer of the Aspen has certified that the vehicle is 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 right front passenger positions, seat track positioning sensors, retractor pretensioners, a front right occupant presence sensor, and safety belt buckle switch sensors. The right side of the Chrysler was impacted by the front of a 2005 Ford F-150 pickup. The Aspen rotated counterclockwise and departed the roadway, where it initiated a trip-over rollover event. The IC's on both sides deployed. The 34-year-old male driver of the Aspen sustained minor severity soft tissue injuries and was transported by ambulance to a regional hospital for treatment.



**Figure 1: 2007 Chrysler Aspen case vehicle.**

The crash was identified through a visit to a regional vehicle salvage facility on June 4, 2009. Based on the rollover crash dynamics of the late model year vehicle and the deployment of the side curtain air bags, this case was assigned for an on-site investigation on June 8, 2009. The on-site investigation was conducted on June 9-10, 2009, and involved the inspections of the Aspen and the F-150, a detailed interview with the driver of the Aspen and documentation of the crash scene.

**SUMMARY**

*Crash Site*

This crash occurred during the daylight hours in May 2009 at a four-leg intersection of two, two-lane roadways. The conditions were police reported as dry and clear. The roadways approaching the intersection from the north and south were controlled by stop signs. There were no traffic controls for the east/west roadway. The east/west roadway consisted of two travel lanes that were 2.8 m (9.2 ft) in width and bordered by narrow shoulders, 0.2 m (0.7 ft) in width. The westbound approach to the intersection contained a shallow curve to the right with a radius of curvature of 445 m (1,459 ft). The westbound approach to the intersection had a negative grade of 1.6 percent. The north/south roadway consisted of two travel lanes that were 3.1 m (10.2 ft) in width and bordered by narrow shoulders that were 0.2 m (0.7 ft) in width. The north/south roadway

intersected the east/west roadway at an angle of 85 degrees. Both roadways and shoulders were surfaced with asphalt. Outboard of the narrow shoulders at the southwest corner of the intersection was a roadside surfaced with cut grass. This roadside was 2.1 m (6.9 ft) in width adjacent to the east/west roadway and 2.9 m (9.5 ft) in width adjacent to the north/south roadway. A 0.9 m (3 ft) deep ditch 3 m (9.8 ft) in width was located outboard of the cut grass. Tall grass and wild brush covered the ditch. Located behind the ditch was a field planted with rows of soybean plants. The posted speed limit for both roadways was 89 km/h (55 mph). The driver of the Aspen stated that he was familiar with the route and had traveled it many times before. The crash schematic is included as **Figure 11** of this report.

***Vehicle Data***

***2007 Chrysler Aspen***

The case vehicle was a 2007 Chrysler Aspen Limited. The Aspen was manufactured in October of 2006 and was identified by the Vehicle Identification Number (VIN) 1A8HX58277Fxxxxxx (production sequence deleted). The vehicle was purchased new in early 2007 by the current owner/driver. The odometer reading at the time of the crash was 44,022 km (27,354 mi). The driver used the vehicle primarily for transportation to and from work and recreational activities.

The rear-wheel drive Aspen was powered by a 5.7-liter V-8 hemispherical cylinder end engine linked to a five-speed automatic transmission. The braking system consisted of front and rear disc brakes with four-wheel anti-lock and electronic brake force distribution. The Aspen was also equipped with Electronic Stability Control (ESC) and an indirect Tire Pressure Monitoring System (TPMS). The driver stated that the TPMS warning light was not on prior to the crash. The side windows were closed and the sunroof was open at the time of the crash. The windshield was OEM AS-1 laminated glass with an aftermarket strip of tint across the upper aspect. The front side windows were AS-2 tempered glass with aftermarket tint. The rear side windows and backlight were AS-3 deep tint with additional aftermarket tint. The sunroof was AS-3 deep tint and did not contain aftermarket tint. The Aspen was equipped with Goodyear Wrangler SR-A tires with Tire Identification Number (TIN) M6C4 EXWR 3606 and sized at P265/60R18. The manufacturer recommended tire size was P265/60R18. The tires were mounted on OEM seven-spoke alloy wheels. The manufacturer recommended cold tire pressure was 228 kPa (33 PSI), front and rear. The specific tire data at the time of the SCI inspection was as follows:

<b>Position</b>	<b>Measured Tire Pressure</b>	<b>Measured Tread Depth</b>	<b>Damage</b>
Left Front	193 kPa (28 PSI)	6 mm (8/32 in)	None
Left Rear	207 kPa (30 PSI)	6 mm (7/32 in)	None
Right Front	Tire flat	6 mm (8/32 in)	Tire and wheel separated from suspension, wheel deformed
Right Rear	172 kPa (25 PSI)	5 mm (6/32 in)	None

The interior of the Aspen was configured with leather-surfaced seven-passenger seating. The front bucket seats were separated by a center console and equipped with adjustable head restraints. The front left head restraint was found in the full-down position. The front right head restraint was found 10 cm (3.9 in) above the full-down position. The front left seat track was found 4 cm (1.6 in) forward of the full-rear position. The front right seat track was found in the full-rear position. The front left seat back angle was measured at 22 degrees aft of vertical and the front right seat back angle was 20 degrees aft of vertical. The second row consisted of two bucket seats with folding backs and cushions that would pivot forward on the front attachment points to allow the seat to fold and tumble forward to create additional rear cargo space if needed. The second row seats were separated by a center console. Both second row adjustable head restraints were found in the full-down position. The second row seat tracks were not adjustable. The second row seat backs were both adjusted to 19 degrees aft of vertical. The third row consisted of a bench seat with a folding back that contained three seating positions. The left and center adjustable head restraints were found in the full-down position. The right head restraint was set 4 cm (1.6 in) above the full down position. The seat back angle was not adjustable and measured 18 degrees aft of vertical. The accelerator and brake pedals were adjustable. The pedals were located at approximately the midpoint of their adjustment range.

The interior occupant safety systems consisted of three-point lap and shoulder belt systems for the seven designated seating positions, front safety belt retractor pretensioners, dual-stage frontal air bags, and IC air bags that provide protection for the six outboard seating positions. The Aspen was equipped with rollover sensing for the IC air bags.

### ***2005 Ford F-150***

The other vehicle in this crash was a 2005 Ford F-150 pickup. This Ford was equipped with an extended cab with four doors, a 198 cm (78 in) bed, on a 369 cm (145 in) wheelbase. The Ford was manufactured in September 2004 and was identified by the VIN 1FTRX14W65Nxxxxxx (production sequence deleted). The four-wheel drive F-150 was powered by a 4.6-liter V-8 engine linked to a four-speed manual 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 windshield was AS-1 laminated glass. The front side windows were AS-2 tempered glass. The rear side windows and backlight were AS-3 glass with deep tint. The manufacturer recommended tire size was P255/70R17, with a recommended cold tire pressure of 241 kPa (35 PSI) for the front and rear. The vehicle was equipped with Continental Contitrac tires, size P255/65R17 mounted on the front wheels, a General Ameritrac TR, size P255/70R17 on the left rear, and a Goodyear Wrangler SR-A, size P245/65R17 on the right rear. All tires were mounted on OEM five-spoke alloy wheels. The specific tire data at the time of the SCI inspection was as follows:

<b>Position</b>	<b>Measured Tire Pressure</b>	<b>Measured Tread Depth</b>	<b>Damage</b>
Left Front	193 kPa (28 PSI)	4 mm (5/32 in)	None
Left Rear	200 kPa (29 PSI)	10 mm (13/32 in)	None
Right Front	159 kPa (23 PSI)	3 mm (4/32 in)	None
Right Rear	207 kPa (30 PSI)	8 mm (10/32 in)	None

The interior of the F-150 was configured with cloth-surfaced six-passenger seating. The front bench seat was split 40/20/40 and contained a center backrest that folded down to form a center console. The front adjustable head restraints were found in the full-down position. The rear seat consisted of a single bench with a fixed backrest and a cushion that would pivot upward at the bight of the seat to increase cargo capacity. The rear outboard seats were equipped with adjustable head restraints. The rear right was in the full down position, and the rear left was 11 cm (4.3 in) above the full-down position.

The interior occupant safety systems consisted of three-point lap and shoulder belt systems for the front outboard and rear seating positions, a lap belt for the front center seating position, and driver and front right passenger frontal air bags and buckle-mounted pretensioners.

***Crash Sequence***  
***Pre-Crash***

The restrained 34-year-old male driver of the Aspen was operating the vehicle westbound approaching to the four-leg intersection (**Figure 2**). His direction of approach contained a shallow curve to the right. The driver of the Chrysler stated in the interview that he was traveling at an estimated speed of 89 km/h (55 mph). The 51-year old male driver of the Ford was on a southbound approach to the same intersection. The Ford's direction of approach was controlled by a stop sign. The driver of the F-150 was southbound at a police estimated 89 km/h (55 mph). Both vehicles entered the intersection.



**Figure 2: Westbound approach to the intersection.**

The driver of the Aspen stated in the interview that his view of the southbound approach to the intersection was obstructed by trees and brush on the north roadside and a house on the northeast corner. He stated that he did not see the Ford until he was nearly in the intersection and he did not have time to initiate avoidance actions prior to the initial impact.



### ***Crash***

The front of the F-150 impacted the right front and center aspects of the Aspen in the intersection. The direction of force to the Aspen was within the one o'clock sector. The direction of force to the F-150 was within the ten o'clock sector. The Damage algorithm of the WINSMASH program was used to calculate a total delta-V of 21 km/h (13 mph) for the Aspen and 36 km/h (23 mph) for the F-150. The longitudinal delta-V's for the Aspen and the F-150 were -16 km/h (-10 mph) and -23 km/h (-14 mph), respectively. The lateral delta-V was -13 km/h (-8.1 mph) for the Aspen and 28 km/h (17 mph) for the F-150. **Figure 3** is a view of the initial impact location. The Aspen was redirected to the left approximately 20 degrees and began to travel towards the southwest corner of the intersection.



**Figure 3: Area of initial impact.**

The driver of the Aspen attempted to steer right to stay on the roadway. The Aspen entered a clockwise yaw and departed the roadway at the southwest corner of the intersection. The Aspen traveled in the left side leading yaw for approximately 16 m (52.5 ft). The left rear wheel left a yaw mark 16.8 m (55.12 ft) in length and the left front wheel left a yaw mark 12.4 m (41.9 ft) in length, beginning on the asphalt in the intersection and ending in the grass/ditch area. The Chrysler rotated 85 degrees clockwise before initiating a trip-over rollover event to the left. The left rear wheel tripped on the wall of the ditch bordering the roadway, and the left front wheel tripped on the ground of the roadside. The Aspen rolled three-quarter turns to the left for a distance of 10 m (32.8 ft), coming to rest between the top and right planes in the ditch off the south roadside, facing northwest. The rollover was not interrupted. **Figure 4** is a view of the location of the rollover of the Aspen. The F-150 came to rest in the southwest corner of the intersection, facing southwest.



**Figure 4: Location of Aspen rollover.**

### ***Post-Crash***

Immediately following the crash, the driver of the Aspen exited the vehicle through the open sunroof. He retrieved his cellular phone from a belt pouch and called the 9-1-1 emergency response system to report the crash. Police, emergency medical and tow personnel responded to the crash site. The driver of the Aspen was transported to a regional hospital where he was treated in the emergency department for soft-tissue injuries to his left shoulder and minor lacerations to his left arm and leg, and released. The Aspen was towed to a local tow yard where it remained until it was transferred to a regional salvage facility for auction. The F-150 was towed to the owner's home where it

remained until it was transferred to the same regional salvage facility for auction. Both vehicles were inspected at the regional salvage facility.

### ***Exterior Damage***

#### ***2007 Chrysler Aspen***

The exterior of the Chrysler sustained moderate severity damage to the right, left, and top planes as a result of this multiple impact crash. The front aspect of the right plane sustained damage in the initial impact (**Figure 5**). The right side door hinges were intact and remained attached to the A- and B-pillars, respectively. Both right side door latches remained engaged, and the right front door was jammed closed after the crash. The right rear and both left side doors remained operational after the crash. The right front wheel



**Figure 5: Right side damage to the Aspen.**

separated from the suspension components. The direct damage measured 276 cm (108.7 in) and began 96 cm (37.8 in) forward of the right rear axle and extended forward to the front right bumper corner. The maximum crush measured 22 cm (8.7 in) and was located at C5, 318 cm (125.2 in) forward of the right rear axle. The documented crush profile was as follows: C1 = 0 cm, C2 = 15 cm (5.9 in), C3 = 16 cm (6.3 in), C4 = 21 cm (8.3 in), C5 = 22 cm (8.7 in), C6 = 18 cm (7.1 in). The Collision Deformation Classification (CDC) assigned for this impact was 01-RYEW-3.

As a result of the rollover event, the Chrysler sustained moderate severity damage to the left and top planes. The windshield glazing was 100 percent fractured with a laminate tear along the full length of the left A-pillar. The left front, left rear, left rear quarter window and backlight all disintegrated as a result of this multiple event crash sequence. The left rear door quarter window and all right side glazing were not damaged. The sunroof was intact and partially open at the time of the inspection. The scratches on the roof were oriented laterally. The direct contact damage to the roof extended 126 cm (49.6 in) laterally from the left roof side rail to the right roof side rail. The longitudinal direct contact damage extended 440 cm (173.2 in) from the leading edge of the hood to the backlight header. The maximum vertical and lateral crush was located on the left roof side rail 76 cm (29.9 in) aft of the left rear door. The maximum lateral crush measured 22 cm (8.7 in). The maximum vertical crush measured 13 cm (5.1 in). **Figures 6 and 7** depict the rollover damage sustained by the Aspen. The CDC assigned for the rollover was 00-TDDO-3.



**Figure 6: Rollover damage to the left rear of the Aspen.**



**Figure 7: Rollover damage to the left front of the Aspen.**

### ***Exterior Damage***

#### ***2005 Ford F-150***

The front plane of the Ford F-150 sustained moderate severity damage in the initial impact with the Chrysler. The direct contact damage extended from bumper corner to bumper corner on the front plane and measured 152 cm (59.8 in) in width (**Figure 8**). The maximum crush measured 33 cm (13 in) and was located at C2, 31 cm (12.2 in) right of the damaged left front bumper corner. A crush profile was documented on the front bumper and was as follows: C1 = 20 cm (7.9 in), C2 = 33 cm (13 in), C3 = 27 cm (10.6 in), C4 = 11 cm (4.3 in), C5 = 7 cm (2.8 in), C6 = 25 cm (9.8 in). The CDC assigned for this impact was 10-FDEW-2.



**Figure 8: Overall view of the frontal damage to the Ford.**

### ***Interior Damage***

#### ***2007 Chrysler Aspen***

The Chrysler Aspen sustained moderate severity damage that was attributed to occupant contact and passenger compartment intrusion. There was a scuff mark on the left roof side rail located 15-28 cm (5.9-11 in) forward of the B-pillar and 0-11 cm (0-4.3 in) above the lower edge of the roof side rail attributed to the driver's head. An injury to support this did not occur. There was a scuff mark on the center console located on the left side of the console 0-15 cm (0-5.9 in) forward of the rear corner and 0-12 cm (0-4.7 in) below the top. The intrusion to the Aspen is listed on the following table.

<b>Position</b>	<b>Component</b>	<b>Magnitude</b>	<b>Direction</b>
Row 1 Left	B-pillar	8 cm (3.1 in)	Lateral
Row 2 Left	C-pillar	8 cm (3.1 in)	Lateral
Row 2 Left	Roof side rail	10 cm (3.9 in)	Lateral
Row 2 Left	Roof	4 cm (1.6 in)	Vertical
Row 2 Center	Roof	4 cm (1.6 in)	Vertical
Row 2 Left	Roof side rail	5 cm (2 in)	Vertical

<b>Position</b>	<b>Component</b>	<b>Magnitude</b>	<b>Direction</b>
Row 3 Left	Roof side rail	14 cm (5.5 in)	Lateral
Row 3 Left	D-pillar	14 cm (5.5 in)	Lateral
Row 3 Left	Roof	6 cm (2.4 in)	Vertical
Row 3 Center	Roof	5 cm (2 in)	Vertical
Row 3 Left	Roof side rail	12 cm (4.7 in)	Vertical

***Manual Restraint Systems***

***2007 Chrysler Aspen***

The Aspen was equipped with three-point manual lap and shoulder belts for the seven designated seating positions. All belt systems utilized continuous loop webbing. The front left belt system utilized a sliding latch plate and a retractor mounted pretensioner, which actuated during the crash. The front left upper D-ring was height adjustable and was found in the full-up position. The driver's belt retracted onto an Emergency Locking Retractor (ELR). The driver used the safety belt at the time of the crash, which was supported by loading evidence on the belt webbing. This evidence consisted of frictional abrasions on the belt webbing near the latch plate and the upper D-ring. Specifically, the latch plate abrasion was located 55 cm (21.7 in) above the lower seat anchor and the D-ring abrasion was located 134-139 cm (52.8-54.7 in) above the lower seat anchor. Additionally, the actuated retractor pretensioner locked the safety belt in the used position. The total length of spooled out webbing measured 155 cm (61 in).

The front right, second row and third row safety belt systems utilized an ELR retractor and a lightweight locking latch plate. In addition, the front right belt system utilized a retractor pretensioner which actuated during the crash, pulling the belt webbing taut against the B-pillar.

***Frontal Air Bag System***

***2007 Chrysler Aspen***

The Aspen was equipped with a CAC frontal air bag system. The manufacturer of the Chrysler Aspen has certified that the vehicle is 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 right front passenger positions, seat track positioning sensors, retractor pretensioners, a front right occupant presence sensor, and safety belt buckle switch sensors. The driver's air bag was concealed within the center hub of the four-spoke steering wheel. The front right passenger's air bag was concealed within the top aspect of the right instrument panel. The frontal air bags did not deploy in this crash.

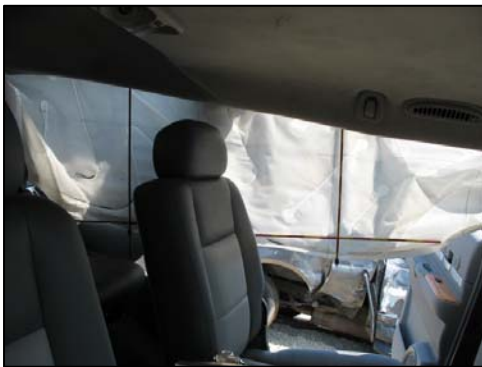
***Side Impact and Rollover Air Bag System***

***2007 Chrysler Aspen***

The Chrysler was equipped with roof side rail mounted curtain air bags with rollover sensing. Both IC air bags deployed during the multiple impact crash sequence; however, it could not be determined if the IC air bags deployed during the side impact or rollover event.

The IC air bags deployed from their respective roof side rails. The curtain air bags measured 235 cm (92.5 in) in length. At the front seating positions, the membrane was 50 cm (19.7 in) in height, and 51 cm (20.1 in) in height at the second and third row seating positions.

At the front of each IC was a non-inflating triangular panel that measured 40 cm (15.7 in) in height, 28 cm (11 in) along the upper edge and 32 cm (12.6 in) along the lower edge. This panel was tethered to the A-pillar by a 12 cm (4.7 in) long strap. The air bags were tethered at the D-pillars by a 10 cm (3.9 in) long strap. At the rear of the air bag, there was a triangular gap between the rear of the IC and the D-pillar measuring 35 cm (13.8 in) in height and 4 cm (1.6 in) and 9 cm (3.5 in) in width at the top and bottom, respectively. **Figures 9 and 10** depict the IC air bags.



**Figure 9: Left IC air bag.**



**Figure 10: Right IC air bag.**

There was an occupant contact attributed to the driver's left shoulder on the inboard side of the left IC. This scuff mark was located 12-30 cm (4.7-11.8 in) above the lower edge of the membrane and 18-30 cm (7.1-11.8 in) rear of the front edge of the membrane. Due to the intrusion, the left B-pillar was in contact with the front left seat back. The left IC was not captured between the pillar and the seat back.

There were two plastic-type deployment transfers on the right IC. The first was located on the outboard side of the air bag 28-33 cm (11-13 in) forward of the B-pillar and 0-8 cm (0-3.1 in) below the roof side rail. The second was located on the inboard side, 34-40 cm (13.4-15.7 in) forward of the rear of the curtain air bag and 9-19 cm (3.5-7.5 in) above the lower edge of the membrane.

The right IC was labeled with the number 28038450. The inboard side of the right air bag in the front row had food particles adhered to the fabric. The food was consistent with a Styrofoam box of food found in the front right seat at the time of the inspection.

#### ***Air Bag Control Module***

The 2007 Chrysler Aspen was equipped with an Air bag Control Module (ACM) that had event data recording capabilities. An attempt was made to image the ACM by applying power to the vehicle and reading the data through the OBD port under the left instrument panel. The system in the Aspen only records data in a frontal event, per the Bosch software, and no data was found to be stored in the module.

***Occupant Demographics/Data***  
***2007 Chrysler Aspen***

Driver Age/Sex: 34-year old/Male  
 Height: 178 cm (70 in)  
 Weight: 100 kg (220 lb)  
 Eyewear: None  
 Seat Track Position: Rear  
 Manual Safety Belt Use: Lap and shoulder belt  
 Usage Source: Vehicle Inspection  
 Egress from Vehicle: Exited without assistance through open sunroof  
 Mode of Transport from Scene: Ground ambulance  
 Type of Medical Treatment: Treated in emergency department and released

***Driver Injuries***

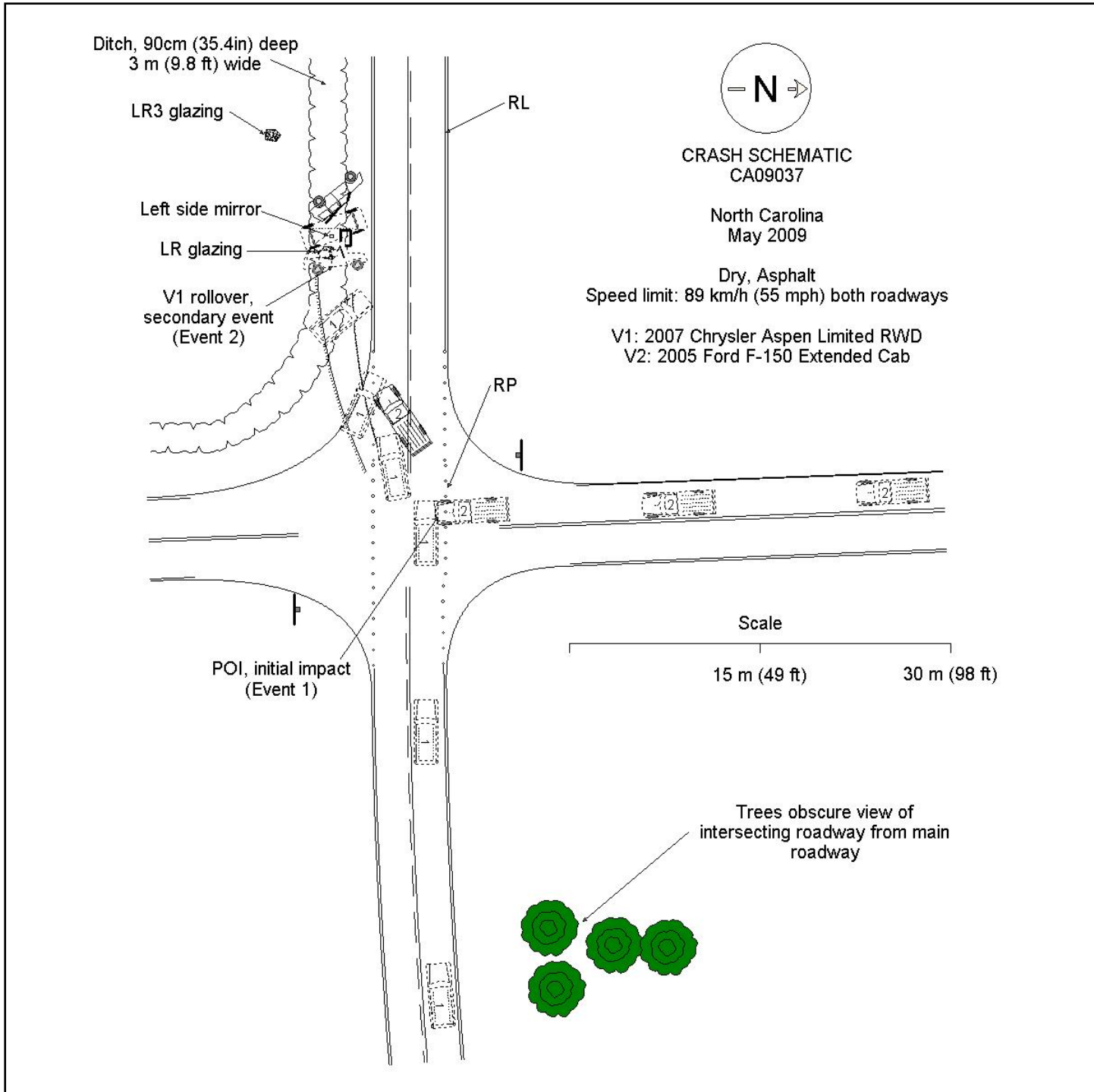
<b>Injury</b>	<b>Injury Severity (AIS 90/Update 98)</b>	<b>Injury Source</b>
Cervical strain	Minor (640278.1,6)	Impact forces
Left upper arm contusion	Minor (790402.1,2)	Left B pillar
Left lower arm and wrist contusion	Minor (790402.1,2)	Forward upper quadrant of the left front door panel
Left elbow abrasion	Minor (790202.1,2)	Left side curtain air bag

Source – Medical records

***Driver Kinematics***

The 34-year-old male driver was seated in a rear-track position and was restrained by the manual three-point lap and shoulder belt system. As the initial impact occurred, the driver initiated a right trajectory within the front left seating position. The driver loaded the center console and the belt system. As the driver attempted to steer to the right to prevent the vehicle from departing the roadway, the Aspen entered a clockwise yaw. The vehicle tripped and initiated a rollover event to the left. As the vehicle began to roll, the roof side mounted curtain air bags deployed and the driver initiated a left and upward trajectory within the front left seating position. The driver loaded the left front door, left side curtain air bag and the left side of the roof, over the front left seating position. This contact resulted in the cervical strain, contusions to the left upper arm and the left wrist, and the abrasion to the left elbow. The left front glazing disintegrated, resulting in the multiple small lacerations to the lower left leg and the lower left arm. The vehicle came to rest inverted at an angle between the roof and right side. The driver exited the vehicle without assistance through the open sunroof.

The driver was transported by ground ambulance to a regional hospital where he was treated in the emergency department and released.



**Figure 11: Crash Schematic**